Fearn Clendaniel
Architects Inc
6 Larch Ave - Suite 398 - Wilmington, DE 19804 (P) 302-998-7615 - (F) 302-998-7685

PROJECT MANUAL

Technical Specifications

CHRISTINA SCHOOL DISTRICT
BID NO. CHR-19-039-AS

F D STUBBS SCHOOL
ADULT SERVICES RENOVATIONS

1100 NORTH PINE STREET
WILMINGTON, DELAWARE 19801

PROJECT NO. 18022-AS

ISSUED FOR BIDDING/CONSTRUCTION

DECEMBER 2019

www.fcarchitects.net

CHRISTINA SCHOOL DISTRICT
F D Stubbs School – Adult Services Renovations
BID NO. CHR-19-039-AS

INVITATION TO BIDDERS

Sealed bids for Christina School District Bid No. CHR-19-039-AS – **F D Stubbs School – Adult Services Renovations** will be received by the Christina School District, at the Christina School District, Eden Support Services Center, 925 Bear Corbitt Rd, Bear, DE 19701 until 4:00 p.m. local time on Thursday, January 30, 2020, 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 includes: 1) The Renovation and reconstruction of two public restrooms, including reconfiguration of fixtures, finishes, and accessories. Conversion of two sets of two existing staff restrooms, including new fixtures, finishes, and accessories into two individual accessible restrooms. 2) Removal of existing non-loadbearing exterior basement infill framing within existing structural opening and installation of a new aluminum entrance system. Door hardware includes a power operator and access control systems. 3) Construction of a new entry / access corridor within the existing basement space, including new construction, modifications to existing construction, and related mechanical, plumbing, and electrical work. 4) Modifications to existing elevator and elevator control systems to provide card reader access control to specific floors.
The project work is located at the existing Christina School District, F D Stubbs School located at 1100 North Pine Street, Wilmington, Delaware 19801.

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

Only General Contractors may submit bids on this project.

A **MANDATORY** Pre-Bid Meeting will be held on January 9, 2020 at 1:30 pm at the Christina School District, F D Stubbs School for the purpose of establishing the listing of subcontractors and to answer questions. Note: Access building through Main Entrance and sign in at Main Office. **ATTENDANCE OF THIS MEETING BY ALL GENERAL CONTRACTORS IS A PREREQUISITE FOR BIDDING ON THIS CONTRACT.**

Sealed bids shall be addressed to the Christina School District ATTN.: G. Wicks. The outer envelope should clearly indicate: **"CONTRACT NO. CHR-19-039-AS – F D STUBBS SCHOOL – ADULT SERVICES RENOVATIONS – SEALED BID – DO NOT OPEN".**

Contract documents notice will be available via State of Delaware's Procurement Portal at
www.mymarketplace.delaware.gov

Contract documents will be available to bidders, upon request, in electronic format at the Pre-Bid Meeting for a $25.00 nonrefundable fee. Electronic documents can be purchased following the Pre-Bid Meeting at the office of Fearn-Clendaniel Architects, Inc., 6 Larch Avenue, Suite 398, Wilmington, Delaware 19804. The electronic documents contain PDF files only (no paper copy included). Checks are to be made payable to "Fearn-Clendaniel Architects, Inc." Please request documents ahead of time to allow time for reproduction.

Bidders will not be subject to discrimination on the basis of race, creed, color, sex, sexual orientation, gender identity or national origin in consideration of this award, and Minority Business Enterprises, Disadvantaged Business Enterprises, Women-Owned Business Enterprises and Veteran-Owned Business Enterprises will be afforded full opportunity to submit bids on this contract. Each bid must be accompanied by a bid security equivalent to 10% (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% (one hundred percent) of the contract price upon execution of the contract. The Christina School District reserves the right to reject any or all bids and to waive any informality therein. The Board may extend the time and place for the opening of the bids from that described in the advertisement, of not less than 2 (two) calendar days' notice by certified delivery, or other electronic means to those bidders receiving plans.

By order of the Christina School District.

END OF ADVERTISEMENT FOR BIDS

STATE OF DELAWARE
DEPARTMENT OF LABOR
DIVISION OF INDUSTRIAL AFFAIRS
OFFICE OF LABOR LAW ENFORCEMENT
PHONE: (302) 761-8200

Mailing Address:
4425 North Market Street
3rd Floor
Wilmington, DE 19802

Located at:
4425 North Market Street
3rd Floor
Wilmington, DE 19802

PREVAILING WAGES FOR **BUILDING CONSTRUCTION** EFFECTIVE MARCH 15, 2019

CLASSIFICATION	NEW CASTLE	KENT	SUSSEX
ASBESTOS WORKERS	23.92	29.46	42.87
BOILERMAKERS	71.61	36.33	53.41
BRICKLAYERS	55.89	55.89	55.89
CARPENTERS	55.63	55.63	44.22
CEMENT FINISHERS	75.54	52.62	23.19
ELECTRICAL LINE WORKERS	47.57	40.79	31.10
ELECTRICIANS	70.49	70.49	70.49
ELEVATOR CONSTRUCTORS	96.27	67.47	33.42
GLAZIERS	75.65	75.65	59.28
INSULATORS	57.88	57.88	57.88
IRON WORKERS	65.57	65.57	65.57
LABORERS	47.70	47.70	47.70
MILLWRIGHTS	74.23	74.23	59.84
PAINTERS	52.47	52.47	52.47
PILEDRIVERS	78.02	41.17	33.30
PLASTERERS	31.22	31.22	23.14
PLUMBERS/PIPEFITTERS/STEAMFITTERS	70.05	55.29	60.31
POWER EQUIPMENT OPERATORS	71.29	71.29	71.29
ROOFERS-COMPOSITION	25.12	24.79	22.64
ROOFERS-SHINGLE/SLATE/TILE	19.24	22.88	17.99
SHEET METAL WORKERS	72.53	72.53	72.53
SOFT FLOOR LAYERS	53.39	53.39	53.39
SPRINKLER FITTERS	60.04	60.04	60.04
TERRAZZO/MARBLE/TILE FNRS	64.45	64.45	64.45
TERRAZZO/MARBLE/TILE STRS	71.27	71.27	71.27
TRUCK DRIVERS	32.19	28.70	21.91

CERTIFIED: 4/04/2019 BY: _____
ADMINISTRATOR, OFFICE OF LABOR LAW ENFORCEMENT

NOTE: THESE RATES ARE PROMULGATED AND ENFORCED PURSUANT TO THE PREVAILING WAGE REGULATIONS ADOPTED BY THE DEPARTMENT OF LABOR ON APRIL 3, 1992.

CLASSIFICATIONS OF WORKERS ARE DETERMINED BY THE DEPARTMENT OF LABOR. FOR ASSISTANCE IN CLASSIFYING WORKERS, OR FOR A COPY OF THE REGULATIONS OR CLASSIFICATIONS, PHONE 302-761-8200

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

PROJECT: CHR-19-039-AS Stubbs School Adult Service Renovations , New Castle County

PREVAILING WAGE DEBARMENT LIST

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

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

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

Updated: January 22, 2019

SUPPLEMENTAL INSTRUCTIONS TO BIDDERS

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ARTICLE 1: GENERAL

1.1 DEFINITIONS

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

1.2 STATE: The State of Delaware.

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

ARTICLE 2: BIDDER'S REPRESENTATIONS

2.1 PRE-BID MEETING

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

2.2 By submitting a Bid, the Bidder represents that:

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

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

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

2.3 JOINT VENTURE REQUIREMENTS

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

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

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

2.3.4 All required insurance certificates shall name both Joint Venturers.

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

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

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

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

2.4 ASSIGNMENT OF ANTITRUST CLAIMS

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

ARTICLE 3: BIDDING DOCUMENTS

3.1 COPIES OF BID DOCUMENTS

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

3.1.2 Bidders shall use complete sets of Bidding Documents for preparation of Bids. Neither the issuing Agency nor the Architect assumes 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 electronically mailed (e-mailed), mailed, faxed, or delivered to all who are known by the Architect to have received a complete set of the Bidding Documents. All addenda conforming to an 8-1/2 x 11" format will be electronically mailed (e-mailed) only.

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

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

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

ARTICLE 4: BIDDING PROCEDURES

4.1 PREPARATION OF BIDS

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

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

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

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

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

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

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

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

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

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

4.2 BID SECURITY

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

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

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

4.3 SUBCONTRACTOR LIST

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

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

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

4.4 EQUALITY OF EMPLOYMENT OPPORTUNITY ON PUBLIC WORKS

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

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

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

4.5 PREVAILING WAGE REQUIREMENT

4.5.1 Wage Provisions: In accordance with Delaware Code, Title 29, Section 6960, renovation projects whose total cost shall exceed $15,000, and $100,000 for new construction, the minimum wage rates for various classes of laborers and mechanics shall be as determined by the Department of Labor, Division of Industrial Affairs of the State of Delaware.

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

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

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

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

4.6 SUBMISSION OF BIDS

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

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

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

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

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

4.7 MODIFICATION OR WITHDRAW OF BIDS

4.7.1 Prior to the closing date for receipt of Bids, a Bidder may withdraw a Bid by personal request and by showing proper identification to the Architect. A request for withdraw by letter or fax,

if the Architect is notified in writing prior to receipt of fax, is acceptable. A fax directing a modification in the bid price will render the Bid informal, causing it to be ineligible for consideration of award. Telephone directives for modification of the bid price shall not be permitted and will have no bearing on the submitted proposal in any manner.

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

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

ARTICLE 5: CONSIDERATION OF BIDS

5.1 OPENING/REJECTION OF BIDS

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

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

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

5.2 COMPARISON OF BIDS

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

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

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

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

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

5.3 DISQUALIFICATION OF BIDDERS

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

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

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

C. The Bidder's written safety plan;

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

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

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

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

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

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

5.3.3.2 Evidence of collusion among Bidders.

5.3.3.3 Unsatisfactory performance record as evidenced by past experience.

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

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

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

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

5.4 ACCEPTANCE OF BID AND AWARD OF CONTRACT

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

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

which case the election to award on the basis of best value shall be stated in the Invitation To Bid."

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

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

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

5.4.6 If the successful Bidder fails to execute the required Contract and Bond, as aforesaid, within twenty (20) calendar days after the date of official Notice of the Award of the Contract, their Bid guaranty shall immediately be taken and become the property of the State for the benefit of the Agency as liquidated damages, and not as a forfeiture or as a penalty. Award will then be made to the next lowest qualified Bidder of the Work or readvertised, as the Agency may decide.

5.4.7 Prior to receiving an award, the successful Bidder shall furnish to the Agency proof of State of Delaware Business Licensure. If the Bidder does not currently have a Business License, they may obtain an application by writing to: Division of Revenue, Carvel State Office Building, 820 French Street, Wilmington, DE 19899. A copy of the letter written to the Division of Revenue, sent with your Bid will be adequate proof for your firm to be considered for award until such time as you receive your license.

5.4.8 The Bid Security shall be returned to the successful Bidder upon the execution of the formal contract. The Bid Securities of unsuccessful bidders shall be returned within thirty (30) calendar days after the opening of the Bids.

ARTICLE 6: POST-BID INFORMATION

6.1 CONTRACTOR'S QUALIFICATION STATEMENT

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

6.2 BUSINESS DESIGNATION FORM

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

ARTICLE 7: PERFORMANCE BOND AND PAYMENT BOND

7.1 BOND REQUIREMENTS

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

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

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

7.2 TIME OF DELIVERY AND FORM OF BONDS

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

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

ARTICLE 8: FORM OF AGREEMENT BETWEEN AGENCY AND CONTRACTOR

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

END OF INSTRUCTIONS TO BIDDERS

PROJECT SUPPLEMENTAL INSTRUCTIONS TO BIDDERS

This "Project Supplemental Instructions to Bidders" is intended as a project specific supplement to the AIA Document A701-1997 "Instructions to Bidders", and the "Supplemental Instructions to Bidders". Where conflicting information or instructions exist between any of these documents, the information or instructions in this Project Supplemental Instructions to Bidders shall prevail.

1. Contract Documents

   Bidding Documents include the Bidding Requirements and the proposed Contract Documents. The Bidding Requirements consist of the Advertisement or Invitation to Bid, Instructions to Bidders, Supplementary Instructions to Bidders, the bid form, and other sample bidding and contract forms. The proposed Contract Documents consist of the form of Agreement between the Owner and Contractor, Conditions of the Contract (General, Supplementary and other Conditions), Drawings, Specifications and all Addenda issued prior to execution of the Contract.

   Addenda are written or graphic instruments issued by the Architect prior to the execution of the Contract, which modify or interpret the Bidding Documents by additions, deletions, clarifications or corrections.

   A Bid is a complete and properly signed proposal to do the Work for the sums stipulated therein, submitted in accordance with the Bidding Documents.

   The Base Bid is 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.

   An Alternate Bid (or Alternate) is an amount stated in the Bid 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.

   A Unit Price is an amount stated in the Bid as a price per unit of measurement for materials, equipment or services or a portion of the Work as described in the Bidding Documents.

2. Bids

   Submit a minimum of one hard copy of the Bidding documents with submission.

   Bidders shall use complete sets of Bidding Documents in preparing Bids; neither the Owner nor Architect assumes responsibility for errors or misinterpretations resulting from the use of incomplete sets of Bidding Documents.

   In making copies of the Bidding Documents available on the above terms, the Owner and the Architect do so only for the purpose of obtaining Bids on the Work and do not confer a license or grant permission for any other use of the Bidding Documents.

   Interpretations, corrections and changes of the Bidding Documents will be made by Addendum. Interpretations, corrections and changes of the Bidding Documents made in any other manner will not be binding, and Bidders shall not rely on them.

   Bids must be prepared by submitting the estimate in the exact form and sequence of the Proposal Form included in these specifications.

   All blanks on the bid form shall be filled in by typewriter or manually in ink.

Where so indicated by the makeup of the bid form, sums shall be expressed in both words and figures, and in case of discrepancy between the two, the amount written in work shall govern,

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

All requested Alternates shall be bid. If no change in the Base Bid is required, enter "No Change."

Each copy of the Bid shall include the legal name of the Bidder and a statement that the Bidder is a sole proprietor, partnership, corporation or other legal entity. 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 the agent's authority to bid the Bidder.

Include a sufficient amount in the bid to cover the cost of any and/or all work called for in Addenda or other instructions issued during the bidding period. Such work shall automatically become a part of the contract.

In the event of a tie in the bids, the Owner will decide which bidder is to be awarded the contract by any criteria the Owner chooses.

Bidders may take exception to the terms and conditions of the bid documents and specifications. Exceptions shall be considered only if they are submitted in writing within five (5) calendar days prior to the bid opening date. Exceptions which create inequity in the treatment of bidders will be rejected. Bidders risk the acceptance of their bids by the Owner, when such exceptions are deemed not in the best interest of the project are submitted.

Bidders acknowledge and accept that the Owner's representative may, at the Owner's option, photograph and/or videotape construction work in progress including Contractor employees.

Bidders acknowledge and accept that the Owner's representative may, at the Owner's option record by audiotape construction progress meetings.

3. Addenda

Addenda will be e-mailed, mailed, faxed, or delivered to all who have purchased or have been given a complete set of Bidding Documents. All addenda conforming to an 8-1/2 x 11" format will be electronically mailed (e-mailed) only.

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

Each Bidder shall ascertain prior to submitting a Bid that the Bidder has received all Addenda issued, and the Bidder shall acknowledge their receipt on the bid form.

4. Listing Subcontractors

As required by Chapter 69, Section 6962 of the Delaware Code, the Bidder shall submit with, and as a part of its Proposal, a complete list of Subcontractors as agreed upon at the Bidder's Meeting during the bidding period. No Proposal will be considered unless the names and addresses, city and state only, are included in the Proposal were called where called for. The work must be awarded to the Subcontractor listed.

No General Contractor shall list itself in any Proposal as the Subcontractor of any part of the Project unless it, in addition to being licensed as a General Contractor of the state, shall also be recognized in the trades as

a Subcontractor in and for any such part of parts of such work so listed in such Proposal. No Subcontractors listed in the Proposal shall be substituted unless the substitution is made in compliance with Section 6962 of the Delaware Code. Refer to Paragraph 5 in this section for further clarification.

In order to determine the various parts, or classifications of the work for which the names of Subcontractors shall be included in the Proposal, a discussion at the Prebid meeting shall be held.

Any Subcontractors (including Subcontractors to Subcontractors) not noted on the "Subcontractor List" (within the bid form), shall be subject to the Owner's approval prior to them performing any Work, on or off site, and prior to them entering into an agreement to perform any work on this project.

5. Notice of Waiver

In submitting these bids, it is understood that the right is reserved by the Owner to reject any and/or all bids and waive informalities therein, and it is further agreed that these bids may not be withdrawn for a period of thirty (30) days from the opening thereof.

6. Delivery of Bids

All copies of the Bid, the bid security, if an, and other documents required to be submitted with the Bid shall be enclosed in a sealed opaque envelope. The envelope shall be addressed to the party receiving the Bids and shall be identified with the Project name and the Bidder's name and address. If the Bid is sent by mail, the sealed envelope shall be enclosed in a separate mailing envelope with the notation "SEALED BID ENCLOSED" on the face thereof.

Bids shall be deposited at the designated location prior to the time and date for receipt of Bids. Bids received after the time and date for receipt of Bids will be returned unopened.

The Bidder shall assume full responsibility for timely delivery at the location designated for receipt of Bids.

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

7. Consideration of Bids.

Opening of Bids: The properly identified Bids received on time will be opened publicly and will be read aloud.

Rejection of Bids: The Owner shall have the right to reject any or all Bids, reject a Bid not accompanied by a required bid security or by other data required by the Bidding Documents, or reject a Bid which is in any way incomplete or irregular.

8. Bid Bond (Bid Guarantee)

Bidders shall use standard OMB Bid Bond form. The Bid Bond shall be in the sum of ten percent (10%) of the Bid.

9. Affidavit of Employee Drug Testing

Bidders shall use standard OMB Affidavit of Employee Drug Testing form as described in General Requirements to Bidders and Supplementary General Conditions.

10. Performance Bond and Labor and Material Payment Bond (Contract Bond)

Bidders shall use Standard OMB Performance Bond form. The Performance Bond and Labor and Material Payment Bond shall be in the sum of one hundred percent (100%) of the contract.

Bond Requirements: The Bidder shall furnish bonds covering the faithful performance of the Contract and payment of all obligations arising thereunder. Bonds may be secured through the Bidder's usual sources.

Cost of bonds shall be included in the Bid.

If the Owner requires that bonds be secured from other than the Bidder's usual sources, changes in cost will be adjusted as provided in the Contract Documents.

Time of Delivery and Form of Bonds: The Bidder shall deliver the required bonds to the Owner not later than three days following the date of execution of the Contract. If the Work is to be commenced prior thereto in response to a letter of intent, the Bidder shall, prior to commencement of the Work, submit evidence satisfactory to the Owner that such bonds will be furnished and delivered.

Unless otherwise provided, the bonds shall be written on AIA Document A311, Labor and Materials Payment Bond. Both bonds shall be written in the amount of the Contract Sum.

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

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

10. Awards

It is the intent of the Owner to award the Contract to the lowest responsible bidder. Accordingly, the following shall apply:

The Owner reserves the right to award the contract on the Base Bid or on the Base Bid plus any combination of Alternate Estimate as listed in the Proposal Form. The amount of each Alternate Estimate shall include any and all costs of modifications made necessary by the use of such Alternate. An amount shall be stated for each and every Unit Price and Alternate Estimate. The Owner reserves the right to reject any and/or all of the bids presented and waive informalities therein. In the event that the sums of the Base Bid plus the selected alternates of any two or more bidders results in an identical low bid price, then the Unit Prices as listed in the Proposal may, at the option of the Owner, be used to determine the apparent low bidder.

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 its bid without the written consent of the agency awarding the contract. No agency shall consent to such substitution unless the agency is satisfied that the Subcontractor in question whose name is listed in the successful bidder's accompanying statement, (1) is unqualified to perform the work required, or (2) has failed to execute a timely reasonable subcontract, or (3) has defaulted in the performance of the part of the work covered by the subcontract, or (4) is no longer engaged in such business.

The Agreement for the Work will be written on AIA Document A101, 2017 Edition Standard Form of Agreement Between owner and Contractor including OMB AIA Document A101, 2017 Contract Amendment, Where the Basis of Payment Is a Stipulated Sum.

11. Plans and Specifications (For Construction Purposes)

Upon the signing of the contract, if the successful bidder (Contractor) requires printed plans and specifications, reproduction will be the responsibility of the Contractor. Conformed construction documents may be provided by the architect as a courtesy 'construction issue' set of documents incorporating addenda items. If provided, in event of discrepancy between the construction issue documents and the issued addenda, the addenda document is the official document.

12. Submission of Post-Bid Information

The selected Bidder, within fifteen (15) days following signing of the contract, shall submit a list of manufacturers it intends to use on the Project.

13. Substitution

It is distinctly understood that ware the term "or equal" is used that the Proposal shall be submitted on the commodity specified. If the Contractor wishes to submit to the Architect a commodity or commodities which it considers equal to that specified, and desires to make a substitution, it shall furnish to the Architect all necessary data, catalogs, samples, etc., in reference to same for Architect's decision as to whether the item is considered "or equal," not later than ten (10) days prior to bid opening. If the Architect decides that such commodity or commodities meet the standard required, an Addendum shall be issued including the item under list of acceptable items.

Any request for the use of a substitute material, apparatus, etc. shall state where an installation if readily available for inspection; complete fabrication details and operating and maintenance performance.

Failure to comply with the requirements of the above paragraphs may be considered sufficient reason for rejection of the entire Proposal.

Manufacturers and/or Materials Suppliers not listed in the Specifications desiring approval of their products by the Architect, as acceptable substitutions for those specified shall apply for consideration of their products through one of the Contractors bidding upon the project. The Contractor receiving the request for product approval shall forward a letter (using its letterhead) regarding the request, including any comments it may have concerning the request to the Architect for consideration. In addition, the Contractor shall attach the manufacturer's original letter of request or a copy of same, plus any literature, etc., received, to its letter, to the Architect.

14. Contract Documents

The contract documents are complementary and what is called for by any one shall be as binding as if called for by all.

For convenience, the specifications have been separated into one or more volumes under various headings with General Requirements listed first and the Technical Specifications following. A group of Divisions comprise the Technical Specifications. Various trades, providing materials or labor or both, whose work is closely related are grouped into these Divisions does not relieve the General Contractor from providing all labor and materials necessary to complete the work, irrespective of the Division in which such labor and material is specified.

15. Examination of Bidding Documents, Site, Etc.

Before submitting bids, bidders shall fully inform themselves of the nature of the work by personal Examination of the site, the drawings and specifications and by such other means as they may consider necessary, as to matters, conditions and considerations bearing on or in any way affecting the preparation of their Proposal and the Contract. They shall not at any time after submission of the Proposal dispute or

complain of such drawings or specifications and the General Conditions, not assert that there is any misunderstanding in regard to the location, extent or nature of the work to be performed.

Each Bidder shall examine the Bidding Documents carefully and, not later than seven (7) days prior to the date for receipt of bids, shall make written request to the Architect for interpretation or correction of any ambiguity, inconsistency or error therein which it may discover.

16. Access to Site

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

17. Protections and Replacement of Roadways, Curbs, Etc.

Before staring any work, the Contractor shall file with the Architect, for approval, a list of all defective areas related to the existing site, including roadways, etc. At the close of the project, the Contractor shall repair any damaged areas to the satisfaction of the Owner and Architect.

18. Repair of Grounds

Toward the completion of the job, go over the grounds, fill any ruts and repair any damage caused by hauling, the storage of materials, and other operations, and leave the whole property in as good condition as at the start of the work.

19. Contractors Responsibilities Under OSHA Requirements

It shall be the General Contractor's and its subcontractors' responsibility to meet the necessary safety requirements, established by the Federal "Occupational Safety and Health Administration" (OSHA) required and applicable while performing work on this project.

20. Time of Completion

Preparation and / or mobilization shall be commenced by the General Contractor upon receipt of the Purchase Order.

A. On-site Work to begin April 10, 2020.

B. **ON-SITE WORK MUST BE 100 PERCENT (100%) COMPLETE BY OCTOBER 15, 2020.** Work not 100 percent complete by this date may be completed by the Owner's forces with the costs back charged to the General or Prime Contractor.

1) Normal work hours shall be from **7**:00 a.m. to 4:00 p.m. Work may be completed beyond these hours at no additional cost, as approved by the Owner.
2) Normal work hours shall be from **7**:00 a.m. to 4:00 p.m., dependent on local noise ordinances. Work may be completed beyond these hours at no additional cost, as approved by the Owner.
3) **Weather Delays**: The project is interior work. Weather delays do not apply to this project.

C. See "Project Supplementary General Conditions" Section for information on liquidated damages.

21. Owner's Inspections

The Christina School District may have a full time inspector for this Work in addition to the inspections completed by the Architect or as indicated in the project specifications.

A. Each site may be videotaped daily and progress meetings may be audio taped.

B. Each site shall have a daily sign-in-log.

22. Secure Storage

Secure Storage shall be the responsibility of the Contractor. The owner shall not provide storage areas on, or off site.

END OF PROJECT SUPPLEMENTAL INSTRUCTIONS TO BIDDERS

CHRISTINA SCHOOL DISTRICT
FD STUBBS SCHOOL – ADULT SERVICES RENOVATIONS
1100 NORTH PINE STREET, WILMINGTON, DE 19801
Bid No. CHR-19-039-AS

BID FORM

For Bids Due: **January, 30 2020 @ 4:00 PM**

To: Christina School District
Eden Support Services Center
925 Bear Corbitt Rd
Bear, DE 19701

Name of Bidder: _____

Delaware Business License No.: _____ **Taxpayer ID No.:** _____
"(A copy of a Bidders Delaware Business License must be attached to this form.)"

(Other License Nos.): _____

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

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

$_____
($)

ALLOWANCE ACKNOWLEDGEMENT

ALLOWANCE No. 1: Include an Allowance equal to **Thirty-five thousand dollars ($35,000.00)** for costs associated with any unforeseen or concealed conditions and / or Owner requested revisions during the construction period. Upon Owner/Architect approval, a Credit or Add Change Order will be applied to the Allowance. I/We have reviewed and familiarized ourselves with the requirements contained in Specification Section 012100 Allowances.

Acknowledged by: _____

CHRISTINA SCHOOL DISTRICT
FD STUBBS SCHOOL – ADULT SERVICES RENOVATIONS
1100 NORTH PINE STREET, WILMINGTON, DE 19801
Bid No. CHR-19-039-AS

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

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

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

Should I/We be awarded this contract, I/We pledge to achieve substantial completion of all the work within _____ calendar days of the Notice to Proceed.

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

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

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

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

_____
(State of Corporation)

Business Address:_____
_____
_____
_____

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

(SEAL)

_____
(Title)

Date: _____

ATTACHMENTS

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

BID FORM

SUBCONTRACTOR LIST

In accordance with Title 29, Chapter 6962 (d)(10)b Delaware Code, the following sub-contractor listing must accompany the bid submittal. The name and address of the sub-contractor **must be listed for each category** where the bidder intends to use a sub-contractor to perform that category of work. In order to provide full disclosure and acceptance of the bid by the Owner, **it is required that bidders list themselves as being the sub-contractor for all categories where he/she is qualified and intends to perform such work.** This form must be filled out completely with no additions or deletions.

Subcontractor Category	Subcontractor Name	Address (City & State)	Subcontractors tax payer ID # or Delaware Business license #
1. Masonry			
2. Metal Stud/Drywall			
3. Doors/Frames/ Hardware Installer			
4. Aluminum Entrances/ Storefront Installer			
5. Painting			
6. Ceramic Tile			
7. Resilient Flooring			
8. Resinous Flooring			
9. Acoustical Ceilings			
10. Mechanical/Plumbing			
11. Electrical			

BID FORM

NON-COLLUSION STATEMENT

This is to certify that the undersigned bidder has neither directly nor indirectly, entered into any agreement, participated in any collusion or otherwise taken any action in restraint of free competitive bidding in connection with this proposal submitted this date to the Christina School District.

All the terms and conditions of the Christina School District, Bayard School – Roof Replacement, Architect Project No. 18021-AS have been thoroughly examined and are understood.

NAME OF BIDDER: _____

AUTHORIZED REPRESENTATIVE (TYPED): _____

AUTHORIZED REPRESENTATIVE (SIGNATURE): _____

TITLE: _____

ADDRESS OF BIDDER: _____

_____

_____

PHONE NUMBER: _____

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

My Commission expires _____. NOTARY PUBLIC _____.

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

BID FORM

AFFIDAVIT
OF
EMPLOYEE DRUG TESTING PROGRAM

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

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

Contractor/Subcontractor Name: _____

Contractor/Subcontractor Address: _____

_____

_____

Authorized Representative (typed or printed): _____

Authorized Representative (signature): _____

Title: _____

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

My Commission expires _____. NOTARY PUBLIC _____.

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

STATE OF DELAWARE
OFFICE OF MANAGEMENT AND BUDGET

BID BOND

TO ACCOMPANY PROPOSAL
(Not necessary if security is used)

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

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

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

SEALED, AND DELIVERED IN THE
Presence of

_____
Name of Bidder (Organization)

Corporate Seal

By: _____
Authorized Signature

Attest _____

_____
Title

_____
Name of Surety

Witness:_____

By: _____

_____
Title

SUPPLEMENT TO AGREEMENT BETWEEN OWNER AND CONTRACTOR A101-2017

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

ARTICLE 3: DATE OF COMMENCEMENT AND SUBSTANTIAL COMPLETION

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

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

ARTICLE 5: PAYMENTS

5.1 PROGRESS PAYMENTS

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

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

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

ARTICLE 6: DISPUTE RESOLUTION

6.2 BINDING DISPUTE RESOLUTION

Check Other – and add the following sentence:

"Any remedies available in law or in equity."

ARTICLE 7: TERMINATION or SUSPENSION

7.1.1 Delete paragraph 7.1.1 in its entirety.

ARTICLE 8: MISCELLANEOUS PROVISIONS

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

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

END OF SUPPLEMENT TO AGREEMENT BETWEEN OWNER AND CONTRACTOR

SUPPLEMENT TO A101-2017 – EXHIBIT A INSURANCE AND BONDS

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

ARTICLE A.2 OWNER'S INSURANCE

A.2.1 General

Delete paragraph A.2.1 in its entirety.

A.2.2 Liability Insurance

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

A.2.3 Required Property Insurance

Delete paragraph A.2.3 in its entirety.

A.2.4 Optional Extended Property Insurance

Delete paragraph A.2.4 in its entirety.

A.2.5 Other Optional Insurance

Delete paragraph A.2.5 in its entirety.

ARTICLE A.3 CONTRACTORS INSURANCE AND BONDS

A.3.1.3 Additional Insured Obligations

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

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

Delete the second sentence in its entirety.

A.3.3.2.1 Delete paragraph 3.3.2.1 in its entirety and replace with the following:
Property Insurance of the same type and scope satisfying the requirements identified in Section A.2.3, The Contractor shall comply with all obligations of the Owner under A.2.3 except to the extent provided below. Upon request, the Contractor shall provide the Owner with a copy of the property insurance policy or policies required.

STATE OF DELAWARE
OFFICE OF MANAGEMENT AND BUDGET

PERFORMANCE BOND

Bond Number: _____

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

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

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

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

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

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

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

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

PRINCIPAL

Name: _____

Witness or Attest: Address: _____

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

(Corporate Seal)

SURETY

Name: _____

Witness or Attest: Address: _____

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

(Corporate Seal)

STATE OF DELAWARE
OFFICE OF MANAGEMENT AND BUDGET

PAYMENT BOND

Bond Number: _____

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

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

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

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

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

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

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

PRINCIPAL

Name: _____

Witness or Attest: Address: _____

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

(Corporate Seal)

SURETY

Name: _____

Witness or Attest: Address: _____

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

(Corporate Seal)

GENERAL REQUIREMENTS

TABLE OF ARTICLES

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ARTICLE 1: GENERAL

1.1 CONTRACT DOCUMENTS

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

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

1.2 EQUALITY OF EMPLOYMENT OPPORTUNITY ON PUBLIC WORKS

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

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

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

ARTICLE 2: OWNER

(NO ADDITIONAL GENERAL REQUIREMENTS – SEE SUPPLEMENTARY GENERAL CONDITIONS)

ARTICLE 3: CONTRACTOR

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

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

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

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

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

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

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

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

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

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

3.11 STATE LICENSE AND TAX REQUIREMENTS

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

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

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

ARTICLE 4: ADMINISTRATION OF THE CONTRACT

4.1 CONTRACT SURETY

4.1.1 PERFORMANCE BOND AND LABOR AND MATERIAL PAYMENT BOND

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

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

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

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

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

4.2 FAILURE TO COMPLY WITH CONTRACT

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

4.3 CONTRACT INSURANCE AND CONTRACT LIABILITY

4.3.1 In addition to the bond requirements stated in the Bid Documents, each successful Bidder shall purchase adequate insurance for the performance of the Contract and, by

submission of a Bid, agrees to indemnify and save harmless and to defend all legal or equitable actions brought against the State, any Agency, officer and/or employee of the State, for and from all claims of liability which is or may be the result of the successful Bidder's actions during the performance of the Contract.

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

4.4 RIGHT TO AUDIT RECORDS

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

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

ARTICLE 5: SUBCONTRACTORS

5.1 SUBCONTRACTING REQUIREMENTS

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

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

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

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

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

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

5.1.2 The decision of the awarding Agency as to whether a Bidder who list itself as the Subcontractor for a Subcontractor category shall be final and binding upon all Bidders,

and no action of any nature shall lie against any awarding agency or its employees or officers because of its decision in this regard.

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

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

A. Is unqualified to perform the work required;

B. Has failed to execute a timely reasonable Subcontract;

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

D. Is no longer engaged in such business.

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

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

5.2 PENALTY FOR SUBSTITUTION OF SUBCONTRACTORS

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

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

5.3 ASBESTOS ABATEMENT

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

5.4 STANDARDS OF CONSTRUCTION FOR THE PROTECTION OF THE PHYSICALLY HANDICAPPED

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

5.5 CONTRACT PERFORMANCE

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

ARTICLE 6: CONSTRUCTION BY OWNER OR SEPARATE CONTRACTORS

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

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

ARTICLE 7: CHANGES IN THE WORK

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

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

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

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

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

7.3.3 In addition to the above, the General Contractor is allowed a fifteen percent (15%) markup for overhead and profit for additional work performed by the General Contractor's own forces. For additional subcontractor work, the Subcontractor is allowed a fifteen (15) percent overhead and profit on change order work above and beyond the direct costs stated previously. To this amount, the General Contractor will be allowed a mark-up not exceeding seven and one half percent (7.5%) on the subcontractors work. These mark-ups shall include all costs including, but not limited to: overhead, profit, bonds, insurance, supervision, etc. No markup is permitted on the work of the subcontractors subcontractor. No additional costs shall be allowed for changes related to the Contractor's onsite superintendent/staff, or project manager, unless a change in the work changes the project duration and is identified by the CPM schedule. There will be no other costs associated with the change order.

ARTICLE 8: TIME

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

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

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

8.4 SUSPENSION AND DEBARMENT

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

8.4.2 "Upon such failure for any of the above stated reasons, the Agency that contracted for the public works project may petition the Director of the Office of Management and Budget for Suspension or Debarment of the Contractor. The Agency shall send a copy of the petition to the Contractor within three (3) working days of filing with the Director. If the Director concludes that the petition has merit, the Director shall schedule and hold a hearing to determine whether to suspend the Contractor, debar the Contractor or deny the petition. The Agency shall have the burden of proving, by a preponderance of the evidence, that the Contractor failed to perform or complete the public works project within the time schedule established by the Agency and failed to do so for one or more of the following reasons: a) failure to supply the adequate labor supply ratio for the project; b) inadequate financial resources; or, c) poor performance on the project. Upon a finding in favor of the Agency, the Director may suspend a Contractor from Bidding on any project funded, in whole or in part, with public funds for up to 1 year for a first offense, up to 3 years for a second offense and permanently debar the Contractor for a third offense. The Director shall issue a written decision and shall send a copy to the Contractor and the Agency. Such decision may be appealed to the Superior Court within thirty (30) days for a review on the record."

8.5 RETAINAGE

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

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

ARTICLE 9: PAYMENTS AND COMPLETION

9.1 APPLICATION FOR PAYMENT

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

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

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

9.2 PARTIAL PAYMENTS

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

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

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

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

9.3 SUBSTANTIAL COMPLETION

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

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

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

9.4 FINAL PAYMENT

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

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

9.4.1.2 An acceptable RELEASE OF LIENS,

9.4.1.3 Copies of all applicable warranties,

9.4.1.4 As-built drawings,

9.4.1.5 Operations and Maintenance Manuals,

9.4.1.6 Instruction Manuals,

9.4.1.7 Consent of Surety to final payment.

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

ARTICLE 10: PROTECTION OF PERSONS AND PROPERTY

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

10.2 The Contractor shall notify the Owner in the event any existing hazardous material such as lead, PCBs, asbestos, etc. is encountered on the project. The Owner will arrange with a qualified specialist for the identification, testing, removal, handling and protection against

exposure or environmental pollution, to comply with applicable regulation laws and ordinances. The Contractor and Architect will not be required to participate in or to perform this operation. Upon completion of this work, the Owner will notify the Contractor and Architect in writing the area has been cleared and approved by the authorities in order for the work to proceed. The Contractor shall attach documentation from the authorities of said approval.

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

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

ARTICLE 11: INSURANCE AND BONDS

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

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

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

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

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

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

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

11.7.1 Contractor's Contractual Liability Insurance

Minimum coverage to be:

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

11.7.2 Contractor's Protective Liability Insurance

Minimum coverage to be:

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

11.7.3 Automobile Liability Insurance

Minimum coverage to be:

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

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

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

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

11.7.5.2 Minimum Limit for all employees working at one site.

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

11.7.7 Social Security Liability

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

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

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

ARTICLE 12: UNCOVERING AND CORRECTION OF WORK

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

SUPPLEMENTARY GENERAL CONDITIONS A201-2017

The following supplements modify the "General Conditions of the Contract for Construction," AIA Document A201-2017. Where a portion of the General Conditions is modified or deleted by the Supplementary Conditions, the unaltered portions of the General Conditions shall remain in effect.

TABLE OF ARTICLES

1. GENERAL PROVISIONS
2. OWNER
3. CONTRACTOR
4. ADMINISTRATION OF THE CONTRACT
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14. TERMINATION OR SUSPENSION OF THE CONTRACT

ARTICLE 1: GENERAL PROVISIONS

1.1 BASIC DEFINITIONS

1.1.1 THE CONTRACT DOCUMENTS

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

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

Add the following Section:

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

1.1.8 INITIAL DECISION MAKER

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

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

1.2 CORRELATION AND INTENT OF THE CONTRACT DOCUMENTS

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

Add the following Sections:

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

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

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

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

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

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

under the Contract Documents. They are not to be used by the Contractor or any Subcontractor, Sub-subcontractor or Material and Equipment Supplier on other Projects or for additions to this Project outside the scope of the Work without the specific written consent of the Owner, Architect and Architect's consultants.

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

Strike Section 1.5.2 in its entirety.

1.7 DIGITAL DATA USE AND TRANSMISSION

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

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

1.8 BUILDING INFORMATION MODELS USE AND RELIANCE

Strike Section 1.8 in its entirety.

ARTICLE 2: OWNER

2.2 EVIDENCE OF THE OWNERS FINANCIAL ARRANGEMENTS

Strike Section 2.2 in its entirety.

2.3 INFORMATION AND SERVICES REQUIRED OF THE OWNER

2.3.3 Strike 2.3.3 in its entirety.

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

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

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

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

2.5 OWNER'S RIGHT TO CARRY OUT THE WORK

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

ARTICLE 3: CONTRACTOR

3.2 REVIEW OF CONTRACT DOCUMENTS AND FIELD CONDITIONS BY CONTRACTOR

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

3.2.4 Strike “subject to Section 15.1.7” in the second sentence.

3.2.4 Strike the third sentence.

3.3 SUPERVISION AND CONSTRUCTION PROCEDURES

Add the following Sections:

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

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

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

3.4 LABOR AND MATERIALS

Add the Following Sections:

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

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

3.5 WARRANTY

Add the following Sections:

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

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

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

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

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

3.8 ALLOWANCES

Add the following Section:

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

3.10 CONTRACTOR'S CONSTRUCTION AND SUBMITTAL SCHEDULES

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

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

3.11 DOCUMENTS AND SAMPLES AT THE SITE

Add the following Sections:

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

"3.11.2 At the completion of the project, the Contractor shall obtain a set of the conformed contract drawings from the Architect, and neatly transfer all information outlined in 3.11.1 to provide a complete record of the as-built conditions."

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

3.12 SHOP DRAWINGS, PRODUCT DATA AND SAMPLES

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

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

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

ARTICLE 4: ADMINISTRATION OF THE CONTRACT

4.2 ADMINISTRATION OF THE CONTRACT

4.2.7 Strike the first sentence and replace with the following:

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

4.2.7 Strike the second sentence and replace with the following:

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

Add the following Section:

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

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

ARTICLE 5: SUBCONTRACTORS

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

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

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

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

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

Add the following Section:

"5.2.5 The Contractor shall comply and shall ensure all Subcontractors comply with all requirements for drug testing as set forth in TITLE 19 LABOR

DELAWARE ADMINISTRATIVE CODE 4000 Office of Management and Budget 4100 Division of Facilities Management **4104 Regulations for the Drug Testing of Contractor and Subcontractor Employees Working on Large Public Works Projects."**

ARTICLE 6: CONSTRUCTION BY OWNER OR BY SEPARATE CONTRACTORS

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

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

6.1.4 Strike Section 6.1.4 in its entirety.

6.2 MUTUAL RESPONSIBILITY

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

ARTICLE 7: CHANGES IN THE WORK

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

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

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

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

ARTICLE 8: TIME

8.2 PROGRESS AND COMPLETION

8.2.1 Add the following Section:

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

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

8.2.4 Add the following Section:

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

8.3 DELAYS AND EXTENSION OF TIME

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

Add the following Section:

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

Strike Section 8.3.3 in its entirety and replace with the following:

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

Add the following Section:

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

ARTICLE 9: PAYMENTS AND COMPLETION

9.2 SCHEDULE OF VALUES

Add the following Sections:

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

"9.2.2 The Schedule of Values is to include a line item for Project Closeout Document Submittal. The value of this item is to be no less than 1.5% of the initial contract amount."

9.3 APPLICATIONS FOR PAYMENT

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

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

Add the following Sections:

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

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

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

9.5 DECISIONS TO WITHHOLD CERTIFICATION

Add the following Subsections to 9.5.1:

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

9.6 PROGRESS PAYMENTS

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

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

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

9.7 FAILURE OF PAYMENT

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

"If the Architect does not issue a Certificate for Payment, through no fault of the Contractor, within fourteen days after receipt of the Contractor's Application for Payment, or if the Owner does not pay the Contractor within thirty days after the date established in the Contract Documents, the amount certified by the Architect, then the Contractor may, upon thirty additional days' notice to the Owner and Architect, stop the Work until payment of the amount owing has been received. The Contract Time shall be extended appropriately and the Contract Sum shall be increased by the amount of the Contractor's reasonable costs of shutdown, delay and start-up, plus interest as provided for in the Contract Documents."

9.8 SUBSTANTIAL COMPLETION

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

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

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

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

9.9 PARTIAL OCCUPANCY OR USE

9.9.1 Strike the first sentence and replace with the following (the remainder of the Section remains as written):
"The Owner may occupy or use any completed or partially completed portion of the Work at any stage when such portion is designated by separate agreement with the Contractor, provided such occupancy or use authorized by public authorities having jurisdiction over the Project."

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

9.10.4.4 Strike "if permitted by the Contract Documents,"

ARTICLE 10: PROTECTION OF PERSONS AND PROPERTY

10.1 SAFETY PRECAUTIONS AND PROGRAMS

Add the following Sections:

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

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

10.2 SAFETY OF PERSONS AND PROPERTY

Add the following Section:

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

10.2.5 Strike the second sentence in its entirety.

10.3 HAZARDOUS MATERIALS AND SUBSTANCES

10.3.3 Strike Section 10.3.3 in its entirety.

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

10.3.6 Strike Section 10.3.6 in its entirety.

ARTICLE 11: INSURANCE AND BONDS

11.1 CONTRACTOR'S INSURANCE AND BONDS

11.1.1 Strike "Owner" from the third sentence.

11.2 OWNER'S LIABILITY INSURANCE

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

11.3 WAIVERS OF SUBROGATION

Delete Section 11.3 in its entirety

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

Delete Section 11.4 in its entirety

ARTICLE 12: UNCOVERING AND CORRECTION OF WORK

12.2.2 AFTER SUBSTANTIAL COMPLETION

Add the following Section:

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

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

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

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

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

ARTICLE 13: MISCELLANEOUS PROVISIONS

13.1 GOVERNING LAW

Strike the last sentence.

13.4 TESTS AND INSPECTIONS

13.4.1 Strike the last sentence and replace with the following:

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

13.5 INTEREST

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

Insert the following Section:

"13.6 CONFLICTS WITH FEDERAL STATUTES OR REGULATIONS

13.6.1 If any provision, specifications or requirement of the Contract Documents conflict or is inconsistent with any statute, law or regulation of the government of the United States of America, the Contractor shall notify the Architect and Owner immediately upon discovery."

ARTICLE 14: TERMINATION OR SUSPENSION OF THE CONTRACT

14.1 TERMINATION BY THE CONTRACTOR

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

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

14.3 SUSPENSION BY OWNER FOR CONVENIENCE

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

14.4 TERMINATION BY THE OWNER FOR CONVENIENCE

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

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

ARTICLE 15: CLAIMS AND DISPUTES

15.1 CLAIMS

15.1.2 TIME LIMITS ON CLAIMS

Strike the last sentence.

15.1.3 NOTICE OF CLAIM

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

15.1.5 CLAIMS FOR ADDITIONAL COSTS

Strike the first sentence and replace with the following:

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

15.1.7 WAIVER OF CLAIMS FOR CONSEQUENTIAL DAMAGES

Strike Section 15.1.7 in its entirety.

15.2 INITIAL DECISION

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

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

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

15.2.6 Strike Section 15.2.6 and its subsections in their entirety.

15.3 MEDIATION

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

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

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

15.3.3 Strike Section 15.3.3 in its entirety.

15.4 ARBITRATION

Strike Section 15.4 and its Subsections in their entirety.

END OF SUPPLEMENTARY GENERAL CONDITIONS

PROJECT SUPPLEMENTAL GENERAL CONDITIONS

This "Project Supplemental Instructions to Bidders" is intended as a project specific supplement to the AIA Document A201-2017 "General Conditions", "Supplemental General Conditions" and the "General Requirements". Where conflicting information or instructions exist between any of these documents, the information or instructions in this Project Supplemental General Conditions shall prevail.

1. AIA General Conditions

The General Conditions of this contract are as stated in the American Institute of Architects Document AIA 201 (2017 Edition) entitled "General Conditions of the Contract for Construction," and is part of this project manual as if herein written in full.

2. Supplementary Conditions

In addition to the General Conditions, these Supplementary Conditions shall apply to the contract as a whole, and to each and every subcontract, and to all persons supplying any materials or labor entering into this project directly or indirectly.

3. Definitions (Addition to AIA General Conditions – Articles 1, 2, 3, 4, and 5)

OWNER:	Christina School District
ARCHITECT:	Fearn-Clendaniel Architects, Inc.
CONTRACTOR:	
SUBCONTRACTOR:	

4. Basic Definitions (Clarification of AIA General Conditions – Article 1, Paragraph 1.1, Subparagraph 1.1.1 "The Contract Documents")

Whether subsequently enumerated in the Owner-Contractor Agreement or not, the Contractor or Contractors preparing Bids on this Project (Architect's Commission No. 18021-AS) and the Contractor or Contractors awarded the project, shall take into account that the Instructions for Obtaining Bidding Documents, the Bid Form, the Instructions to Bidders, and any portions of Addenda relating to any of these Bidding Documents are (unless otherwise noted) to be strictly adhered to and shall become part of this agreement.

5. Basic Definitions (Addition to AIA General Conditions – Article 1, Paragraph 1, Subparagraph 1.1.5 "The Drawings")

See the Project Manual Table of Contents for a full listing of the drawings.

6. Basic Definitions (Alteration to AIA General Conditions – Article 1, Paragraph 1.1, Add Subparagraph 1.1.9 The Project Manual)

1.1.9 Project Manual: The Project Manual is the volume which includes the *Bidding Documents,* such as Project Forward, Advertisement to Bidders, and Bid Form; *Contract Forms* such as Contract Agreement between the Owner and General Contractor, Performance Bond and other AIA documents in support of the Contract; *Conditions of the Contract* which include the General Conditions of the contract and Supplementary Conditions; and the *Technical Specifications*.

7. Execution, Correlation, Intent and Interpretations (Alteration to AIA General Conditions – Article 1, Paragraph 1.2, Subparagraph 1.2.1, Begin paragraph with sentence below.)

The Owner-Contractor Agreement shall be signed by the Owner and Contractor respectively. Signature of both parties on the Owner-Contractor agreement represents signature of each and every Contract Document.

(Also)

(Addition to AIA General Conditions – Article 1, Paragraph 1.2, Subparagraphs 1.2.1 and 1.2.3)

Should anything be omitted from the Drawings or Specifications which is necessary to a clear understanding of the work or should any error appear in the various instruments furnished or included in these specifications, it shall be the duty of the Contractor to notify the Architect and obtain the necessary information and see that the work is carried out in compliance therewith, and that any damage or defect in the work caused thereby is properly corrected.

The Contractor shall be responsible for all measurements; shall check all drawings; shall report any discrepancies to the Architect; and shall furnish correct dimensions to all trades. It shall also furnish all lines and dimensions required in the performance of the work. Scaled dimensions shall not be allowed. The drawings will be held in preference of the following order: Contract Drawings, Scale Drawings, and F.S. Details, but the Contractor must check all drawings and verify all coordination. All details shall work together, and details indicated at various scales shall require all components whether or not they are indicated at all different scales.

8. Labor and Materials (Addition to AIA General Conditions – Article 3, Paragraph 3.4, Subparagraph 3.4.1)

All materials delivered to the premises which are to form a part of the work are to be considered the property of the Owner and must not be removed without the Owner's consent, but the Contractor shall remove all surplus materials upon completion of each phase of the work and as directed by the Owner.

The Contractor shall not subcontract, sublet, sell, transfer, assign, purchase work or materials from an organization other than its own, or otherwise dispose of the contract or any portion thereof, or of its right, title interest therein without written permission from the School District.

9. <u>Storm Protection</u>

The Contractor shall check weather forecasts daily and shall take every precaution to minimize danger to persons, to the work, the building equipment within the building and to adjacent property from wind and weather.

10. <u>Fire Prevention</u>

An adequate fire watch and adequate fire extinguishing equipment approved by the Consultant shall be used.

Welding, burning, and open flame work, shall be permitted, but only subject to the following conditions.

A. The methods shall be approved by the Owner and the Consultant.

B. The Contractor shall inform the Owner of the exact time that welding or open flame work will be performed.

C. The application of roofing materials by the use of butane or propane torches, either hand held or as a part of a wheeled device used for that purpose shall be permitted, but only subject to the following conditions:

1) Thoroughly knowledgeable workmen shall be employed.

2) An inspection of all torched areas shall be made at the end of the day's work to determine if there are any "hot spots" that might indicate the presence of a smoldering fire within or beneath the membrane.

12. Permits, Fees and Notices (Alterations to AIA General Conditions – Article 3, Paragraph 3.7)

The Contractor shall be responsible for permits and governmental fees necessary for the proper execution and completion of the work, and the Contractor is required to have proper State and County licenses. The Contractor will secure all permits including, but not limited to, inspections, utility connections, etc.

The Contractor shall coordinate permit requirements. The Owner will pay remaining permit and Town impact fees. The Contractor will be responsible for any additional permit and/or impact fees due to improper submissions or delays.

13. Superintendent (Alteration to AIA General Conditions – Article 3, Paragraph 3.9)

A full-time superintendent shall be provided, and shall be present onsite during all construction activities including but not limited to time limits specified for substantial completion.

14. Shop Drawings, product Data and Samples (Addition to AIA General Conditions – Article 3, Paragraph 3.12, Subparagraph 3.12.3)

3.12.3

.1 The Contractor shall furnish for the approval of the Architect, any samples required by the specifications or that may be requested by the Architect, of any and/or all materials or equipment it proposes to use and shall prepay all shipping charges on the samples. The intent is for the Contractor to furnish two samples of each item called for, unless otherwise determined before start of construction.

.2 No samples are to be submitted with the bids.

.3 No materials or equipment, of which samples are required, to be submitted for approval shall be used on the work until such approval has been given by the Architect, except at the Contractor's risk and expense.

.4 Each sample shall have a label indicating the material represented, its place of origin and names of the producer, the contractor and the building or work for which the material is intended. Samples of finished materials shall be so marked as to indicate where the materials represented are required by the drawings or specifications.

.5 A letter in duplicate submitting each shipment of samples shall be mailed under separate cover by the Contractor to the Architect and contain a list of the samples, the name of the building or work for which the materials are intended and the brands of the materials and names of the manufacturers.

.6 The approval of any samples shall be only for the characteristics or for the uses named in such approval and no other. No approval of a sample shall be taken in itself to change or modify the contract requirements. When a material has been approved, no additional sample of that material will be considered and no change in brand or make will be permitted. Approved samples of hardware in good condition may be suitable marked for identification and used in the work.

.7 Failure of any material to pass the specified tests will be sufficient cause of refusal to consider, under this contract, any further samples of the same brand or make of this material.

.8 Test samples, as the Architect may deem necessary, will be procured from the various materials or equipment delivered by the Contractor for use in the work. If any of these test samples fail to meet the specification requirements, any previous approvals will be withdrawn and such materials or equipment shall be subject to removal and replacement by the Contractor, with materials or equipment meeting the specification requirements, or at the discretion of the Owner, the defective materials and equipment may be permitted to remain in place subject to a proper adjustment of the Contract Price. The costs of the tests will be borne by the Owner except where laboratory tests are hereinafter specified elsewhere in this specification.

(also)

(Addition to AIA General Conditions – Article 3, Paragraph 3.12)

3.12.11 The Contractor shall submit all required shop drawings and samples in accordance with the approved construction progress schedule and with such promptness as to cause no delay in its own work or in that of any other contractor or subcontractor. No extensions of time will be granted to the Contractor for any delay caused by it failure to have shop drawings or samples submitted in ample time to allow for review and approval.

3.12.12 Each subcontractor shall submit all shop drawings manufacturer's data, and samples through the Contractor, to the Architect for approval. All shop drawings shall be thoroughly checked by the Contractor for completeness and for compliance with the contract documents before submitting them to the Architect and shall bear the Contractor's stamp of approval certifying that they have been checked.

Each sheet of shop drawings shall identify the project, Contractor, subcontractor and fabricator or manufacturer and the date of the drawings. All shop drawings shall be numbered in consecutive sequence and each sheet shall indicate the total number of sheets in the set.

The shop drawings shall indicate types, gauges, and finishes of all materials. Where a shop coat of paint is required, its brand name and manufacturer's identification number or type shall be indicated. Sufficient date in each set of shop drawings shall be included to permit a detailed study of the item submitted.

15. Cleaning Up (Addition to AIA General Conditions – Article 3, Paragraph 3.15, Subparagraph 3.15.1)

The Contractor shall police and clean up on a continuing basis during its presence on the project, all areas in which it is performing work. No burning of any kind will be permitted.

16. Administration of the Contract (Addition to AIA General Conditions – Article 4, Paragraph 4.2, Subparagraph 4.2.1)

In addition to the general supervision by the Architect, the Owner may at its option employ a Project Manager who will at times represent it and the Architect. All matters involving the interpretation of the drawings and specifications shall be brought to the attention of this Project Manager, who shall consult with the Architect and advise the Contractor of the decision made thereon. The Project Manager shall have power to reject any materials, form of workmanship or method which is not in accordance with the drawings and specifications, subject to approval of the Architect.

(also)

(Alteration to AIA General Conditions – Article 4, Paragraph 4.2, Subparagraph 4.2.2)

4.2.2 The Architect will make such periodic visits to the site as may be necessary to familiarize itself generally with the progress and quality of the work and to determine in general, if the work is proceeding in accordance with the Contract Documents and to carry out the obligations of the Architect under its Agreement with the Owner in accordance with acceptable professional standards. On the basis of its on-site observations as

Architect, it will keep the Owner informed of the progress of the work and will endeavor to guard the Owner against defects and deficiencies in the work of the Contractor. The Architect will not be required to make exhaustive or continuous on-site inspections to check the quality of the work.

18. Addition to AIA General Conditions – Article 7

Add paragraph 7.2.2 as follows:

"The additional cost, or the 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.

"DPE" shall be defined to mean "direct personnel expense". Direct payroll expense includes direct salary plus customary fringe benefits (prevailing wage rates), and documented statutory costs such as workman's compensation insurance, Social Security/Medicare, and unemployment insurance, (a maximum of the prevailing wage rate times 1.35).

"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 vender, 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.

In addition to the above, the Contractor shall be allowed a combined markup per the following schedule:

.1 For the Contractor, for work performed by the Contractor's own forces, up to $10,000.00, 15% of the cost.
.2 For the Contractor, for work performed by the Contractor's own forces, over $10,000.00, 7.5% of the cost.
.3 For the Contractor, for work performed by the Contractor's Subcontractor, up to $10,000.00, 7.5% of the cost.
.4 For the Contractor, for work performed by the Contractor's Subcontractor, over $10,000.00, 5% of the total cost.
.5 For each Subcontractor, for work performed by that Subcontractor or Sub-subcontractor's own forces, 10% of the cost.
.6 For each Subcontractor, for work performed by the Subcontractor's Sub-subcontractor, 2.5% of the cost.

These mark-ups shall include all costs including, but not limited to: overhead, profit, bonds, insurance, etc.

No additional costs shall be allowed for changes related to the Contractor's onsite superintendent/staff, or project manager, unless a change in the work changes the project duration and is identified by the CPM schedule. In this event, these costs will only be reviewed after the time limits specified have been exceeded. If project is substantially completed within the time limits specified no additional costs will be accepted for the Contractor's onsite superintendent/staff, or project manager. There will be no other costs associated with the change order.

In order to facilitate checking of quotations for extras or credits, all proposals, except those so minor that their propriety can be seen by inspection, shall be accompanied by a complete itemization of costs including labor, materials and Subcontractors. Labor and materials shall be itemized in the manner prescribed above. Where major cost items are Subcontracts, they shall be itemized also. In no case will a change involving over $200.00 be approved without such itemization.

Add paragraph 7.2.3 as follows:

Time limits on change order requests must be submitted in writing to the architect within 2 working days following a change in work giving rise to such a request or within 2 working days after the discovery of conditions giving rise to such a request. Supporting documentation required to substantiate such requests as indicated in paragraph 7.2.2 must be submitted within 10 working days

19. Payments and Completion (Addition to AIA General Conditions – Article 9)

Monthly payments on account will be made upon certificates from the Contractor. There will be a five percent (5%) retainage on all Contractor's monthly invoices until the completion of the project. The intent of the Owner will be to issue payment to the Contractor within 30 days following receipt of the approved certificate. Retainage will become payable upon issuance of a Certificate of Substantial Completion by the Architect and with Consent of Surety, provided all other requirements of the contract documents have been met.

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 one percent (1.5%) of the initial contract amount.

On the 20th of each month, the Contractor shall submit its application for progress payment to the Architect. Upon receipt of Contractor's itemized application for payment, such application will be audited, modified if found necessary, and certificate issued for the amount approved by the Architect. Statement shall be submitted in triplicate to the office of the Architect.

Statements must indicate clearly the proportion of completion of work for each Contract and subcontract. Statements shall, when so requested by Architect, be accompanied by bills showing the amounts of labor and material incorporated into the building during the previous month, which would also show the amount of material delivered to the site where furnished for this particular contract. Bills shall be returned when payments are made.

20. Liquidated Damages

Liquidated damages have been waived for this Project. However the Contractor will be liable for delays as indicated in Article 8 of the General Requirements specification. Any associated architectural and engineering fees incurred beyond the stipulated completion date will be included in any forfeiture of retainage indicated in General Requirements Article 8.

Substantial Complete Criteria: Beneficial occupancy by the Owner, including, but not limited to, "Certificate of Occupancy" if applicable, from the appropriate issuing office.

21. Accident Prevention (Addition to AIA general Conditions – Article 10)

Precaution against accidents shall be exercised at all time for the protection of all persons and property.

Machinery and equipment shall be guarded, and all hazards shall be guarded against or eliminated in accordance with the safety provisions of the Manual of Accident Prevention in Construction, published by the Associated General Contractors of America, to the extent that such provisions are not in contravention of applicable laws.

This Project, its Prime Contractor and his Subcontractors shall, at all times, be governed by Chapter XIII of Title 29, Code of Federal Regulations, Part 1518 – Safety and Health Regulations for Construction (36 FR 75), as amended to date.

The Prime Contractor and all Subcontractors shall immediately report all accidents, injuries, or health hazards the Owner, or his designated representative, in writing. This shall not obviate any mandatory reporting under the provisions of the Occupational Safety and Health Administration Act of 1970 as may be amended.

The OSHA Act of 1970 and amendments shall become a part of the contract documents and the contract between the Owner and Prime Contractor, and the Prime Contractor and all subcontractors, as though fully written herein.

The inclusion of the OSHA Act in this specification in no way commits the Owner or his representative to guarantee compliance by the Contractor or Subcontractors. Compliance is the sole responsibility of the Contractor and Subcontractors.

The Contractor will also observe and comply with the Owner's specific safety requirements for construction contracts, if any, as if written fully herein.

22. Alcoholic Beverages and Controlled Substances:

Alcoholic beverages and controlled substances, and those people who are under their influence are hereby barred from the project site.

The Contractor shall be responsible to assure complete compliance with the requirements of this paragraph.

23. Smoking:

There shall be no smoking on the project site.

24. Daily Construction Report:

The Contractor shall at the end of each working day, unless expressly excused from this requirement by the Owner, carefully prepare a Daily Construction Report that shall include the weather and temperature, a general description of the work accomplished and its location on the roof, the number of men and regular and overtime hours by craft, and any accidents or unusual occurrences, and shall submit such reports to the Owner on a weekly basis.

25. Insurance (Addition to AIA General Conditions – Article 11)

11.5.1 Limits of Liability Insurance: The Contractor shall use the standard "ACORD" form titled "Certificate of Insurance" in submitting its liability insurance limits. The required limits to be inserted in the "ACORD" form as specified in the General Conditions.

11.5.2 Other Insurance: Contractor shall carry any necessary insurance required to cover Owner and Rental Equipment that may be necessary for it to use in the performance of its contract.

.1 the Christina School District will NOT provide Builder's All Risk Insurance for the Project. The contractor shall provide Builder's All Risk Insurance (also called Special Form Insurance) and include building materials stored on site.

11.5.3 General Notes: Contractor shall have the following additional items added to its required "ACORD" form Certificate Insurance:

.1 Name and Address of Insured (Contractor)
.2 Description of Operations/Locations
.3 Name and Address of Certificate Holder:

Christina School District,
Eden Support Services Center,
925 Bear Corbitt Rd.
Bear, DE 19701

.4 Name of Added Insured:

Fearn/Clendaniel Architects, Inc.

END OF SUPPLEMENTARY CONDITIONS

SECTION 011000 - SUMMARY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the following:

1. Project information.
2. Work covered by Contract Documents.
3. Phased construction.
4. Work by Owner.
5. Work under separate contracts.
6. Access to site.
7. Coordination with occupants.
8. Work restrictions.
9. Specification and drawing conventions.

B. Related Sections include the following:

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

1.3 WORK COVERED BY CONTRACT DOCUMENTS

A. Project Identification: F D Stubbs School – Adult Services Renovations, 1100 North Pine Street, Wilmington, DE 19801.

B. Owner: Christina School District

1. Owner's Representative: Mr. George Wicks, Supervisor, Planning and Facilities Services.

C. Architect: Fearn-Clendaniel Architects, Inc.

1.4 WORK COVERED BY CONTRACT DOCUMENTS

A. The Work of Project is defined by the Contract Documents and consists of the following:

1. Renovation and reconstruction of two (2) public restrooms, including reconfiguration of fixtures, finishes, and accessories. Conversion of two (2) sets of two (2) existing staff restrooms, including new fixtures, finishes, and accessories into two (2) individual accessible restrooms.
2. Removal of existing non-loadbearing exterior basement infill framing within existing structural opening and installation of a new aluminum entrance system, as indicated on the drawings. Door hardware includes a power operator and access control systems.
3. Construction of a new entry / access corridor within the existing basement space, including new construction, modifications to existing construction, and related mechanical, plumbing, and electrical work.
4. Modifications to existing elevator and elevator control systems to provide card reader access control to specific floors.
5. Project will be constructed under a single prime contract.

1.5 WORK PHASES/SEQUENCING

A. Construction is expected to commence **April 10, 2020** and continue through completion by **August 15, 2020** and **October 15, 2020**. The general contractor shall take all appropriate precautions to protect the property and occupants of the building and adjacent buildings during construction operations when occupied.

B. Phased Construction: Work is to be sequenced in the following phases. Coordinate final sequencing with Owner.

1. Phase I: Basement – Construct new entry, allowing separate access to the new corridor construction area as shown on drawings. This work shall take place during the school year, commencing on or about spring break on **April 10, 2020**.
2. Phase II: Balance of renovation as indicated on drawings, including all first and second floor work. This work shall take place during the summer break, commencing on or about **June 15, 2020**. Earlier access could potentially be coordinated with the Owner. First floor work must be completed by **August 15, 2020**.

1.6 ACCESS TO SITE

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

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

1. Limits: Confine construction operations to areas within the Contract limits identified in construction drawings and specifications.
2. Driveways, Walkways 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 for storage of materials.

    a. Schedule deliveries to minimize use of driveways and entrances by construction operations.

b. Schedule deliveries to minimize space and time requirements for storage of materials and equipment on-site.

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

D. Condition of Existing Grounds: Maintain portions of existing grounds, landscaping, and hardscaping affected by construction operations throughout construction period. Repair damage caused by construction operations.

1.7 COORDINATION WITH OCCUPANTS

A. Partial Owner Occupancy: Owner will occupy the premises during entire construction period, with the exception of areas under construction. Cooperate with Owner during construction operations to minimize conflicts and facilitate Owner usage. Perform the Work so as not to interfere with Owner's operations. Maintain existing exits unless otherwise indicated.

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

1.8 WORK RESTRICTIONS

A. On-Site Work Hours: Work shall be generally performed inside the existing building during normal business working hours of 7:00 a.m. to 4:00 p.m., Monday through Friday, except as otherwise indicated or negotiated with the Owner.

1. Hours for Utility Shutdowns: To be coordinated with Owner on an incident by incident basis.
2. Hours for Core Drilling and other noise producing activities that could be disruptive to the Owners continued operation within and around the building shall be coordinated with Owner on an incident by incident basis.

B. Existing Utility Interruptions: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary utility services according to requirements indicated:

1. Notify Owner not less than five business days in advance of proposed utility interruptions.
2. Do not proceed with utility interruptions without Owner's written permission.

C. Nonsmoking Building: Smoking is not permitted within the building or within the building site.

1.9 SPECIFICATION FORMATS AND CONVENTIONS

A. Specification Format: The Specifications are organized into Divisions and Sections using the 50-division format and CSI/CSC's "MasterFormat" numbering system.

1. Section Identification: The Specifications use Section numbers and titles to help cross-referencing in the Contract Documents. Sections in the Project Manual are in numeric sequence; however, the sequence is incomplete because all available Section numbers are not used. Consult the table of contents at the beginning of the Project Manual to determine numbers and names of Sections in the Contract Documents.
2. Division 01: Sections in Division 01 govern the execution of the Work of all Sections in the Specifications.

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

1. Abbreviated Language: Language used in the Specifications and other Contract Documents is abbreviated. Words and meanings shall be interpreted as appropriate. Words implied, but not stated, shall be inferred as the sense requires. Singular words shall be interpreted as plural, and plural words shall be interpreted as singular where applicable as the context of the Contract Documents indicates.
2. Imperative mood and streamlined language are generally used in the Specifications. The words "shall," "shall be," or "shall comply with," depending on the context, are implied where a colon (:) is used within a sentence or phrase.
3. Specification requirements are to be performed by Contractor unless specifically stated otherwise.

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

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

1. Terminology: Materials and products are identified by the typical generic terms used in the individual Specifications Sections.
2. Abbreviations: Materials and products are identified by abbreviations scheduled on Drawings.
3. Keynoting: Materials and products are identified by reference keynotes.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 011000

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 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes administrative and procedural requirements governing allowances.

B. Types of allowances include the following:

1. Lump-sum allowances.

C. Related Requirements:

1. Section 014000 "Quality Requirements" for procedures governing the use of allowances for field testing by an independent testing agency.

1.3 DEFINITIONS

A. Allowance is a quantity of work or dollar amount established in lieu of additional requirements, used to defer selection of actual materials / equipment or allow for unforeseen conditions uncovered during the work. Direction will be provided to Contractor. If necessary, additional requirements will be issued by an Owners Allowance Authorization form.

1.4 SELECTION AND PURCHASE

A. At the earliest practical date after award of the Contract, advise Architect of the date when final selection, or purchase and delivery, of each product or system described by an allowance must be completed by the Owner 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.

1.5 ACTION SUBMITTALS

A. Submit proposals for purchase of products or systems included in allowances in the form specified for Change Orders.

1.6 INFORMATIONAL SUBMITTALS

A. Submit invoices or delivery slips to show actual quantities of materials delivered to the site for use in fulfillment of each allowance.

B. Submit time sheets and other documentation to show labor time and cost for installation of allowance items that include installation as part of the allowance.

C. Coordinate and process submittals for allowance items in same manner as for other portions of the Work.

1.7 LUMP-SUM ALLOWANCES

A. Allowance shall include cost to Contractor of specific products and materials ordered by Owner or selected by Architect under allowance and shall include taxes, freight, and delivery to Project site.

B. Unused Materials: 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, retain and prepare unused material for storage by Owner. Deliver unused material to Owner's storage space as directed. 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

A. **Allowance No. 1**: Include an Allowance equal to Thirty-five thousand dollars ($35,000.00) for costs associated with any unforeseen conditions or Owner requested revisions during the construction period. Upon Owner/Architect approval, a Credit or Add Change Order will be applied to the Allowance.

END OF SECTION 012100

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 01 Specification Sections, apply to this Section.

1.2 SUMMARY

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

B. Related Requirements:

1. Section 012100 "Allowances" for procedural requirements for handling and processing allowances.
2. Section 016000 "Product Requirements" for administrative procedures for handling requests for substitutions made after the Contract award.

1.3 MINOR CHANGES IN THE WORK

A. Architect will issue supplemental instructions authorizing minor changes in the Work, not involving adjustment to the Contract Sum or the Contract Time, on AIA Document G710 form or an Owners Allowance Authorization form.

1.4 PROPOSAL REQUESTS

A. Owner-Initiated Proposal Requests: Architect will issue a detailed description of proposed changes in the Work that may require adjustment to the Contract Sum or the Contract Time. If necessary, the description will include supplemental or revised Drawings and Specifications.

1. Work Change Proposal Requests issued by Architect are not instructions either to stop work in progress or to execute the proposed change.
1. Within (7) days after receipt of Proposal Request, submit a quotation estimating cost adjustments to the Contract Sum and the Contract Time necessary to execute the change.

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

d. Include an updated Contractor's construction schedule that indicates the effect of the change, including, but not limited to, changes in activity duration, start and finish times, and activity relationship. Use available total float before requesting an extension of the Contract Time.

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

1. Include a statement outlining reasons for the change and the effect of the change on the Work. Provide a complete description of the proposed change. Indicate the effect of the proposed change on the Contract Sum and the Contract Time.
2. Include a list of quantities of products required or eliminated and unit costs, with total amount of purchases and credits to be made. If requested, furnish survey data to substantiate quantities.
3. Indicate applicable taxes, delivery charges, equipment rental, and amounts of trade discounts.
4. Include costs of labor and supervision directly attributable to the change.
5. Include an updated Contractor's construction schedule that indicates the effect of the change, including, but not limited to, changes in activity duration, start and finish times, and activity relationship. Use available total float before requesting an extension of the Contract Time.
6. Comply with requirements in Section 012500 "Substitution Procedures" if the proposed change requires substitution of one product or system for product or system specified.

1.5 ADMINISTRATIVE CHANGE ORDERS

A. Allowance Adjustment: See Section 012100 "Allowances" for administrative procedures for preparation of Change Order Proposal for adjusting the Contract Sum to reflect actual costs of allowances.

1.6 CHANGE ORDER PROCEDURES

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

1.7 CONSTRUCTION CHANGE DIRECTIVE

A. Construction Change Directive: Architect may issue a Construction Change Directive on AIA Document G714. Construction Change Directive instructs Contractor to proceed with a change in the Work, for subsequent inclusion in a Change Order.

1. Construction Change Directive contains a complete description of change in the Work. It also designates method to be followed to determine change in the Contract Sum or the Contract Time.

B. Documentation: Maintain detailed records on a time and material basis of work required by the Construction Change Directive.

1. After completion of change, submit an itemized account and supporting data necessary to substantiate cost and time adjustments to the Contract.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 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 01 Specification Sections, apply to this Section.

1.2 SUMMARY

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

B. Related Requirements:

1. Section 012100 "Allowances" for procedural requirements governing the handling and processing of allowances.
2. Section 012600 "Contract Modification Procedures" for administrative procedures for handling changes to the Contract.
3. Section 013200 "Construction Progress Documentation" for administrative requirements governing the preparation and submittal of the Contractor's construction schedule.

1.3 DEFINITIONS.

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

1.4 SCHEDULE OF VALUES

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

1. 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.
   c. Contractor's Construction Schedule.

2. Submit the Schedule of Values to Architect at earliest possible date but no later than (14) days before the date scheduled for submittal of initial Applications for Payment.

3. Subschedules: Where the Work is separated into phases requiring separately phased payments, provide subschedules showing values correlated with each phase of payment.

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

1. Identification: Include the following Project identification on the Schedule of Values:

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

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

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

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

4. Provide a breakdown of the Contract Sum in enough detail to facilitate continued evaluation of Applications for Payment and progress reports. Provide multiple line items for principal subcontract amounts in excess of five percent of 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. If specified or requested, include evidence of insurance or bonded warehousing.
6. Allowances: Provide a separate line item in the schedule of values for each allowance. Show line-item value of unit-cost allowances, as a product of the unit cost, multiplied by measured quantity. Use information indicated in the Contract Documents to determine quantities.
7. Overhead Costs: Include total cost and proportionate share of general overhead and profit for each line item.

8. Closeout Costs. Include separate line items under Contractor and principal subcontracts for Project closeout requirements in an amount totaling five percent of the Contract Sum and subcontract amount.
9. Schedule of Values Revisions: Revise the schedule of values when Change Orders or Construction Change Directives result in a change in the Contract Sum. Include at least one separate line item for each Change Order and Construction Change Directive.

1.5 APPLICATIONS FOR PAYMENT

A. Each Application for Payment shall be consistent with previous applications and payments as certified by Architect and paid for by Owner.

1. Initial Application for Payment, Application for Payment at time of Substantial Completion, and final Application for Payment involve additional requirements.

B. Payment Application Times: The date for each progress payment is indicated in the Agreement between Owner and Contractor. The period of construction Work covered by each Application for Payment is the period indicated in the Agreement.

C. Payment Application Times: Each progress payment date is indicated in the Agreement. The period of construction Work covered by each Application for Payment is the period indicated in the Agreement.

D. Payment Application Forms: Use AIA Document G702 and AIA Document G703 Continuation Sheets as form for Applications for Payment. Electronic versions shall only be acceptable if they are identical in format to the G702 and G703 forms.

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

1. Entries shall match data on the Schedule of Values and Contractor's Construction Schedule. Use updated schedules if revisions were made.
2. Include amounts of Change Orders and Construction Change Directives issued before last day of construction period covered by application.

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

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

a. Value of materials previously stored and remaining stored as of date of previous Applications for Payment.

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

G. Transmittal: Submit (5) signed and notarized original copies of each Application for Payment to Architect by a method ensuring receipt within 24 hours. One copy shall include waivers of lien and similar attachments if required.

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

H. 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, prior to 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. Submit each Application of Payment with the Contractor’s waiver of mechanics lien for the period of construction covered by the application.
5. Submit final Application for Payment with or preceded by final waivers from every entity involved with performance of the Work covered by the application who is lawfully entitled to a lien.
6. Waiver Forms: Submit waivers of lien on forms, executed in a manner acceptable to Owner.

I. 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. List of principal suppliers and fabricators.
3. Schedule of Values.
4. Contractor's Construction Schedule (preliminary if not final).
5. Schedule of principal products.
6. Copies of building permits.
7. Copies of authorizations and licenses from authorities having jurisdiction for performance of the Work.
8. Initial progress report.
9. Report of preconstruction conference.
10. Certificates of insurance and insurance policies.
11. Performance and payment bonds.
12. Data needed to acquire Owner's insurance.
13. Initial settlement survey and damage report if required.

J. 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.
3. Administrative actions and submittals that shall preceded or coincide with this application include:
   a. Occupancy permits and similar approvals.
   b. Warranties (guarantees) and maintenance agreements.
   c. Equipment testing and adjusting records.
   d. Maintenance instructions.
   e. Meter readings.
   f. Startup performance reports.
   g. Changeover information related to Owner's occupancy, us, operation, and maintenance.
   h. Final cleaning.
   i. Application for reduction of retainage and consent of surety.
   j. Advice on shifting insurance coverages.
   k. Final progress photographs.
   l. List of incomplete Work, recognized as exceptions to Architect's Certificate of Substantial Completion.

K. 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. Completion of Project closeout requirements.
2. Completion of items specified for completion after Substantial Completion.
3. Ensure that unsettled claims will be settled.
4. Ensue that incomplete Work is not accepted and will be completed without undue delay.
5. Transmittal of required Project construction records to the Owner.
6. Certified property survey.
7. Insurance certificates for products and completed operations where required and proof that taxes, fees, and similar obligations were paid.
8. Updated final statement, accounting for final changes to the Contract Sum.
9. AIA Document G706, "Contractor's Affidavit of Payment of Debts and Claims."
10. AIA Document G706A, "Contractor's Affidavit of Release of Liens."
11. AIA Document G707, "Consent of Surety to Final Payment."
12. 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.
13. Removal of temporary facilities and services.
14. Removal of surplus materials, rubbish, and similar elements.
15. Change of door locks to Owner's access.

PART 2 - PRODUCTS (Not Used)
PART 3 - EXECUTION (Not Used)

END OF SECTION 012900

SECTION 013100 - PROJECT MANAGEMENT AND COORDINATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

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

1. General coordination procedures.
2. Coordination drawings.
3. RFIs.
4. Project meetings.

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

C. Related Sections include the following:

1. Section 013200 "Construction Progress Documentation" for preparing and submitting Contractor's construction schedule.
2. Section 013516 “Alteration Project Procedures” for cutting, patching, and renovating work performed with existing spaces or on existing surfaces.
3. Section 017300 "Execution" for procedures for coordinating general installation and field-engineering services, including establishment of benchmarks and control points.
4. Section 017700 "Closeout Procedures" for coordinating closeout of the Contract.

1.3 DEFINITIONS

A. BIM: Building Information Modeling.

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

1.4 COORDINATION

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

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

1. Schedule construction operations in sequence required to obtain the best results where installation of one part of the Work depends on installation of other components, before or after its own installation.
2. Coordinate installation of different components with other contractors to ensure maximum accessibility for required maintenance, service, and repair.
3. Make adequate provisions to accommodate items scheduled for later installation.
4. Where availability of space is limited, coordinate installation of different components to ensure maximum performance and accessibility for required maintenance, service, and repair of all components, including mechanical and electrical.

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

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

a. Use applicable Drawings as a basis for preparation of coordination drawings. Prepare sections, elevations, and details as needed to describe relationship of various systems and components.
b. Coordinate the addition of trade-specific information to coordination drawings by multiple contractors in a sequence that best provides for coordination of the information and resolution of conflicts between installed components before submitting for review.
c. Indicate functional and spatial relationships of components of architectural, structural, mechanical, and electrical systems.
d. Indicate space requirements for routine maintenance and for anticipated replacement of components during the life of the installation.
e. Show location and size of access doors required for access to concealed dampers, valves, and other controls.
f. Indicate required installation sequences.
g. Indicate dimensions shown on Drawings. Specifically note dimensions that appear to be in conflict with submitted equipment and minimum clearance requirements. Provide alternative sketches to Architect indicating proposed resolution of such conflicts. Minor dimension changes and difficult installations will not be considered changes to the Contract.

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

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

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

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

F. Conservation: Coordinate construction activities to ensure that operations are carried out with consideration given to conservation of energy, water, and materials.

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

1.5 SUBMITTALS

A. Coordination Drawings: Prepare Coordination Drawings if limited space availability necessitates maximum utilization of space for efficient installation of different components or if coordination is required for installation of products and materials fabricated by separate entities.

1. Content: Project-specific information, drawn accurately to scale. Do not base Coordination Drawings on reproductions of the Contract Documents or standard printed data. Include the following information, as applicable:

a. Indicate functional and spatial relationships of components of architectural, structural, civil, mechanical, and electrical systems.
b. Indicate required installation sequences.
c. Indicate dimensions shown on the Contract Drawings and make specific note of dimensions that appear to be in conflict with submitted equipment and minimum clearance requirements. Provide alternate sketches to Architect for resolution of such conflicts. Minor dimension changes and difficult installations will not be considered changes to the Contract.

2. Refer to individual Sections for Coordination Drawing requirements for Work in those Sections.

B. Key Personnel Names: Within (7) days of starting construction operations, submit a list of key personnel assignments, including superintendent and other personnel in attendance at Project

site. Identify individuals and their duties and responsibilities; list addresses and telephone numbers, including home and office telephone numbers. Provide names, addresses, and telephone numbers of individuals assigned as standbys in the absence of individuals assigned to Project.

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

1.6 ADMINISTRATIVE AND SUPERVISORY PERSONNEL

A. General: In addition to Project superintendent, provide other administrative and supervisory personnel as required for proper performance of the Work.

1. Include special personnel required for coordination of operations with other contractors.

1.7 PROJECT MEETINGS

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

1. Attendees: Inform participants and others involved, and individuals whose presence is required, of date and time of each meeting. Notify Owner and Architect of scheduled meeting dates and times.
2. Agenda: Prepare the meeting agenda. Distribute the agenda to all invited attendees.
3. Minutes: Record significant discussions and agreements achieved. Distribute the meeting minutes to everyone concerned, including Owner and Architect, within three days of the meeting.

B. Preconstruction Conference: Schedule a preconstruction conference before starting construction, at a time convenient to Owner and Architect, but no later than 15 days after execution of the Agreement. Hold the conference at Project site or another convenient location. Conduct the meeting to review responsibilities and personnel assignments.

1. Attendees: Authorized representatives of Owner, Architect, and their consultants; Contractor and its superintendent; major subcontractors; suppliers; and other concerned parties shall attend the conference. All participants at the conference shall be familiar with Project and authorized to conclude matters relating to the Work.
2. Agenda: Discuss items of significance that could affect progress, including the following:

   a. Tentative construction schedule.
   b. Phasing.
   c. Critical work sequencing and long-lead items.
   d. Designation of key personnel and their duties.
   e. Procedures for processing field decisions and Change Orders.
   f. Procedures for RFIs.
   g. Procedures for testing and inspecting.
   h. Procedures for processing Applications for Payment.

i. Distribution of the Contract Documents.
j. Submittal procedures.
k. Preparation of Record Documents.
l. Use of the premises and existing building.
m. Work restrictions.
n. Working hours
o. Owner's occupancy requirements.
p. Responsibility for temporary facilities and controls.
q. Procedures for disruptions and shutdowns.
r. Construction waste management and recycling.
s. Parking availability.
t. Office, work, and storage areas.
u. Equipment deliveries and priorities.
v. First aid.
w. Security.
x. Progress cleaning.

3. Minutes: Record and distribute meeting minutes.

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

1. Attendees: Installer and representatives of manufacturers and fabricators involved in or affected by the installation and its coordination or integration with other materials and installations that have preceded or will follow, shall attend the meeting. Advise Architect of scheduled meeting dates.
2. Record significant conference discussions, agreements, and disagreements, including required corrective measures and actions.
3. Reporting: Distribute minutes of the meeting to each party present and to parties who should have been present.
4. Do not proceed with installation if the conference cannot be successfully concluded. Initiate whatever actions are necessary to resolve impediments to performance of the Work and reconvene the conference at earliest feasible date.

D. Progress Meetings: Conduct progress meetings at biweekly intervals. Coordinate dates of meetings with preparation of payment requests.

1. Attendees: In addition to representatives of Owner and Architect, each contractor, subcontractor, supplier, and other entity concerned with current progress or involved in planning, coordination, or performance of future activities shall be represented at these meetings. All participants at the conference shall be familiar with Project and authorized to conclude matters relating to the Work.
2. Agenda: Review and correct or approve minutes of previous progress meeting. Review other items of significance that could affect progress. Include topics for discussion as appropriate to status of Project.

a. Contractor's Construction Schedule: Review progress since the last meeting. Determine whether each activity is on time, ahead of schedule, or behind schedule, in relation to Contractor's Construction Schedule. Determine how construction behind schedule will be expedited; secure commitments from parties involved to

do so. Discuss whether schedule revisions are required to ensure that current and subsequent activities will be completed within the Contract Time.

1) Review schedule for next period.

b. Review present and future needs of each entity present.

3. Minutes: Record the meeting minutes.
4. Reporting: Distribute minutes of the meeting to each party present and to parties who should have been present.

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

E. Project Closeout Conference: Schedule and conduct a project closeout conference, at a time convenient to Owner and Architect, but no later than 12 days prior to the scheduled date of Substantial Completion.

1. Conduct the conference to review requirements and responsibilities related to Project closeout.
2. Attendees: Authorized representatives of Owner, Owner's Commissioning Authority, Architect, and their consultants; Contractor and its superintendent; major subcontractors; suppliers; and other concerned parties shall attend the meeting. Participants at the meeting shall be familiar with Project and authorized to conclude matters relating to the Work.
3. Agenda: Discuss items of significance that could affect or delay Project closeout, including the following:

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

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

1.8 REQUESTS FOR INTERPRETATION (RFIs)

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

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

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

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

    a. Supplementary drawings prepared by Contractor shall include dimensions, thicknesses, structural grid references, and details of affected materials, assemblies, and attachments.

C. Software-Generated RFIs: Software-generated form with substantially the same content as indicated above.

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

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

1. The following RFIs will be returned without action:

    a. Requests for approval of submittals.
    b. Requests for approval of substitutions.
    c. Requests for coordination information already indicated in the Contract Documents.

d. Requests for adjustments in the Contract Time or the Contract Sum.
e. Requests for interpretation of Architect's actions on submittals.
f. Incomplete RFIs or RFIs with numerous errors.

2. Architect's action may include a request for additional information, in which case Architect's time for response will start again.
3. Architect's action on RFIs that may result in a change to the Contract Time or the Contract Sum may be eligible for Contractor to submit Change Proposal according to Division 01 Section "Contract Modification Procedures."

a. If Contractor believes the RFI response warrants change in the Contract Time or the Contract Sum, notify Architect in writing within (5) business days of receipt of the RFI response.

E. On receipt of Architect's action, update the RFI log and immediately distribute the RFI response to affected parties. Review response and notify Architect within (5) business days if Contractor disagrees with response.

F. RFI Log: Prepare, maintain, and submit a tabular log of RFIs organized by the RFI number. Submit log at the biweekly progress meetings. Include the following:

1. Project name.
2. Name and address of Contractor.
3. Name and address of Architect.
4. RFI number including RFIs that were dropped and not submitted.
5. RFI description.
6. Date the RFI was submitted.
7. Date Architect's response was received.
8. Identification of related Minor Change in the Work, Construction Change Directive, and Proposal Request, as appropriate.
9. Identification of related Field Order, Work Change Directive, and Proposal Request, as appropriate.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 013100

SECTION 013200 - CONSTRUCTION PROGRESS DOCUMENTATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

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

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

1.3 DEFINITIONS

A. Activity: A discrete part of a project that can be identified for planning, scheduling, monitoring, and controlling the construction Project. Activities included in a construction schedule consume time and resources.

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

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

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

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

E. 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 successor activity.
3. Total float is the measure of leeway in starting or completing an activity without adversely affecting the planned Project completion date.

F. Resource Loading: The allocation of manpower and equipment necessary for completing an activity as scheduled.

1.4 INFORMATIONAL SUBMITTALS

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

1. Working electronic copy of schedule file, where indicated.
2. PDF file.
3. Two paper copies, of sufficient size to display entire period or schedule, as required.

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

1. Submit a working digital copy of schedule, using software indicated, and labeled to comply with requirements for submittals.

C. Daily Construction Reports: Submit two copies if requested.

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

E. Unusual Event Reports: Submit at time of unusual event.

1.5 COORDINATION

A. Coordinate Contractor's Construction Schedule with the schedule of values, list of subcontracts, submittal schedule, progress reports, payment requests, and other required schedules and reports.

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

1.6 CONTRACTOR'S CONSTRUCTION SCHEDULE, GENERAL

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

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

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

1. Activity Duration: Define activities so no activity is longer than 10 days, unless specifically allowed by Architect.
2. Procurement Activities: Include procurement process activities for the following long lead items and major items, requiring a cycle of more than 60 days, as separate activities in schedule. Procurement cycle activities include, but are not limited to, submittals, approvals, purchasing, fabrication, and delivery.
3. Submittal Review Time: Include review and resubmittal times indicated in Section 013300 "Submittal Procedures" in schedule. Coordinate submittal review times in Contractor's Construction Schedule with submittal schedule.
4. Startup and Testing Time: Include time within schedule for startup and testing.
5. Commissioning Time: Include time within schedule for commissioning.
6. Substantial Completion: Indicate completion in advance of date established for Substantial Completion, and allow time for Architect's administrative procedures necessary for certification of Substantial Completion.
7. Punch List and Final Completion: Include scheduled days for completion of punch list items and final completion.

C. Constraints: Include constraints and work restrictions indicated in the Contract Documents and as follows in schedule, and show how the sequence of the Work is affected.

1. Phasing: Arrange list of activities on schedule by phase.
2. Work under More Than One Contract: Include a separate activity for each contract.
3. Work by Owner: Include a separate activity for each portion of the Work performed by Owner.
4. Products Ordered in Advance: Include a separate activity for each product. Include delivery date indicated in Section 011000 "Summary." Delivery dates indicated stipulate the earliest possible delivery date.
5. Work Restrictions: Show the effect of the following items on the schedule:

    a. Coordination with existing construction.
    b. Limitations of continued occupancies.
    c. Uninterruptible services.
    d. Partial occupancy before Substantial Completion.
    e. Use-of-premises restrictions.
    f. Environmental control.

6. 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. Fabrication.
    e. Deliveries.

f. Installation.
g. Tests and inspections.
h. Adjusting.
i. Curing.
j. Building flush-out.
k. Startup and placement into final use and operation.
l. Commissioning.

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

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

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

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

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

F. 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.

1.7 REPORTS

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

1. List of subcontractors at Project site.

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

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

C. Unusual Event Reports: 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, responses by Contractor's personnel, evaluation of results or effects, and similar pertinent information. Advise Owner in advance when these events are known or predictable.

1. Submit unusual event reports directly to Owner within one day(s) of an occurrence. Distribute copies of report to parties affected by the occurrence.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 013200

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 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes administrative and procedural requirements for the following:

1. Preconstruction photographs.
2. Periodic construction photographs.
3. Final Completion construction photographs.

B. Related Sections include the following:

1. Section 017700 "Closeout Procedures" for submitting photographic documentation as Project Record Documents at Project closeout.
2. Section 024119 "Selective Demolition" for photographic documentation before selective demolition operations commence.

1.3 SUBMITTALS

1. Digital Images: Submit a complete set of digital image electronic files as a Project Record Document on CD-ROM or flash drive. Identify electronic media with date photographs were taken. Submit images that have same aspect ratio as the sensor, uncropped.

1.4 COORDINATION

A. Auxiliary Services: Provide project access and auxiliary services including temporary lighting required to produce clear, well-lit photographs without obscuring shadows.

1.5 USAGE RIGHTS

A. The Contractor shall allow the Owner copyright usage rights from photographer for unlimited reproduction of photographic documentation.

PART 2 - PRODUCTS

2.1 PHOTOGRAPHIC MEDIA

A. Digital Images: Provide images in TIFF or JPEG format, produced by a digital camera with minimum sensor size of 5.0 megapixels, and at an image resolution of not less than 1024 by 768 pixels.

PART 3 - EXECUTION

3.1 CONSTRUCTION PHOTOGRAPHS

A. General: Take photographs using the maximum range of depth of field, and that are in focus, to clearly show the Work. Photographs with blurry or out-of-focus areas will not be accepted.

A. Digital Photographs: Provide color images in JPG format, produced by a digital camera with minimum sensor size of 12 megapixels, and at an image resolution of not less than 3200 by 2400 pixels, and with vibration-reduction technology. Use flash in low light levels or backlit conditions.

1. Date and Time: Include date and time in filename or metadata for each image.

B. Preconstruction Photographs: Before starting construction, take, digital photographs of Project site and surrounding properties, including existing items to remain during construction, from different vantage points.

C. Periodic Construction Photographs: Take digital photographs regularly to document condition of any exposed construction that will be concealed as work progresses. Document all areas for Owner's information and record. Compose photographs to adequately display the location and extent of each condition.

END OF SECTION 013233

SECTION 013300 - SUBMITTAL PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes administrative and procedural requirements for submitting Shop Drawings, Product Data, Samples, and other submittals.

B. Related Sections include the following:

1. Section 012900 "Payment Procedures" for submitting Applications for Payment and the schedule of values.
2. Section 013100 "Project Management and Coordination" for submitting coordination drawings and subcontract list and for requirements for web-based Project software.
3. Section 013200 "Construction Progress Documentation" for submitting schedules and reports, including Contractor's construction schedule.
4. Section 013233 "Photographic Documentation" for submitting preconstruction photographs, periodic construction photographs, and final completion construction photographs.
5. Section 014000 "Quality Requirements" for submitting test and inspection reports, and schedule of tests and inspections.
6. Section 017700 "Closeout Procedures" for submitting closeout submittals and maintenance material submittals.
7. Section 017823 "Operation and Maintenance Data" for submitting operation and maintenance manuals.
8. Section 017839 "Project Record Documents" for submitting record Drawings, record Specifications, and record Product Data.
9. Section 017900 "Demonstration and Training" for submitting video recordings of demonstration of equipment and training of Owner's personnel.
10. Divisions 02 through 49 Sections for specific requirements for submittals in those Sections.

1.3 DEFINITIONS

A. Action Submittals: Written and graphic information and physical samples that require Architect's responsive action. Action submittals are those submittals indicated in individual Specification Sections as "action submittals."

1.4 Informational Submittals: Written and graphic information and physical samples that do not require Architect's responsive action. Submittals may be rejected for not complying with requirements. Informational submittals are those submittals indicated in individual Specification Sections as "informational submittals

1.5 SUBMITTAL PROCEDURES

A. General: Electronic copies of CAD Drawings of the Contract Drawings will be provided by Architect upon request for Contractor's use in preparing submittals. Prior to release of CAD Drawings, all contractors shall be required to execute a document release agreement in a form prescribed by the Architect.

B. Electronic Submittals: In lieu of hard copies, Contractor should submit information and documents as electronic files to greatest extent possible via email, download, and/or CD-ROM.

1. All files are to be in Adobe Acrobat (.PDF) format.
2. Include all information and drawings that would be included in a hard copy submittal.
3. Material samples, finish selectors, and color charts must be submitted as original samples in addition to electronic scans or documents.

C. Coordination: Coordinate preparation and processing of submittals with performance of construction activities.

1. Coordinate each submittal with fabrication, purchasing, testing, delivery, other submittals, and related activities that require sequential activity.
2. Coordinate transmittal of different types of submittals for related parts of the Work so processing will not be delayed because of need to review submittals concurrently for coordination.

a. Architect reserves the right to withhold action on a submittal requiring coordination with other submittals until related submittals are received.

D. Processing Time: Allow enough time for submittal review, including time for resubmittals, as follows. Time for review shall commence on Architect's receipt of submittal. No extension of the Contract Time will be authorized because of failure to transmit submittals enough in advance of the Work to permit processing, including resubmittals.

1. Initial Review: Allow 10 business days for initial review of each submittal. Allow additional time if coordination with subsequent submittals is required. Architect will advise Contractor when a submittal being processed must be delayed for coordination.
2. Intermediate Review: If intermediate submittal is necessary, process it in same manner as initial submittal.
3. Resubmittal Review: Allow 10 business days for review of each resubmittal.
4. Sequential Review: Where sequential review of submittals by Architect's consultants, Owner, or other parties is indicated, allow 15 business days for initial review of each submittal.
5. Concurrent Consultant Review: Where the Contract Documents indicate that submittals may be transmitted simultaneously to Architect and to Architect's consultants, allow 10

business days for review of each submittal. Submittal will be returned to Architect before being returned to Contractor.

E. Identification: Place a permanent label or title block on each submittal for identification.

1. Indicate name of firm or entity that prepared each submittal on label or title block.
2. Provide a space approximately 4 by 6 inches (100 by 150 mm) on label or beside title block to record Contractor's review and approval markings and action taken by Architect.
3. Include the following information on label for processing and recording action taken:

a. Project name.
b. Date.
c. Name and address of Architect.
d. Name and address of Contractor.
e. Name and address of subcontractor.
f. Name and address of supplier.
g. Name of manufacturer.
h. Submittal number or other unique identifier, including revision identifier.

1) Submittal number shall use Specification Section number followed by a decimal point and then a sequential number (e.g., 061000.01). Resubmittals shall include an alphabetic suffix after another decimal point (e.g., 061000.01.A).

i. Number and title of appropriate Specification Section.
j. Drawing number and detail references, as appropriate.
k. Location(s) where product is to be installed, as appropriate.
l. Other necessary identification.

F. Deviations: Highlight, encircle, or otherwise specifically identify deviations from the Contract Documents on submittals. Deviations from the Contract Documents that are not specifically identified shall not be deemed accepted by the Architect. Unless noted specifically by the Architect, the Contractor shall be required to provide the work as originally prescribed in the Construction Documents.

G. Additional Copies: Unless additional copies are required for final submittal, and unless Architect observes noncompliance with provisions in the Contract Documents, initial submittal may serve as final submittal.

1. Submit one copy of submittal to concurrent reviewer in addition to specified number of copies to Architect.
2. Additional copies submitted for maintenance manuals will be marked with action taken and will be returned.

H. Transmittal: Package each submittal individually and appropriately for transmittal and handling. Transmit each submittal using a transmittal form. Architect will return submittals, without review, received from sources other than Contractor.

1. On an attached separate sheet, prepared on Contractor's letterhead, record relevant information, requests for data, revisions other than those requested by Architect on previous submittals, and deviations from requirements in the Contract Documents,

including minor variations and limitations. Include same label information as related submittal.

I. Resubmittals: Make resubmittals in same form and number of copies as initial submittal.

1. Note date and content of previous submittal.
2. Note date and content of revision in label or title block and clearly indicate extent of revision.
3. Resubmit submittals until they are marked "Furnish As Submitted", or “Furnish As Corrected”.

J. Distribution: Furnish copies of final submittals to manufacturers, subcontractors, suppliers, fabricators, installers, authorities having jurisdiction, and others as necessary for performance of construction activities. Show distribution on transmittal forms.

K. Use for Construction: Use only final submittals with mark indicating "Furnish As Submitted", “Furnish As Corrected”, “Approved”, or “Approved as Corrected”, as indicated by Architect or the Architect’s consultants.

1.6 CONTRACTOR'S USE OF ARCHITECT'S CAD FILES

A. General: At Contractor's written request, copies of Architect's CAD files will be provided to Contractor for Contractor's use in connection with Project, subject to the following conditions:

1. Prior to release of CAD Drawings, all contractors shall be required to execute a document release agreement in a form prescribed by the Architect. Architect reserves the right to charge a nominal fee to cover preparation or reproduction costs.

PART 2 - PRODUCTS

2.1 ACTION SUBMITTALS

A. General: Prepare and submit Action Submittals required by individual Specification Sections.

B. Product Data: Collect information into a single submittal for each element of construction and type of product or equipment.

1. If information must be specially prepared for submittal because standard printed data are not suitable for use, submit as Shop Drawings, not as Product Data.
2. Mark each copy of each submittal to show which products and options are applicable.
3. Include the following information, as applicable:

a. Manufacturer's written recommendations.
b. Manufacturer's product specifications.
c. Manufacturer's installation instructions.
d. Standard color charts.
e. Manufacturer's catalog cuts.

f. Wiring diagrams showing factory-installed wiring.
g. Printed performance curves.
h. Operational range diagrams.
i. Mill reports.
j. Standard product operation and maintenance manuals.
k. Compliance with specified referenced standards.
l. Testing by recognized testing agency.
m. Application of testing agency labels and seals.
n. Notation of coordination requirements.

4. Submit Product Data before or concurrent with Samples.
5. Number of Copies: Submit five (5) copies of Product Data, unless otherwise required for Contractor's use. Architect will retain two copies and return the remainder. Mark up and retain one returned copy as a Project Record Document.

C. Shop Drawings: Prepare Project-specific information, drawn accurately to scale. Do not base Shop Drawings on reproductions of the Contract Documents or standard printed data, unless submittal of Architect's CAD Floor Plan Drawings are otherwise permitted.

1. Preparation: Fully illustrate requirements in the Contract Documents. Include the following information, as applicable:

a. Dimensions.
b. Identification of products.
c. Fabrication and installation drawings.
d. Roughing-in and setting diagrams.
e. Wiring diagrams showing field-installed wiring, including power, signal, and control wiring.
f. Shopwork manufacturing instructions.
g. Templates and patterns.
h. Schedules.
i. Design calculations.
j. Compliance with specified standards.
k. Notation of coordination requirements.
l. Notation of dimensions established by field measurement.
m. Relationship to adjoining construction clearly indicated.
n. Seal and signature of professional engineer if specified.
o. Wiring Diagrams: Differentiate between manufacturer-installed and field-installed wiring.

2. Sheet Size: Except for templates, patterns, and similar full-size drawings, submit Shop Drawings on sheets at least 8-1/2 by 11 inches but no larger than 30 by 42 inches.
3. Number of Copies: Submit six copies of Product Data, unless otherwise required for Contractor's use. Architect will retain two copies and return the remainder. Mark up and retain one returned copy as a Project Record Document.

D. Samples: Submit Samples for review of kind, color, pattern, and texture for a check of these characteristics with other elements and for a comparison of these characteristics between submittal and actual component as delivered and installed.

1. Transmit Samples that contain multiple, related components such as accessories together in one submittal package.
2. Identification: Attach label on unexposed side of Samples that includes the following:

    a. Generic description of Sample.
    b. Product name and name of manufacturer.
    c. Sample source.
    d. Number and title of appropriate Specification Section.

3. Disposition: Maintain sets of approved Samples at Project site, available for quality-control comparisons throughout the course of construction activity. Sample sets may be used to determine final acceptance of construction associated with each set.

    a. Samples that may be incorporated into the Work are indicated in individual Specification Sections. Such Samples must be in an undamaged condition at time of use.
    b. Samples not incorporated into the Work, or otherwise designated as Owner's property, are the property of Contractor.

4. Samples for Initial Selection: Submit manufacturer's color charts consisting of units or sections of units showing the full range of colors, textures, and patterns available.

    a. Number of Samples: Submit two full set(s) of available choices where color, pattern, texture, or similar characteristics are required to be selected from manufacturer's product line. Architect will return submittal with options selected.

E. Contractor's Construction Schedule: Comply with requirements specified in Division 01 Section "Construction Progress Documentation" for Construction Manager's action.

F. Application for Payment: Comply with requirements specified in Division 01 Section "Payment Procedures."

G. Schedule of Values: Comply with requirements specified in Division 01 Section "Payment Procedures."

2.2 INFORMATIONAL SUBMITTALS

A. General: Prepare and submit Informational Submittals required by other Specification Sections.

1. Number of Copies: Submit two (2) copies of each submittal, unless otherwise indicated. Architect will not return copies.
2. Certificates and Certifications: Provide a notarized statement that includes signature of entity responsible for preparing certification. Certificates and certifications shall be signed by an officer or other individual authorized to sign documents on behalf of that entity.
3. Test and Inspection Reports: Comply with requirements specified in Division 01 Section "Quality Requirements."

B. Coordination Drawings: Comply with requirements specified in Division 01 Section "Project Management and Coordination."

C. Contractor's Construction Schedule: Comply with requirements specified in Division 01 Section "Construction Progress Documentation."

D. Qualification Data: Prepare written information that demonstrates capabilities and experience of firm or person. Include lists of completed projects with project names and addresses, names and addresses of architects and owners, and other information specified.

E. Welding Certificates: Prepare written certification that welding procedures and personnel comply with requirements in the Contract Documents. Submit record of Welding Procedure Specification (WPS) and Procedure Qualification Record (PQR) on AWS forms. Include names of firms and personnel certified.

F. Installer Certificates: Prepare written statements on manufacturer's letterhead certifying that Installer complies with requirements in the Contract Documents and, where required, is authorized by manufacturer for this specific Project.

G. Manufacturer Certificates: Prepare written statements on manufacturer's letterhead certifying that manufacturer complies with requirements in the Contract Documents. Include evidence of manufacturing experience where required.

H. Product Certificates: Prepare written statements on manufacturer's letterhead certifying that product complies with requirements in the Contract Documents.

I. Material Certificates: Prepare written statements on manufacturer's letterhead certifying that material complies with requirements in the Contract Documents.

J. Material Test Reports: Prepare reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting test results of material for compliance with requirements in the Contract Documents.

K. Product Test Reports: Prepare written reports indicating current product produced by manufacturer complies with requirements in the Contract Documents. Base reports on evaluation of tests performed by manufacturer and witnessed by a qualified testing agency, or on comprehensive tests performed by a qualified testing agency.

L. Schedule of Tests and Inspections: Comply with requirements specified in Division 01 Section "Quality Requirements."

M. Preconstruction Test Reports: Prepare reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of tests performed before installation of product, for compliance with performance requirements in the Contract Documents.

N. Compatibility Test Reports: Prepare reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of compatibility tests performed before installation of product. Include written recommendations for primers and substrate preparation needed for adhesion.

O. Field Test Reports: Prepare reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of field tests performed either during installation of product or after product is installed in its final location, for compliance with requirements in the Contract Documents.

P. Maintenance Data: Prepare written and graphic instructions and procedures for operation and normal maintenance of products and equipment. Comply with requirements specified in Division 01 Section "Operation and Maintenance Data."

Q. Design Data: Prepare written and graphic information, including, but not limited to, performance and design criteria, list of applicable codes and regulations, and calculations. Include list of assumptions and other performance and design criteria and a summary of loads. Include load diagrams if applicable. Provide name and version of software, if any, used for calculations. Include page numbers.

R. Manufacturer's Instructions: Prepare written or published information that documents manufacturer's recommendations, guidelines, and procedures for installing or operating a product or equipment. Include name of product and name, address, and telephone number of manufacturer. Include the following, as applicable:

1. Preparation of substrates.
2. Required substrate tolerances.
3. Sequence of installation or erection.
4. Required installation tolerances.
5. Required adjustments.
6. Recommendations for cleaning and protection.

S. Manufacturer's Field Reports: Prepare written information documenting factory-authorized service representative's tests and inspections. Include the following, as applicable:

1. Name, address, and telephone number of factory-authorized service representative making report.
2. Statement on condition of substrates and their acceptability for installation of product.
3. Statement that products at Project site comply with requirements.
4. Summary of installation procedures being followed, whether they comply with requirements and, if not, what corrective action was taken.
5. Results of operational and other tests and a statement of whether observed performance complies with requirements.
6. Statement whether conditions, products, and installation will affect warranty.
7. Other required items indicated in individual Specification Sections.

T. Insurance Certificates and Bonds: Prepare written information indicating current status of insurance or bonding coverage. Include name of entity covered by insurance or bond, limits of coverage, amounts of deductibles, if any, and term of the coverage.

U. Construction Photographs: Comply with requirements specified in Division 01 Section "Photographic Documentation."

V. Material Safety Data Sheets (MSDSs): Submit information directly to Owner; do not submit to Architect.

1. Architect will not review submittals that include MSDSs and will return the entire submittal for resubmittal.

2.3 DELEGATED DESIGN

A. Performance and Design Criteria: Where professional design services or certifications by a design professional are specifically required of Contractor by the Contract Documents, provide products and systems complying with specific performance and design criteria indicated.

1. If criteria indicated are not sufficient to perform services or certification required, submit a written request for additional information to Architect.

B. Delegated-Design Submittal: In addition to Shop Drawings, Product Data, and other required submittals, submit three copies of a statement, signed and sealed by the responsible design professional, for each product and system specifically assigned to Contractor to be designed or certified by a design professional.

1. Indicate that products and systems comply with performance and design criteria in the Contract Documents. Include list of codes, loads, and other factors used in performing these services.

PART 3 - EXECUTION

3.1 CONTRACTOR'S REVIEW

A. Review each submittal and check for coordination with other Work of the Contract and for compliance with the Contract Documents. Note corrections and field dimensions. Mark with approval stamp before submitting to Architect.

B. Approval Stamp: Stamp each submittal with a uniform, approval stamp. Include Project name and location, submittal number, Specification Section title and number, name of reviewer, date of Contractor's approval, and statement certifying that submittal has been reviewed, checked, and approved for compliance with the Contract Documents.

3.2 ARCHITECT'S / ACTION

A. General: Architect will not review submittals that do not bear Contractor's approval stamp and will return them without action.

B. Action Submittals: Architect will review each submittal, make marks to indicate corrections or modifications required, and return it. Architect will stamp each submittal with an action stamp and will mark stamp appropriately to indicate action taken, as follows:

1. Final Unrestricted Release: When the Architect marks a submittal “Furnish As Submitted” or “Approved”, the Work covered by the submittal may proceed provided it

complies with the requirements of the Contract Documents. Final payment depends on that compliance.

2. Final-But-Restricted Release: When the Architect marks a submittal "Furnish As Corrected" or "Approved as Corrected", the Work covered by the submittal may proceed provided it complies with notations or corrections on the submittal and the requirements of the Contract Documents. Final payment depends on that compliance.
3. Returned for Resubmittal: When the Architect marks a submittal "Submit Specified Item", "Rejected", or "Revise and Resubmit", do not proceed with Work covered by the submittal, including purchasing, fabrication, delivery, or other activity. Revise or prepare a new submittal according to the notations; resubmit without delay. Repeat if necessary to obtain different action mark.

    a. Do not use, or allow others to use, submittals marked "Submit Specified Item", "Rejected", or "Revise and Resubmit" at the Project Site or elsewhere where Work is in progress.

C. Informational Submittals: Architect will review each submittal and will not return it, or will return it if it does not comply with requirements. Architect will forward each submittal to appropriate party.

D. Partial submittals are not acceptable, will be considered nonresponsive, and will be returned without review.

E. Submittals not required by the Contract Documents may not be reviewed and may be discarded.

F. Electronic submittals will be returned electronically, bearing Architect's or Consultant's electronic review stamp and comments incorporated into the .PDF format. Hard copies will not be returned.

END OF SECTION 013300

SECTION 013516 - ALTERATION PROJECT PROCEDURES

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 special procedures for alteration work.

1.3 DEFINITIONS

A. Alteration Work: This term includes remodeling, renovation, repair, and maintenance work performed within existing spaces or on existing surfaces as part of the Project.

B. Cutting: Removal of in-place construction necessary to permit installation or performance of other Work.

C. Consolidate: To strengthen loose or deteriorated materials in place.

D. Design Reference Sample: A sample that represents the Architect's prebid selection of work to be matched; it may be existing work or work specially produced for the Project.

E. Dismantle: To remove by disassembling or detaching an item from a surface, using gentle methods and equipment to prevent damage to the item and surfaces; disposing of items unless indicated to be salvaged or reinstalled.

F. Match: To blend with adjacent construction and manifest no apparent difference in material type, species, cut, form, detail, color, grain, texture, or finish; as approved by Architect.

G. Patching: Fitting and repair work required to restore surfaces to match original conditions after installation of other Work.

H. Refinish: To remove existing finishes to base material and apply new finish to match original, or as otherwise indicated.

I. Repair: To correct damage and defects, retaining existing materials, features, and finishes. This includes patching, piecing-in, splicing, consolidating, or otherwise reinforcing or upgrading materials.

J. Replace: To remove, duplicate, and reinstall entire item with new material. The original item is the pattern for creating duplicates unless otherwise indicated.

K. Replicate: To reproduce in exact detail, materials, and finish unless otherwise indicated.

L. Reproduce: To fabricate a new item, accurate in detail to the original, and from either the same or a similar material as the original, unless otherwise indicated.

M. Retain: To keep existing items that are not to be removed or dismantled.

N. Strip: To remove existing finish down to base material unless otherwise indicated.

1.4 COORDINATION

A. Alteration Work Subschedule: A construction schedule coordinating the sequencing and scheduling of alteration work for entire Project, including each activity to be performed, and based on Contractor's Construction Schedule. Secure time commitments for performing critical construction activities from separate entities responsible for alteration work.

1. Schedule construction operations in sequence required to obtain best Work results.
2. Coordinate sequence of alteration work activities to accommodate the following:

   a. Owner's continuing occupancy of portions of existing building.
   b. Owner's partial occupancy of completed Work.
   c. Other known work in progress.
   d. Tests and inspections.

3. Detail sequence of alteration work, with start and end dates.
4. Utility Services: Indicate how long utility services will be interrupted. Coordinate shutoff, capping, and continuation of utility services.
5. Use of elevator and stairs.
6. Equipment Data: List gross loaded weight, axle-load distribution, and wheel-base dimension data for mobile and heavy equipment proposed for use in existing structure. Do not use such equipment without certification from Contractor's professional engineer that the structure can support the imposed loadings without damage.

B. Pedestrian and Vehicular Circulation: Coordinate alteration work with circulation patterns within Project building(s) and site. Some work is near circulation patterns. Circulation patterns cannot be closed off entirely and in places can be only temporarily redirected around small areas of work. Plan and execute the Work accordingly.

1.5 PROJECT MEETINGS FOR ALTERATION WORK

A. Preliminary Conference for Alteration Work: Before starting alteration work, conduct conference at Project site.

1. Attendees: In addition to representatives of Owner, Architect, and Contractor, testing service representative, specialists, and chemical-cleaner manufacturer(s) shall be represented at the meeting.
2. Agenda: Discuss items of significance that could affect progress of alteration work, including review of the following:

a. Alteration Work Subschedule: Discuss and finalize; verify availability of materials, specialists' personnel, equipment, and facilities needed to make progress and avoid delays.
b. Fire-prevention plan.
c. Governing regulations.
d. Areas where existing construction is to remain and the required protection.
e. Hauling routes.
f. Sequence of alteration work operations.
g. Storage, protection, and accounting for salvaged and specially fabricated items.
h. Existing conditions, staging, and structural loading limitations of areas where materials are stored.
i. Qualifications of personnel assigned to alteration work and assigned duties.
j. Requirements for extent and quality of work, tolerances, and required clearances.
k. Embedded work such as flashings and lintels, special details, collection of waste, protection of occupants and the public, and condition of other construction that affects the Work or will affect the work.

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

B. Coordination Meetings: Conduct coordination meetings specifically for alteration work at bi-weekly intervals. Coordination meetings are in addition to specific meetings held for other purposes, such as progress meetings and preinstallation conferences.

1. Attendees: In addition to representatives of Owner, Architect, and Contractor, each specialist, supplier, installer, and other entity concerned with progress or involved in planning, coordination, or performance of alteration work activities shall be represented at these meetings. All participants at conference shall be familiar with Project and authorized to conclude matters relating to alteration work.
2. Agenda: Review and correct or approve minutes of previous coordination meeting. Review other items of significance that could affect progress of alteration work. Include topics for discussion as appropriate to status of Project.

a. Alteration Work Subschedule: Review progress since last coordination meeting. Determine whether each schedule item is on time, ahead of schedule, or behind schedule. Determine how construction behind schedule will be expedited with retention of quality; secure commitments from parties involved to do so. Discuss whether schedule revisions are required to ensure that current and subsequent activities are completed within the Contract Time.
b. Schedule Updating: Revise Contractor's Alteration Work Subschedule after each coordination meeting where revisions to schedule have been made or recognized. Issue revised schedule concurrently with report of each meeting.
c. Review present and future needs of each entity present, including review items listed in the "Preliminary Conference for Alteration Work" Paragraph in this article and the following:

1) Interface requirements of alteration work with other Project Work.
2) Status of submittals for alteration work.
3) Access to alteration work locations.
4) Effectiveness of fire-prevention plan.

5) Quality and work standards of alteration work.
6) Change Orders for alteration work.

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

1.6 INFORMATIONAL SUBMITTALS

A. Alteration Work Subschedule:

1. Submit alteration work subschedule within seven days of date established for commencement of alteration work.

B. Preconstruction Documentation: Show preexisting conditions of adjoining construction and site improvements that are to remain, including finish surfaces, that might be misconstrued as damage caused by Contractor's alteration work operations.

C. Alteration Work Program: Submit 30 days before work begins.

D. Fire-Prevention Plan: Submit 30 days before work begins.

1.7 QUALITY ASSURANCE

A. Specialist Qualifications: An experienced firm regularly engaged in specialty work similar in nature, materials, design, and extent to alteration work as specified in each Section and that has completed a minimum of five recent projects with a record of successful in-service performance that demonstrates the firm's qualifications to perform this work.

1. Field Supervisor Qualifications: Full-time supervisors experienced in specialty work similar in nature, material, design, and extent to that indicated for this Project. Supervisors shall be on-site when specialty work begins and during its progress. Supervisors shall not be changed during Project except for causes beyond the control of the specialist firm.

B. Title X Requirement: Each firm conducting activities that disturb painted surfaces shall be a "Lead-Safe Certified Firm" according to 40 CFR 745, Subpart E, and use only workers that are trained in lead-safe work practices.

C. Alteration Work Program: Prepare a written plan for alteration work for whole Project, including each phase or process and protection of surrounding materials during operations. Show compliance with indicated methods and procedures specified in this and other Sections. Coordinate this whole-Project alteration work program with specific requirements of programs required in other alteration work Sections.

1. Dust and Noise Control: Include locations of proposed temporary dust- and noise-control partitions and means of egress from occupied areas coordinated with continuing on-site operations and other known work in progress.

2. Debris Hauling: Include plans clearly marked to show debris hauling routes, turning radii, and locations and details of temporary protective barriers.

D. Structural Elements: Do not cut and patch structural elements in a manner that could change their load-carrying capacity or load-deflection ratio. Structural elements include, but are not limited to the following:

1. Walls and partitions.
2. Lintel and headers in walls and partitions.
3. Floors above grade.
4. Roof deck or structure.
5. Bracing and shoring.
6. Guy wires and struts.

E. Operational Elements: Do not cut and patch operating elements and related components in a manner that results in reducing their capacity to perform as intended or that results in increased maintenance or decreased operational life or safety. Operating elements include, but are not limited to, the following:

1. Primary operational systems and equipment.
2. Air or smoke barriers.
3. Mechanical systems piping and ducts.
4. Control systems.
5. Communication systems.
6. Conveying systems.
7. Electrical wiring systems.
8. Operating systems of special construction in Division 13 Sections.

F. Miscellaneous Elements: Do not cut and patch miscellaneous elements or related components in a manner that could change their load-carrying capacity, that results in reducing their capacity to perform as intended, or that results in increased maintenance or decreased operational life or safety. Miscellaneous elements include, but are not limited to, the following:

1. Water, moisture, or vapor barriers intended to remain in service.
2. Membranes and flashings intended to remain in service.
3. Exterior curtain-wall construction.
4. Equipment supports.
5. Piping, ductwork, vessels, and equipment.
6. Noise- and vibration-control elements and systems.

G. 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.

H. Fire-Prevention Plan: Prepare a written plan for preventing fires during the Work, including placement of fire extinguishers, fire blankets, rag buckets, and other fire-control devices during each phase or process. Coordinate plan with Owner's fire-protection equipment and

requirements. Include fire-watch personnel's training, duties, and authority to enforce fire safety.

I. Safety and Health Standard: Comply with ANSI/ASSE A10.6.

1.8 STORAGE AND HANDLING OF SALVAGED MATERIALS

A. Salvaged Materials:

1. Clean loose dirt and debris from salvaged items unless more extensive cleaning is indicated.
2. Pack or crate items after cleaning; cushion against damage during handling. Label contents of containers.
3. Store items in a secure area until delivery to Owner.
4. Transport items to Owner's storage area on-site as designated by Owner.
5. Protect items from damage during transport and storage.

B. Existing Materials to Remain: Protect construction indicated to remain against damage and soiling from construction work. Where permitted by Architect, items may be dismantled and taken to a suitable, protected storage location during construction work and reinstalled in their original locations after alteration and other construction work in the vicinity is complete.

C. Storage Space:

1. Owner will arrange for limited on-site location(s) for free storage of salvaged material.

1.9 FIELD CONDITIONS

A. Survey of Existing Conditions: Record existing conditions that affect the Work by use of measured drawings and preconstruction photographs.

1. Comply with requirements specified in Section 013233 "Photographic Documentation."

B. Discrepancies: Notify Architect of discrepancies between existing conditions and Drawings before proceeding with removal and dismantling work.

C. Size Limitations in Existing Spaces: Materials, products, and equipment used for performing the Work and for transporting debris, materials, and products shall be of sizes that clear surfaces within existing spaces, areas, rooms, and openings, including temporary protection, by 12 inches (300 mm) or more.

PART 2 - PRODUCTS - (Not Used)

PART 3 - EXECUTION

3.1 PROTECTION

A. Protect persons, motor vehicles, surrounding surfaces of building, building site, plants, and surrounding buildings from harm resulting from alteration work.

1. Use only proven protection methods, appropriate to each area and surface being protected.
2. Provide temporary barricades, barriers, and directional signage to exclude the public from areas where alteration work is being performed.
3. Erect temporary barriers to form and maintain fire-egress routes.
4. Erect temporary protective covers over walkways and at points of pedestrian and vehicular entrance and exit that must remain in service during alteration work.
5. Contain dust and debris generated by alteration work, and prevent it from reaching the public or adjacent surfaces.
6. Provide shoring, bracing, and supports as necessary. Do not overload structural elements.
7. Protect floors and other surfaces along hauling routes from damage, wear, and staining.
8. Provide supplemental sound-control treatment to isolate demolition work from other areas of the building.

B. Temporary Protection of Materials to Remain:

1. Protect existing materials with temporary protections and construction. Do not remove existing materials unless otherwise indicated.
2. Do not attach temporary protection to existing surfaces except as indicated as part of the alteration work program.

C. Comply with each product manufacturer's written instructions for protections and precautions. Protect against adverse effects of products and procedures on people and adjacent materials, components, and vegetation.

D. Utility and Communications Services:

1. Notify Owner, Architect, authorities having jurisdiction, and entities owning or controlling wires, conduits, pipes, and other services affected by alteration work before commencing operations.
2. Disconnect and cap pipes and services as required by authorities having jurisdiction, as required for alteration work.
3. Maintain existing services unless otherwise indicated; keep in service, and protect against damage during operations. Provide temporary services during interruptions to existing utilities.

E. Existing Drains: Prior to the start of work in an area, test drainage system to ensure that it is functioning properly. Notify Architect immediately of inadequate drainage or blockage. Do not begin work in an area until the drainage system is functioning properly.

1. Prevent solids such as adhesive or mortar residue or other debris from entering the drainage system. Clean out drains and drain lines that become sluggish or blocked by sand or other materials resulting from alteration work.
2. Protect drains from pollutants. Block drains or filter out sediments, allowing only clean water to pass.

3.2 PROTECTION FROM FIRE

A. General: Follow fire-prevention plan and the following:

1. Comply with NFPA 241 requirements unless otherwise indicated.
2. Remove and keep area free of combustibles, including rubbish, paper, waste, and chemicals, unless necessary for the immediate work.

    a. If combustible material cannot be removed, provide fire blankets to cover such materials.

B. Heat-Generating Equipment and Combustible Materials: Comply with the following procedures while performing work with heat-generating equipment or combustible materials, including welding, torch-cutting, soldering, brazing, removing paint with heat, or other operations where open flames or implements using high heat or combustible solvents and chemicals are anticipated:

1. Obtain Owner's approval for operations involving use of welding or other high-heat equipment. Notify Owner at least 72 hours before each occurrence, indicating location of such work.
2. As far as practicable, restrict heat-generating equipment to shop areas or outside the building.
3. Do not perform work with heat-generating equipment in or near rooms or in areas where flammable liquids or explosive vapors are present or thought to be present. Use a combustible gas indicator test to ensure that the area is safe.
4. Use fireproof baffles to prevent flames, sparks, hot gases, or other high-temperature material from reaching surrounding combustible material.
5. Prevent the spread of sparks and particles of hot metal through open windows, doors, holes, and cracks in floors, walls, ceilings, roofs, and other openings.
6. Fire Watch: Maintain Fire Watch as approved by the State Fire Marshal.

C. Fire-Control Devices: Provide and maintain fire extinguishers, fire blankets, and rag buckets for disposal of rags with combustible liquids. Maintain each as suitable for the type of fire risk in each work area. Ensure that nearby personnel and the fire-watch personnel are trained in fire-extinguisher and blanket use.

D. Sprinklers: Where sprinkler protection exists and is functional, maintain it without interruption while operations are being performed. If operations are performed close to sprinklers, shield them temporarily with guards.

1. Remove temporary guards at the end of work shifts, whenever operations are paused, and when nearby work is complete.

3.3 WARRANTY

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

3.4 GENERAL ALTERATION WORK

A. Have specialty work performed only by qualified specialists.

B. Ensure that supervisory personnel are present when work begins and during its progress.

C. Record existing work before each procedure (preconstruction), and record progress during the work. Use digital preconstruction documentation photographs. Comply with requirements in Section 013233 "Photographic Documentation."

D. Perform surveys of Project site as the Work progresses to detect hazards resulting from alterations.

E. Notify Architect of visible changes in the integrity of material or components whether from environmental causes including biological attack, UV degradation, freezing, or thawing or from structural defects including cracks, movement, or distortion.

1. Do not proceed with the work in question until directed by Architect.

F. Cutting: Cut in-place construction by sawing, drilling, breaking, chipping, grinding, and similar operations, including excavation, using methods least likely to damage elements retained or adjoining construction. If possible, review proposed procedures with original Installer; comply with original Installer's written recommendations.

1. In general, use hand or small power tools designed for sawing and grinding, not hammering and chopping. Cut holes and slots as small as possible, neatly to size required, and with minimum disturbance of adjacent surfaces. Temporarily cover openings when not in use.
2. Finished Surfaces: Cut or drill from the exposed or finished side into concealed surfaces.
3. Concrete and Masonry: Cut using a cutting machine, such as an abrasive saw or a diamond-core drill.
4. 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.

G. Patching: Patch construction by filling, repairing, refinishing, closing up, and similar operations following performance of other Work. Patch with durable seams that are as invisible as 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.

4. Ceilings: Patch, repair, or rehang in-place ceilings as necessary to provide an even-plane surface of uniform appearance.

H. Cleaning: Clean areas and spaces where cutting and patching are performed. Completely remove paint, mortar, oils, putty, and similar materials.

END OF SECTION 013516

SECTION 014000 - QUALITY REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes administrative and procedural requirements for quality assurance and quality control.

B. Testing and inspection services are required to verify compliance with requirements specified or indicated. These services do not relieve Contractor of responsibility for compliance with the Contract Document requirements.

1. Specific quality-assurance and quality-control requirements for individual work results are specified in their respective Specification Sections. Requirements in individual Sections may also cover production of standard products.
2. Specified tests, inspections, and related actions do not limit Contractor's other quality-assurance and quality-control procedures that facilitate compliance with the Contract Document requirements.
3. Requirements for Contractor to provide quality-assurance and quality-control services required by Architect, Owner, Commissioning Authority, or authorities having jurisdiction are not limited by provisions of this Section.
4. Specific test and inspection requirements are not specified in this Section.

C. Related Requirements:

1. Section 012100 "Allowances" for owner allowances.
3. Section 013200 "Construction Progress Documentation" for preparing and submitting Contractor's construction schedule.
4. Section 013516 “Alteration Project Procedures” for cutting, patching, and renovating work performed with existing spaces or on existing surfaces.
5. Divisions 02 through 49 Sections for specific test and inspection requirements.

1.3 DEFINITIONS

A. Quality-Assurance Services: Activities, actions, and procedures performed before and during execution of the Work to guard against defects and deficiencies and substantiate that proposed construction will comply with requirements.

B. Quality-Control Services: Tests, inspections, procedures, and related actions during and after execution of the Work to evaluate that actual products incorporated into the Work and completed construction comply with requirements. Services do not include contract enforcement activities performed by Architect.

C. Preconstruction Testing: Tests and inspections that are performed specifically for the Project before products and materials are incorporated into the Work to verify performance or compliance with specified criteria.

D. Product Testing: Tests and inspections that are performed by an NRTL, an NVLAP, or a testing agency qualified to conduct product testing and acceptable to authorities having jurisdiction, to establish product performance and compliance with industry standards.

E. Source Quality-Control Testing: Tests and inspections that are performed at the source, i.e., plant, mill, factory, or shop.

F. Field Quality-Control Testing: Tests and inspections that are performed on-site for installation of the Work and for completed Work.

G. Testing Agency: An entity engaged to perform specific tests, inspections, or both. Testing laboratory shall mean the same as testing agency.

H. Installer/Applicator/Erector: Contractor or another entity engaged by Contractor as an employee, Subcontractor, or Sub-subcontractor, to perform a particular construction operation, including installation, erection, application, and similar operations.

1. Using a term such as "carpentry" does not imply that certain construction activities must be performed by accredited or unionized individuals of a corresponding generic name, such as "carpenter." It also does not imply that requirements specified apply exclusively to tradespeople of the corresponding generic name.

I. Experienced: When used with an entity, "experienced" means having successfully completed a minimum of five previous projects similar in size and scope to this Project; being familiar with special requirements indicated; and having complied with requirements of authorities having jurisdiction.

1.4 CONFLICTING REQUIREMENTS

A. General: If compliance with two or more standards is specified and the standards establish different or conflicting requirements for minimum quantities or quality levels, comply with the most stringent requirement. Refer uncertainties and requirements that are different, but apparently equal, to Architect for a decision before proceeding.

B. Minimum Quantity or Quality Levels: The quantity or quality level shown or specified shall be the minimum provided or performed. The actual installation may comply exactly with the minimum quantity or quality specified, or it may exceed the minimum within reasonable limits. To comply with these requirements, indicated numeric values are minimum or maximum, as appropriate, for the context of requirements. Refer uncertainties to Architect for a decision before proceeding.

1.5 SUBMITTALS

A. Qualification Data: For testing agencies specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include proof of qualifications in the form of a recent report on the inspection of the testing agency by a recognized authority.

B. Schedule of Tests and Inspections: Prepare in tabular form and include the following:

1. Specification Section number and title.
2. Description of test and inspection.
3. Identification of applicable standards.
4. Identification of test and inspection methods.
5. Number of tests and inspections required.
6. Time schedule or time span for tests and inspections.
7. Entity responsible for performing tests and inspections.
8. Requirements for obtaining samples.
9. Unique characteristics of each quality-control service.

C. Reports: Prepare and submit certified written reports that include the following:

1. Date of issue.
2. Project title and number.
3. Name, address, and telephone number of testing agency.
4. Dates and locations of samples and tests or inspections.
5. Names of individuals making tests and inspections.
6. Description of the Work and test and inspection method.
7. Identification of product and Specification Section.
8. Complete test or inspection data.
9. Test and inspection results and an interpretation of test results.
10. Record of temperature and weather conditions at time of sample taking and testing and inspecting.
11. Comments or professional opinion on whether tested or inspected Work complies with the Contract Document requirements.
12. Name and signature of laboratory inspector.
13. Recommendations on retesting and reinspecting.

D. Permits, Licenses, and Certificates: For Owner's records, submit copies of permits, licenses, certifications, inspection reports, releases, jurisdictional settlements, notices, receipts for fee payments, judgments, correspondence, records, and similar documents, established for compliance with standards and regulations bearing on performance of the Work.

1.6 QUALITY ASSURANCE

A. General: Qualifications paragraphs in this Article establish the minimum qualification levels required; individual Specification Sections specify additional requirements.

B. Installer Qualifications: A firm or individual experienced in installing, erecting, or assembling work similar in material, design, and extent to that indicated for this Project, whose work has resulted in construction with a record of successful in-service performance.

C. Manufacturer Qualifications: A firm experienced in manufacturing products or systems similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.

D. Fabricator Qualifications: A firm experienced in producing products similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.

E. Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installations of the system, assembly, or product that are similar to those indicated for this Project in material, design, and extent.

F. Specialists: Certain sections of the Specifications require that specific construction activities shall be performed by entities who are recognized experts in those operations. Specialists shall satisfy qualification requirements indicated and shall be engaged for the activities indicated.

1. Requirement for specialists shall not supersede building codes and regulations governing the Work.

G. Testing Agency Qualifications: An NRTL, an NVLAP, or an independent agency with the experience and capability to conduct testing and inspecting indicated, as documented according to ASTM E 548; and with additional qualifications specified in individual Sections; and where required by authorities having jurisdiction, that is acceptable to authorities.

1. NRTL: A nationally recognized testing laboratory according to 29 CFR 1910.7.
2. NVLAP: A testing agency accredited according to NIST's National Voluntary Laboratory Accreditation Program.

H. Factory-Authorized Service Representative Qualifications: An authorized representative of manufacturer who is trained and approved by manufacturer to inspect installation of manufacturer's products that are similar in material, design, and extent to those indicated for this Project.

I. Preconstruction Testing: Where testing agency is indicated to perform preconstruction testing for compliance with specified requirements for performance and test methods, comply with the following:

1. Contractor responsibilities include the following:

a. Provide test specimens representative of proposed products and construction.
b. Submit specimens in a timely manner with sufficient time for testing and analyzing results to prevent delaying the Work.
c. Provide sizes and configurations of test assemblies, mockups, and laboratory mockups to adequately demonstrate capability of products to comply with performance requirements.
d. Build site-assembled test assemblies and mockups using installers who will perform same tasks for Project.

e. Build laboratory mockups at testing facility using personnel, products, and methods of construction indicated for the completed Work.
f. When testing is complete, remove test specimens, assemblies, mockups, and laboratory mockups; do not reuse products on Project.

2. Testing Agency Responsibilities: Submit a certified written report of each test, inspection, and similar quality-assurance service to Architect, with copy to Contractor. Interpret tests and inspections and state in each report whether tested and inspected work complies with or deviates from the Contract Documents.

1.7 QUALITY CONTROL

A. Tests and inspections are Contractor's responsibility. Provide quality-control services specified and those required by authorities having jurisdiction. Perform quality-control services required of any Contractor by authorities having jurisdiction, whether specified or not.

1. Engage a qualified testing agency to perform these quality-control services.
2. Notify testing agencies in advance of time when Work that requires testing or inspecting will be performed, and as required so the progress of construction is not delayed.
3. Where quality-control services are indicated or required, submit a certified written report, in duplicate, of each quality-control service.
4. Testing and inspecting requested by Contractor and not required by the Contract Documents are Contractor's responsibility.
5. Submit additional copies of each written report directly to authorities having jurisdiction, when they so direct.

B. Manufacturer's Field Services: Where indicated, engage a factory-authorized service representative to inspect field-assembled components and equipment installation, including service connections. Report results in writing as specified in Division 01 Section "Submittal Procedures."

C. Retesting/Reinspecting: Regardless of whether original tests or inspections were Contractor's responsibility, provide quality-control services, including retesting and reinspecting, for construction that replaced Work that failed to comply with the Contract Documents.

D. Testing Agency Responsibilities: Cooperate with Architect and Contractor in performance of duties. Provide qualified personnel to perform required tests and inspections.

1. Notify Architect and Contractor promptly of irregularities or deficiencies observed in the Work during performance of its services.
2. Determine the location from which test samples will be taken and in which in-situ tests are conducted.
3. Conduct and interpret tests and inspections and state in each report whether tested and inspected work complies with or deviates from requirements.
4. Submit a certified written report, in duplicate, of each test, inspection, and similar quality-control service through Contractor.
5. Do not release, revoke, alter, or increase the Contract Document requirements or approve or accept any portion of the Work.
6. Do not perform any duties of Contractor.

E. Associated Services: Cooperate with agencies performing required tests, inspections, and similar quality-control services, and provide reasonable auxiliary services as requested. Notify agency sufficiently in advance of operations to permit assignment of personnel. Provide the following:

1. Access to the Work.
2. Incidental labor and facilities necessary to facilitate tests and inspections.
3. Adequate quantities of representative samples of materials that require testing and inspecting. Assist agency in obtaining samples.
4. Facilities for storage and field curing of test samples.
5. Delivery of samples to testing agencies.
6. Preliminary design mix proposed for use for material mixes that require control by testing agency.
7. Security and protection for samples and for testing and inspecting equipment at Project site.

F. Coordination: Coordinate sequence of activities to accommodate required quality-assurance and -control services with a minimum of delay and to avoid necessity of removing and replacing construction to accommodate testing and inspecting.

1. Schedule times for tests, inspections, obtaining samples, and similar activities.

G. Schedule of Tests and Inspections: Prepare a schedule of tests, inspections, and similar quality-control services required by the Contract Documents. Submit schedule within [**30**] days of date established for commencement of the Work.

1. Distribution: Distribute schedule to Owner, Architect, testing agencies, and each party involved in performance of portions of the Work where tests and inspections are required.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 TEST AND INSPECTION LOG

A. Prepare a record of tests and inspections. Include the following:

1. Date test or inspection was conducted.
2. Description of the Work tested or inspected.
3. Date test or inspection results were transmitted to Architect.
4. Identification of testing agency or special inspector conducting test or inspection.

B. Maintain log at Project site. Post changes and modifications as they occur. Provide access to test and inspection log for Architect's reference during normal working hours.

3.2 REPAIR AND PROTECTION

A. General: On completion of testing, inspecting, sample taking, and similar services, repair damaged construction and restore substrates and finishes.

1. Provide materials and comply with installation requirements specified in other Specification Sections. Restore patched areas and extend restoration into adjoining areas with durable seams that are as invisible as possible.
2. Comply with the Contract Document requirements for Division 01 Section "Cutting and Patching."

B. Protect construction exposed by or for quality-control service activities.

C. Repair and protection are Contractor's responsibility, regardless of the assignment of responsibility for quality-control services.

END OF SECTION 014000

SECTION 014200 - REFERENCES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 DEFINITIONS

A. General: Basic Contract definitions are included in the Conditions of the Contract.

B. "Approved": When used to convey Architect's action on Contractor's submittals, applications, and requests, "approved" is limited to Architect's duties and responsibilities as stated in the Conditions of the Contract.

C. "Directed": A command or instruction by Architect. Other terms including "requested," "authorized," "selected," "required," and "permitted" have the same meaning as "directed."

D. "Indicated": Requirements expressed by graphic representations or in written form on Drawings, in Specifications, and in other Contract Documents. Other terms including "shown," "noted," "scheduled," and "specified" have the same meaning as "indicated."

E. "Regulations": Laws, ordinances, statutes, and lawful orders issued by authorities having jurisdiction, and rules, conventions, and agreements within the construction industry that control performance of the Work.

F. "Furnish": Supply and deliver to Project site, ready for unloading, unpacking, assembly, installation, and similar operations.

G. "Install": Unload, temporarily store, unpack, assemble, erect, place, anchor, apply, work to dimension, finish, cure, protect, clean, and similar operations at Project site.

H. "Provide": Furnish and install, complete and ready for the intended use.

I. "Project Site": Space available for performing construction activities. The extent of Project site is shown on Drawings and may or may not be identical with the description of the land on which Project is to be built.

1.3 INDUSTRY STANDARDS

A. Applicability of Standards: Unless the Contract Documents include more stringent requirements, applicable construction industry standards have the same force and effect as if bound or copied directly into the Contract Documents to the extent referenced. Such standards are made a part of the Contract Documents by reference.

B. Publication Dates: Comply with standards in effect as of date of the Contract Documents unless otherwise indicated.

C. Copies of Standards: Each entity engaged in construction on Project should be familiar with industry standards applicable to its construction activity. Copies of applicable standards are not bound with the Contract Documents.

1. Where copies of standards are needed to perform a required construction activity, obtain copies directly from publication source.

1.4 ABBREVIATIONS AND ACRONYMS

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

B. Industry Organizations: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities in the following list. This information is subject to change and is believed to be accurate as of the date of the Contract Documents.

1. AABC - Associated Air Balance Council; www.aabc.com.
2. AAMA - American Architectural Manufacturers Association; www.aamanet.org.
3. AAPFCO - Association of American Plant Food Control Officials; www.aapfco.org.
4. AASHTO - American Association of State Highway and Transportation Officials; www.transportation.org.
5. AATCC - American Association of Textile Chemists and Colorists; www.aatcc.org.
6. ABMA - American Bearing Manufacturers Association; www.americanbearings.org.
7. ABMA - American Boiler Manufacturers Association; www.abma.com.
8. ACI - American Concrete Institute; (Formerly: ACI International); www.concrete.org
9. ACPA - American Concrete Pipe Association; www.concrete-pipe.org.
10. AEIC - Association of Edison Illuminating Companies, Inc. (The); www.aeic.org.
11. AF&PA - American Forest & Paper Association; www.afandpa.org.
12. AGA - American Gas Association; www.aga.org.
13. AHAM - Association of Home Appliance Manufacturers; www.aham.org.
14. AHRI - Air-Conditioning, Heating, and Refrigeration Institute (The); www.ahrinet.org.
15. AI - Asphalt Institute; www.asphaltinstitute.org.
16. AIA - American Institute of Architects (The); www.aia.org.
17. AISC - American Institute of Steel Construction; www.aisc.org.
18. AISI - American Iron and Steel Institute; www.steel.org.
19. AITC - American Institute of Timber Construction; www.aitc-glulam.org.
20. AMCA - Air Movement and Control Association International, Inc.; www.amca.org.
21. ANSI - American National Standards Institute; www.ansi.org.
22. AOSA - Association of Official Seed Analysts, Inc.; www.aosaseed.com.
23. APA - APA - The Engineered Wood Association; www.apawood.org.
24. APA - Architectural Precast Association; www.archprecast.org.
25. API - American Petroleum Institute; www.api.org.
26. ARI - Air-Conditioning & Refrigeration Institute; (See AHRI).

27. ARI - American Refrigeration Institute; (See AHRI).
28. ARMA - Asphalt Roofing Manufacturers Association; www.asphaltroofing.org.
29. ASCE - American Society of Civil Engineers; www.asce.org.
30. ASCE/SEI - American Society of Civil Engineers/Structural Engineering Institute; (See ASCE).
31. ASHRAE - American Society of Heating, Refrigerating and Air-Conditioning Engineers; www.ashrae.org.
32. ASME - ASME International; (American Society of Mechanical Engineers); www.asme.org.
33. ASSE - American Society of Safety Engineers (The); www.asse.org.
34. ASSE - American Society of Sanitary Engineering; www.asse-plumbing.org.
35. ASTM - ASTM International; www.astm.org.
36. ATIS - Alliance for Telecommunications Industry Solutions; www.atis.org.
37. AWEA - American Wind Energy Association; www.awea.org.
38. AWI - Architectural Woodwork Institute; www.awinet.org.
39. AWMAC - Architectural Woodwork Manufacturers Association of Canada; www.awmac.com.
40. AWPA - American Wood Protection Association; www.awpa.com.
41. AWS - American Welding Society; www.aws.org.
42. AWWA - American Water Works Association; www.awwa.org.
43. BHMA - Builders Hardware Manufacturers Association; www.buildershardware.com.
44. BIA - Brick Industry Association (The); www.gobrick.com.
45. BICSI - BICSI, Inc.; www.bicsi.org.
46. BIFMA - BIFMA International; (Business and Institutional Furniture Manufacturer's Association); www.bifma.org.
47. BISSC - Baking Industry Sanitation Standards Committee; www.bissc.org.
48. BWF - Badminton World Federation; (Formerly: International Badminton Federation); www.bissc.org.
49. CDA - Copper Development Association; www.copper.org.
50. CE - Conformite Europeenne; http://ec.europa.eu/growth/single-market/ce-marking/
51. CEA - Canadian Electricity Association; www.electricity.ca.
52. CEA - Consumer Electronics Association; www.ce.org.
53. CFFA - Chemical Fabrics and Film Association, Inc.; www.chemicalfabricsandfilm.com.
54. CFSEI - Cold-Formed Steel Engineers Institute; www.cfsei.org.
55. CGA - Compressed Gas Association; www.cganet.com.
56. CIMA - Cellulose Insulation Manufacturers Association; www.cellulose.org.
57. CISCA - Ceilings & Interior Systems Construction Association; www.cisca.org.
58. CISPI - Cast Iron Soil Pipe Institute; www.cispi.org.
59. CLFMI - Chain Link Fence Manufacturers Institute; www.chainlinkinfo.org.
60. CPA - Composite Panel Association; www.pbmdf.com.
61. CRI - Carpet and Rug Institute (The); www.carpet-rug.org.
62. CRRC - Cool Roof Rating Council; www.coolroofs.org.
63. CRSI - Concrete Reinforcing Steel Institute; www.crsi.org.
64. CSA - CSA Group; www.csa.ca.
65. CSA - CSA International; (Formerly: IAS - International Approval Services); www.csa-international.org.
66. CSI - Construction Specifications Institute (The); www.csinet.org.
67. CSSB - Cedar Shake & Shingle Bureau; www.cedarbureau.org.
68. CTI - Cooling Technology Institute; (Formerly: Cooling Tower Institute); www.cti.org.
69. CWC - Composite Wood Council; (See CPA).

70. DASMA - Door and Access Systems Manufacturers Association; www.dasma.com.
71. DHI - Door and Hardware Institute; www.dhi.org.
72. ECA - Electronic Components Association; (See ECIA).
73. ECAMA - Electronic Components Assemblies & Materials Association; (See ECIA).
74. ECIA - Electronic Components Industry Association; www.eciaonline.org.
75. EIA - Electronic Industries Alliance; (See TIA).
76. EIMA - EIFS Industry Members Association; www.eima.com.
77. EJMA - Expansion Joint Manufacturers Association, Inc.; www.ejma.org.
78. ESD - ESD Association; (Electrostatic Discharge Association); www.esda.org .
79. ESTA - Entertainment Services and Technology Association; (See PLASA).
80. ETL - Intertek (See Intertek); www.intertek.com.
81. EVO - Efficiency Valuation Organization; www.evo-world.org.
82. FCI - Fluid Controls Institute; www.fluidcontrolsinstitute.org.
83. FIBA - Federation Internationale de Basketball; (The International Basketball Federation); www.fiba.com.
84. FIVB - Federation Internationale de Volleyball; (The International Volleyball Federation); www.fivb.org.
85. FM Approvals - FM Approvals LLC; www.fmglobal.com.
86. FM Global - FM Global; (Formerly: FMG - FM Global); www.fmglobal.com.
87. FRSA - Florida Roofing, Sheet Metal & Air Conditioning Contractors Association, Inc.; www.floridaroof.com.
88. FSA - Fluid Sealing Association; www.fluidsealing.com.
89. FSC - Forest Stewardship Council U.S.; www.fscus.org.
90. GA - Gypsum Association; www.gypsum.org.
91. GANA - Glass Association of North America; www.glasswebsite.com.
92. GS - Green Seal; www.greenseal.org.
93. HI - Hydraulic Institute; www.pumps.org.
94. HI/GAMA - Hydronics Institute/Gas Appliance Manufacturers Association; (See AHRI).
95. HMMA - Hollow Metal Manufacturers Association; (See NAAMM).
96. HPVA - Hardwood Plywood & Veneer Association; www.hpva.org.
97. HPW - H. P. White Laboratory, Inc.; www.hpwhite.com.
98. IAPSC - International Association of Professional Security Consultants; www.iapsc.org.
99. IAS - International Accreditation Service; www.iasonline.org.
100. IAS - International Approval Services; (See CSA).
101. ICBO - International Conference of Building Officials; (See ICC).
102. ICC - International Code Council; www.iccsafe.org.
103. ICEA - Insulated Cable Engineers Association, Inc.; www.icea.net.
104. ICPA - International Cast Polymer Alliance; www.icpa-hq.org.
105. ICRI - International Concrete Repair Institute, Inc.; www.icri.org.
106. IEC - International Electrotechnical Commission; www.iec.ch.
107. IEEE - Institute of Electrical and Electronics Engineers, Inc. (The); www.ieee.org.
108. IES - Illuminating Engineering Society; (Formerly: Illuminating Engineering Society of North America); www.ies.org.
109. IESNA - Illuminating Engineering Society of North America; (See IES).
110. IEST - Institute of Environmental Sciences and Technology; www.iest.org.
111. IGMA - Insulating Glass Manufacturers Alliance; www.igmaonline.org.
112. IGSHPA - International Ground Source Heat Pump Association; www.igshpa.okstate.edu.
113. ILI - Indiana Limestone Institute of America, Inc.; www.iliai.com.

114. Intertek - Intertek Group; (Formerly: ETL SEMCO; Intertek Testing Service NA); www.intertek.com.
115. ISA - International Society of Automation (The); (Formerly: Instrumentation, Systems, and Automation Society); www.isa.org.
116. ISAS - Instrumentation, Systems, and Automation Society (The); (See ISA).
117. ISFA - International Surface Fabricators Association; (Formerly: International Solid Surface Fabricators Association); www.isfanow.org.
118. ISO - International Organization for Standardization; www.iso.org.
119. ISSFA - International Solid Surface Fabricators Association; (See ISFA).
120. ITU - International Telecommunication Union; www.itu.int/home.
121. KCMA - Kitchen Cabinet Manufacturers Association; www.kcma.org.
122. LMA - Laminating Materials Association; (See CPA).
123. LPI - Lightning Protection Institute; www.lightning.org.
124. MBMA - Metal Building Manufacturers Association; www.mbma.com.
125. MCA - Metal Construction Association; www.metalconstruction.org.
126. MFMA - Maple Flooring Manufacturers Association, Inc.; www.maplefloor.org.
127. MFMA - Metal Framing Manufacturers Association, Inc.; www.metalframingmfg.org.
128. MHIA - Material Handling Industry of America; www.mhia.org.
129. MIA - Marble Institute of America; www.marble-institute.com.
130. MMPA - Moulding & Millwork Producers Association; www.wmmpa.com.
131. MPI - Master Painters Institute; www.paintinfo.com.
132. MSS - Manufacturers Standardization Society of The Valve and Fittings Industry Inc.; www.mss-hq.org.
133. NAAMM - National Association of Architectural Metal Manufacturers; www.naamm.org.
134. NACE - NACE International; (National Association of Corrosion Engineers International); www.nace.org.
135. NADCA - National Air Duct Cleaners Association; www.nadca.com.
136. NAIMA - North American Insulation Manufacturers Association; www.naima.org.
137. NBGQA - National Building Granite Quarries Association, Inc.; www.nbgqa.com.
138. NBI - New Buildings Institute; www.newbuildings.org.
139. NCAA - National Collegiate Athletic Association (The); www.ncaa.org.
140. NCMA - National Concrete Masonry Association; www.ncma.org.
141. NEBB - National Environmental Balancing Bureau; www.nebb.org.
142. NECA - National Electrical Contractors Association; www.necanet.org.
143. NeLMA - Northeastern Lumber Manufacturers Association; www.nelma.org.
144. NEMA - National Electrical Manufacturers Association; www.nema.org.
145. NETA - InterNational Electrical Testing Association; www.netaworld.org.
146. NFHS - National Federation of State High School Associations; www.nfhs.org.
147. NFPA - National Fire Protection Association; www.nfpa.org.
148. NFPA - NFPA International; (See NFPA).
149. NFRC - National Fenestration Rating Council; www.nfrc.org.
150. NHLA - National Hardwood Lumber Association; www.nhla.com.
151. NLGA - National Lumber Grades Authority; www.nlga.org.
152. NOFMA - National Oak Flooring Manufacturers Association; (See NWFA).
153. NOMMA - National Ornamental & Miscellaneous Metals Association; www.nomma.org.
154. NRCA - National Roofing Contractors Association; www.nrca.net.
155. NRMCA - National Ready Mixed Concrete Association; www.nrmca.org.
156. NSF - NSF International; www.nsf.org.
157. NSPE - National Society of Professional Engineers; www.nspe.org.

158. NSSGA - National Stone, Sand & Gravel Association; www.nssga.org.
159. NTMA - National Terrazzo & Mosaic Association, Inc. (The); www.ntma.com.
160. NWFA - National Wood Flooring Association; www.nwfa.org.
161. PCI - Precast/Prestressed Concrete Institute; www.pci.org.
162. PDI - Plumbing & Drainage Institute; www.pdionline.org.
163. PLASA - PLASA; (Formerly: ESTA - Entertainment Services and Technology Association); http://www.plasa.org.
164. RCSC - Research Council on Structural Connections; www.boltcouncil.org.
165. RFCI - Resilient Floor Covering Institute; www.rfci.com.
166. RIS - Redwood Inspection Service; www.redwoodinspection.com.
167. SAE - SAE International; www.sae.org.
168. SCTE - Society of Cable Telecommunications Engineers; www.scte.org.
169. SDI - Steel Deck Institute; www.sdi.org.
170. SDI - Steel Door Institute; www.steeldoor.org.
171. SEFA - Scientific Equipment and Furniture Association (The); www.sefalabs.com.
172. SEI/ASCE - Structural Engineering Institute/American Society of Civil Engineers; (See ASCE).
173. SIA - Security Industry Association; www.siaonline.org.
174. SJI - Steel Joist Institute; www.steeljoist.org.
175. SMA - Screen Manufacturers Association; www.smainfo.org.
176. SMACNA - Sheet Metal and Air Conditioning Contractors' National Association; www.smacna.org.
177. SMPTE - Society of Motion Picture and Television Engineers; www.smpte.org.
178. SPFA - Spray Polyurethane Foam Alliance; www.sprayfoam.org.
179. SPIB - Southern Pine Inspection Bureau; www.spib.org.
180. SPRI - Single Ply Roofing Industry; www.spri.org.
181. SRCC - Solar Rating & Certification Corporation; www.solar-rating.org.
182. SSINA - Specialty Steel Industry of North America; www.ssina.com.
183. SSPC - SSPC: The Society for Protective Coatings; www.sspc.org.
184. STI - Steel Tank Institute; www.steeltank.com.
185. SWI - Steel Window Institute; www.steelwindows.com.
186. SWPA - Submersible Wastewater Pump Association; www.swpa.org.
187. TCA - Tilt-Up Concrete Association; www.tilt-up.org.
188. TCNA - Tile Council of North America, Inc.; www.tileusa.com.
189. TEMA - Tubular Exchanger Manufacturers Association, Inc.; www.tema.org.
190. TIA - Telecommunications Industry Association (The); (Formerly: TIA/EIA - Telecommunications Industry Association/Electronic Industries Alliance); www.tiaonline.org.
191. TIA/EIA - Telecommunications Industry Association/Electronic Industries Alliance; (See TIA).
192. TMS - The Masonry Society; www.masonrysociety.org.
193. TPI - Truss Plate Institute; www.tpinst.org.
194. TPI - Turfgrass Producers International; www.turfgrasssod.org.
195. TRI - Tile Roofing Institute; www.tileroofing.org.
196. UL - Underwriters Laboratories Inc.; http://www.ul.com.
197. UNI - Uni-Bell PVC Pipe Association; www.uni-bell.org.
198. USAV - USA Volleyball; www.usavolleyball.org.
199. USGBC - U.S. Green Building Council; www.usgbc.org.
200. USITT - United States Institute for Theatre Technology, Inc.; www.usitt.org.
201. WA - Wallcoverings Association; www.wallcoverings.org

202. WASTEC - Waste Equipment Technology Association; www.wastec.org.
203. WCLIB - West Coast Lumber Inspection Bureau; www.wclib.org.
204. WCMA - Window Covering Manufacturers Association; www.wcmanet.org.
205. WDMA - Window & Door Manufacturers Association; www.wdma.com.
206. WI - Woodwork Institute; www.wicnet.org.
207. WSRCA - Western States Roofing Contractors Association; www.wsrca.com.
208. WWPA - Western Wood Products Association; www.wwpa.org.

C. Code Agencies: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities in the following list. This information is believed to be accurate as of the date of the Contract Documents.

1. DIN - Deutsches Institut fur Normung e.V.; www.din.de.
2. IAPMO - International Association of Plumbing and Mechanical Officials; www.iapmo.org.
3. ICC - International Code Council; www.iccsafe.org.
4. ICC-ES - ICC Evaluation Service, LLC; www.icc-es.org.

D. Federal Government Agencies: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities in the following list. Information is subject to change and is up to date as of the date of the Contract Documents.

1. COE - Army Corps of Engineers; www.usace.army.mil.
2. CPSC - Consumer Product Safety Commission; www.cpsc.gov.
3. DOC - Department of Commerce; National Institute of Standards and Technology; www.nist.gov.
4. DOD - Department of Defense; www.quicksearch.dla.mil.
5. DOE - Department of Energy; www.energy.gov.
6. EPA - Environmental Protection Agency; www.epa.gov.
7. FAA - Federal Aviation Administration; www.faa.gov.
8. FG - Federal Government Publications; www.gpo.gov/fdsys.
9. GSA - General Services Administration; www.gsa.gov.
10. HUD - Department of Housing and Urban Development; www.hud.gov.
11. LBL - Lawrence Berkeley National Laboratory; Environmental Energy Technologies Division; www.eetd.lbl.gov.
12. OSHA - Occupational Safety & Health Administration; www.osha.gov.
13. SD - Department of State; www.state.gov.
14. TRB - Transportation Research Board; National Cooperative Highway Research Program; The National Academies; www.trb.org.
15. USDA - Department of Agriculture; Agriculture Research Service; U.S. Salinity Laboratory; www.ars.usda.gov.
16. USDA - Department of Agriculture; Rural Utilities Service; www.usda.gov.
17. USDOJ - Department of Justice; Office of Justice Programs; National Institute of Justice; www.ojp.usdoj.gov.
18. USP - U.S. Pharmacopeial Convention; www.usp.org.
19. USPS - United States Postal Service; www.usps.com.

E. Standards and Regulations: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the standards and

regulations in the following list. This information is subject to change and is believed to be accurate as of the date of the Contract Documents.

1. CFR - Code of Federal Regulations; Available from Government Printing Office; www.gpo.gov/fdsys.
2. DOD - Department of Defense; Military Specifications and Standards; Available from DLA Document Services; www.quicksearch.dla.mil.
3. DSCC - Defense Supply Center Columbus; (See FS).
4. FED-STD - Federal Standard; (See FS).
5. FS - Federal Specification; Available from DLA Document Services; www.quicksearch.dla.mil.

    a. Available from Defense Standardization Program; www.dsp.dla.mil.
    b. Available from General Services Administration; www.gsa.gov.
    c. Available from National Institute of Building Sciences/Whole Building Design Guide; www.wbdg.org/ccb.

6. MILSPEC - Military Specification and Standards; (See DOD).
7. USAB - United States Access Board; www.access-board.gov.
8. USATBCB - U.S. Architectural & Transportation Barriers Compliance Board; (See USAB).

F. State Government Agencies: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities in the following list. This information is subject to change and is believed to be accurate as of the date of the Contract Documents.

1. CBHF; State of California; Department of Consumer Affairs; Bureau of Electronic and Appliance Repair, Home Furnishings and Thermal Insulation; www.bearhfti.ca.gov.
2. CCR; California Code of Regulations; Office of Administrative Law; California Title 24 Energy Code; www.calregs.com.
3. CDHS; California Department of Health Services; (See CDPH).
4. CDPH; California Department of Public Health; Indoor Air Quality Program; www.cal-iaq.org.
5. CPUC; California Public Utilities Commission; www.cpuc.ca.gov.
6. SCAQMD; South Coast Air Quality Management District; www.aqmd.gov.
7. TFS; Texas A&M Forest Service; Sustainable Forestry and Economic Development; www.txforestservice.tamu.edu.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 014200

SECTION 015000 - TEMPORARY FACILITIES AND CONTROLS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes requirements for temporary utilities, support facilities, and security and protection facilities.

B. Related Requirements:

1. Section 011000 "Summary" for work restrictions and limitations on utility interruptions.

1.3 USE CHARGES

A. General: Cost or use charges for temporary facilities shall be included in the Contract Sum. Allow other entities to use temporary services and facilities without cost, including, but not limited to, Owner's construction forces, Architect, occupants of Project, testing agencies, and authorities having jurisdiction.

B. Water Service: Water from Owner's existing water system is available for use without metering and without payment of use charges. Provide connections and extensions of services as required for construction operations.

C. Water and Sewer Service from Existing System: Water from Owner's existing water system is available for use without metering and without payment of use charges. Provide connections and extensions of services as required for construction operations.

D. Electric Power Service from Existing System: Electric power from Owner's existing system is available for use without metering and without payment of use charges. Provide connections and extensions of services as required for construction operations.

1.4 INFORMATIONAL SUBMITTALS

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

1.5 QUALITY ASSURANCE

A. Electric Service: Comply with NECA, NEMA, and UL standards and regulations for temporary electric service. Install service to comply with NFPA 70.

B. Tests and Inspections: Arrange for authorities having jurisdiction to test and inspect each temporary utility before use. Obtain required certifications and permits.

C. Accessible Temporary Egress: Comply with applicable provisions in ICC/ANSI A117.1.

1.6 PROJECT CONDITIONS

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

PART 2 - PRODUCTS

2.1 MATERIALS

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

B. Lumber and Plywood: Comply with requirements in Division 06 Section "Miscellaneous Rough Carpentry" and “Sheathing”.

C. Polyethylene Sheet: Reinforced, fire-resistive sheet, 10-mil (0.25-mm) minimum thickness, with flame-spread rating of 15 or less per ASTM E 84 and passing NFPA 701 Test Method 2.

D. Dust-Control Adhesive-Surface Walk-Off Mats: Provide mats minimum 36 by 60 inches (914 by 1524 mm).3

2.2 TEMPORARY FACILITIES

A. Field Offices, General: A Field Office is not required for this project. If the contractor prefers to locate a field office at the site, the location shall be as directed by Owner. Space for meetings may be arranged by Owner with minimum of 24 hours’ advance notice.

B. Storage and Fabrication Sheds: Provide sheds sized, furnished, and equipped to accommodate materials and equipment for construction operations.

1. Store combustible materials apart from building.

2.3 EQUIPMENT

A. Fire Extinguishers: Portable, UL rated; with class and extinguishing agent as required by locations and classes of fire exposures.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Locate facilities where they will serve Project adequately and result in minimum interference with performance of the Work. Relocate and modify facilities as required by progress of the Work.

1. Locate facilities to limit site disturbance as specified in Section 011000 "Summary."

B. Provide each facility ready for use when needed to avoid delay. Do not remove until facilities are no longer needed or are replaced by authorized use of completed permanent facilities.

3.2 TEMPORARY UTILITY INSTALLATION

A. General: Install temporary service or connect to existing service.

1. Arrange with utility company, Owner, and existing users for time when service can be interrupted, if necessary, to make connections for temporary services.

B. Sewers and Drainage: Provide temporary utilities to remove effluent lawfully.

C. Water Service: Install water service and distribution piping in sizes and pressures adequate for construction.

D. Sanitary Facilities: Provide temporary toilets, wash facilities, and drinking water for use of construction personnel. Comply with authorities having jurisdiction for type, number, location, operation, and maintenance of fixtures and facilities.

1. Toilets: Use of Owner's existing toilet facilities is not permitted.

E. Isolation of Work Areas in Occupied Facilities: Prevent dust, fumes, and odors from entering occupied areas.

1. Maintain dust partitions during the Work. Use vacuum collection attachments on dust-producing equipment. Isolate limited work within occupied areas using portable dust-containment devices.
2. Perform daily construction cleanup and final cleanup using approved, HEPA-filter-equipped vacuum equipment.

F. Electric Power Service: Connect to Owner's existing electric power service. Maintain equipment in a condition acceptable to Owner.

G. Telephone Service: Provide superintendent with cellular telephone.

3.3 SUPPORT FACILITIES INSTALLATION

A. General: Comply with the following:

1. Provide incombustible construction for offices, shops, and sheds located within construction area or within 30 feet (9 m) of building lines. Comply with NFPA 241.
2. Maintain support facilities until near Substantial Completion. Remove before Substantial Completion. Personnel remaining after Substantial Completion will be permitted to use permanent facilities, under conditions acceptable to Owner.

B. Traffic Controls: Comply with requirements of authorities having jurisdiction.

1. Protect existing site improvements to remain including curbs, pavement, and utilities.
2. Maintain access for fire-fighting equipment and access to fire hydrants.

C. Parking: Use designated areas of Owner's existing parking areas for construction personnel.

D. Waste Disposal Facilities: Comply with requirements specified in Division 01 Section "Construction Waste Management and Disposal."

E. Lifts and Hoists: Provide facilities necessary for hoisting materials.

1. Truck cranes and similar devices used for hoisting materials are considered "tools and equipment" and not temporary facilities.

F. Existing Elevator Use: Use of Owner's existing elevators will be permitted, provided elevators are cleaned and maintained in a condition acceptable to Owner. At Substantial Completion, restore elevators to condition existing before initial use, including replacing worn cables, guide shoes, and similar items of limited life.

1. Do not load elevators beyond their rated weight capacity.
2. Provide protective coverings, barriers, devices, signs, or other procedures to protect elevator car and entrance doors and frame. If, despite such protection, elevators become damaged, engage elevator Installer to restore damaged work so no evidence remains of correction work. Return items that cannot be refinished in field to the shop, make required repairs and refinish entire unit, or provide new units as required.

G. Existing Stair Usage: Use of Owner's existing stairs will be permitted, provided stairs are cleaned and maintained in a condition acceptable to Owner. At Substantial Completion, restore stairs to condition existing before initial use.

1. Provide protective coverings, barriers, devices, signs, or other procedures to protect stairs and to maintain means of egress. If stairs become damaged, restore damaged areas so no evidence remains of correction work.

3.4 SECURITY AND PROTECTION FACILITIES INSTALLATION

A. Protection of Existing Facilities: Protect existing vegetation, equipment, structures, utilities, and other improvements at Project site and on adjacent properties, except those indicated to be removed or altered. Repair damage to existing facilities.

B. Environmental Protection: Provide protection, operate temporary facilities, and conduct construction in ways and by methods that comply with environmental regulations and that minimize possible air, waterway, and subsoil contamination or pollution or other undesirable effects.

1. Comply with work restrictions specified in Division 01 Section "Summary."

C. Tree and Plant Protection: Install temporary fencing located as indicated or outside the drip line of trees to protect vegetation from damage from construction operations. Protect tree root systems from damage, flooding, and erosion.

D. Barricades, Warning Signs, and Lights: Comply with requirements of authorities having jurisdiction for erecting structurally adequate barricades, including warning signs and lighting.

E. Temporary Egress: Maintain temporary egress from existing occupied facilities as indicated and as required by authorities having jurisdiction.

F. Temporary Fire Protection: Install and maintain temporary fire-protection facilities of types needed to protect against reasonably predictable and controllable fire losses. Comply with NFPA 241.

1. Prohibit smoking on site.
2. Supervise welding operations, combustion-type temporary heating units, and similar sources of fire ignition according to requirements of authorities having jurisdiction.
3. Develop and supervise an overall fire-prevention and -protection program for personnel at Project site. Review needs with local fire department and establish procedures to be followed. Instruct personnel in methods and procedures. Post warnings and information.

3.5 OPERATION, TERMINATION, AND REMOVAL

A. Supervision: Enforce strict discipline in use of temporary facilities. To minimize waste and abuse, limit availability of temporary facilities to essential and intended uses.

B. Maintenance: Maintain facilities in good operating condition until removal.

1. Maintain operation of temporary enclosures, heating, cooling, humidity control, ventilation, and similar facilities on a 24-hour basis where required to achieve indicated results and to avoid possibility of damage.

C. Temporary Facility Changeover: Do not change over from using temporary security and protection facilities to permanent facilities until Substantial Completion.

D. Termination and Removal: Remove each temporary facility when need for its service has ended, when it has been replaced by authorized use of a permanent facility, or no later than Substantial Completion. Complete or, if necessary, restore permanent construction that may have been delayed because of interference with temporary facility. Repair damaged Work, clean exposed surfaces, and replace construction that cannot be satisfactorily repaired.

1. Materials and facilities that constitute temporary facilities are property of Contractor. Owner reserves right to take possession of Project identification signs.
2. Remove temporary paving not intended for or acceptable for integration into permanent paving. Where area is intended for landscape development, remove soil and aggregate fill that do not comply with requirements for fill or subsoil. Remove materials contaminated with road oil, asphalt and other petrochemical compounds, and other substances that might impair growth of plant materials or lawns. Repair or replace street paving, curbs, and sidewalks at temporary entrances, as required by authorities having jurisdiction.
3. At Substantial Completion, clean and renovate permanent facilities used during construction period. Comply with final cleaning requirements specified in Division 01 Section "Closeout Procedures."

END OF SECTION 015000

SECTION 016000 - PRODUCT REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes administrative and procedural requirements for selection of products for use in Project; product delivery, storage, and handling; manufacturers' standard warranties on products; special warranties; product substitutions; and comparable products.

B. Related Sections include the following:

1. Section 012100 "Allowances" for products selected under an allowance.
2. Supplemental Instructions to Bidders and Project Supplemental Instructions to Bidders for Substitutions.
3. Section 014200 "References" for applicable industry standards for products specified.
4. Divisions 02 through 49 Sections for specific requirements for warranties on products and installations specified to be warranted.

1.3 DEFINITIONS

A. Products: Items purchased for incorporating into the Work, whether purchased for Project or taken from previously purchased stock. The term "product" includes the terms "material," "equipment," "system," and terms of similar intent.

1. Named Products: Items identified by manufacturer's product name, including make or model number or other designation shown or listed in manufacturer's published product literature, that is current as of date of the Contract Documents.
2. New Products: Items that have not previously been incorporated into another project or facility, except that products consisting of recycled-content materials are allowed, unless explicitly stated otherwise. Products salvaged or recycled from other projects are not considered new products.
3. Comparable Product: Product that is demonstrated and approved through submittal process, or where indicated as a product substitution, to have the indicated qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics that equal or exceed those of specified product.

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

C. Basis-of-Design Product Specification: Where a specific manufacturer's product is named and accompanied by the words "basis of design," including make or model number or other designation, to establish the significant qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics for purposes of evaluating comparable products of other named manufacturers.

1.4 SUBMITTALS

A. Product List: Submit a list, in tabular from, showing specified products. Include generic names of products required. Include manufacturer's name and proprietary product names for each product.

1. Coordinate product list with Contractor's Construction Schedule.
2. Form: Tabulate information for each product under the following column headings:

   a. Specification Section number and title.
   b. Generic name used in the 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.
   h. Identification of items that require early submittal approval for scheduled delivery date.

3. Initial Submittal: Within 10 days after date of Notice to Proceed, submit initial product list. Include a written explanation for omissions of data and for variations from Contract requirements.

   a. At Contractor's option, initial submittal may be limited to product selections and designations that must be established early in Contract period.

4. Architect's Action: Architect will respond in writing to Contractor within 10 days of receipt of completed product list. Architect's response will include a list of unacceptable product selections and a brief explanation of reasons for this action. Architect's response, or lack of response, does not constitute a waiver of requirement to comply with the Contract Documents.

B. Substitution Requests: Architect will consider requests for substitution if received within the time frame indicated in the Instructions to Bidders. Requests received after that time may be considered or rejected at the discretion of the Architect. Submit three copies of each request for consideration. Identify product or fabrication or installation method to be replaced. Include Specification Section number and title and Drawing numbers and titles.

1. Substitution Request Form: Use CSI Form 13.1A.
2. Documentation: Show compliance with requirements for substitutions and the following, as applicable:

   a. Statement indicating why specified material or product cannot be provided.

b. Coordination information, including a list of changes or modifications needed to other parts of the Work and to construction performed by Owner and separate contractors, that will be necessary to accommodate proposed substitution.
c. Detailed comparison of significant qualities of proposed substitution with those of the Work specified. Significant qualities may include attributes such as performance, weight, size, durability, visual effect, and specific features and requirements indicated.
d. Product Data, including drawings and descriptions of products and fabrication and installation procedures.
e. Samples, where applicable or requested.
f. List of similar installations for completed projects with project names and addresses and names and addresses of architects and owners.
g. Material test reports from a qualified testing agency indicating and interpreting test results for compliance with requirements indicated.
h. Research/evaluation reports evidencing compliance with building code in effect for Project, from a model code organization acceptable to authorities having jurisdiction.
i. Detailed comparison of Contractor's Construction Schedule using proposed substitution with products specified for the Work, including effect on the overall Contract Time. If specified product or method of construction cannot be provided within the Contract Time, include letter from manufacturer, on manufacturer's letterhead, stating lack of availability or delays in delivery.
j. Cost information, including a proposal of change, if any, in the Contract Sum.
k. Contractor's certification that proposed substitution complies with requirements in the Contract Documents and is appropriate for applications indicated.
l. Contractor's waiver of rights to additional payment or time that may subsequently become necessary because of failure of proposed substitution to produce indicated results.

C. Basis-of-Design Product Specification Submittal: Comply with requirements in Division 01 Section "Submittal Procedures." Show compliance with requirements.

1.5 QUALITY ASSURANCE

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

1. Each contractor is responsible for providing products and construction methods compatible with products and construction methods of other contractors.
2. If a dispute arises between contractors over concurrently selectable but incompatible products, Architect will determine which products shall be used.

1.6 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, and handle products using means and methods that will prevent damage, deterioration, and loss, including theft. Comply with manufacturer's written instructions.

B. Delivery and Handling:

1. Schedule delivery to minimize long-term storage at Project site and to prevent overcrowding of construction spaces.
2. Coordinate delivery with installation time to ensure minimum holding time for items that are flammable, hazardous, easily damaged, or sensitive to deterioration, theft, and other losses.
3. Deliver products to Project site in an undamaged condition in manufacturer's original sealed container or other packaging system, complete with labels and instructions for handling, storing, unpacking, protecting, and installing.
4. Inspect products on delivery to determine compliance with the Contract Documents and to determine that products are undamaged and properly protected.

C. Storage:

1. Store products to allow for inspection and measurement of quantity or counting of units.
2. Store materials in a manner that will not endanger Project structure.
3. Store products that are subject to damage by the elements, under cover in a weathertight enclosure above ground, with ventilation adequate to prevent condensation.
4. Store foam plastic from exposure to sunlight, except to extent necessary for period of installation and concealment.
5. Comply with product manufacturer's written instructions for temperature, humidity, ventilation, and weather-protection requirements for storage.
6. Protect stored products from damage and liquids from freezing.

1.7 PRODUCT WARRANTIES

A. Warranties specified in other Sections shall be in addition to, and run concurrent with, other warranties required by the Contract Documents. Manufacturer's disclaimers and limitations on product warranties do not relieve Contractor of obligations under requirements of the Contract Documents.

1. Manufacturer's Warranty: Preprinted written warranty published by individual manufacturer for a particular product and specifically endorsed by manufacturer to Owner.
2. Special Warranty: Written warranty required by or incorporated into the Contract Documents, either to extend time limit provided by manufacturer's warranty or to provide more rights for Owner.

B. Special Warranties: Prepare a written document that contains appropriate terms and identification, ready for execution. Submit a draft for approval before final execution.

1. Manufacturer's Standard Form: Modified to include Project-specific information and properly executed.
2. Specified Form: When specified forms are included with the Specifications, prepare a written document using appropriate form properly executed.
3. Refer to Divisions 02 through 49 Sections for specific content requirements and particular requirements for submitting special warranties.

C. Submittal Time: Comply with requirements in Division 01 Section "Closeout Procedures."

PART 2 - PRODUCTS

2.1 PRODUCT SELECTION PROCEDURES

A. General Product Requirements: Provide products that comply with the Contract Documents, that are undamaged and, unless otherwise indicated, that are new at time of installation.

1. Provide products complete with accessories, trim, finish, fasteners, and other items needed for a complete installation and indicated use and effect.
2. Standard Products: If available, and unless custom products or nonstandard options are specified, provide standard products of types that have been produced and used successfully in similar situations on other projects.
3. Owner reserves the right to limit selection to products with warranties not in conflict with requirements of the Contract Documents.
4. Where products are accompanied by the term "as selected," Architect will make selection.
5. Where products are accompanied by the term "match sample," sample to be matched is Architect's.
6. Descriptive, performance, and reference standard requirements in the Specifications establish "salient characteristics" of products.
7. Or Equal: Where products are specified by name and accompanied by the term "or equal" or "or approved equal" or "or approved," comply with provisions in Part 2 "Comparable Products" Article to obtain approval for use of an unnamed product.

B. Product Selection Procedures:

1. Product: Where Specifications name a single product and manufacturer, provide the named product that complies with requirements.
2. Manufacturer/Source: Where Specifications name a single manufacturer or source, provide a product by the named manufacturer or source that complies with requirements.
3. Products: Where Specifications include a list of names of both products and manufacturers, provide one of the products listed that complies with requirements.
4. Manufacturers: Where Specifications include a list of manufacturers' names, provide a product by one of the manufacturers listed that complies with requirements.
5. Available Products: Where Specifications include a list of names of both products and manufacturers, provide one of the products listed, or an unnamed product, that complies with requirements. Comply with provisions in Part 2 "Comparable Products" Article for consideration of an unnamed product.
6. Available Manufacturers: Where Specifications include a list of manufacturers, provide a product by one of the manufacturers listed, or an unnamed manufacturer, that complies with requirements. Comply with provisions in Part 2 "Comparable Products" Article for consideration of an unnamed product.
7. Product Options: Where Specifications indicate that sizes, profiles, and dimensional requirements on Drawings are based on a specific product or system, provide the specified product or system. Comply with provisions in Part 2 "Product Substitutions" Article for consideration of an unnamed product or system.

8. Basis-of-Design Product: Where Specifications name a product and include a list of manufacturers, provide the specified product or a comparable product by one of the other named manufacturers. Drawings and Specifications indicate sizes, profiles, dimensions, and other characteristics that are based on the product named. Comply with provisions in Part 2 "Comparable Products" Article for consideration of an unnamed product by the other named manufacturers.
9. Visual Matching Specification: Where Specifications require matching an established Sample, select a product that complies with requirements and matches Architect's sample. Architect's decision will be final on whether a proposed product matches.

    a. If no product available within specified category matches and complies with other specified requirements, comply with provisions in Part 2 "Product Substitutions" Article for proposal of product.

10. Visual Selection Specification: Where Specifications include the phrase "as selected from manufacturer's colors, patterns, textures" or a similar phrase, select a product that complies with other specified requirements.

    a. Standard Range: Where Specifications include the phrase "standard range of colors, patterns, textures" or similar phrase, Architect will select color, pattern, density, or texture from manufacturer's product line that does not include premium items.
    b. Full Range: Where Specifications include the phrase "full range of colors, patterns, textures" or similar phrase, Architect will select color, pattern, density, or texture from manufacturer's product line that includes both standard and premium items.

PART 3 - EXECUTION (Not Used)

END OF SECTION 016000

SECTION 017300 - EXECUTION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes general procedural requirements governing execution of the Work including, but not limited to, the following:

1. Construction layout.
2. Field engineering and surveying.
3. General installation of products.
4. Coordination of Owner-installed products.
5. Progress cleaning.
6. Starting and adjusting.
7. Protection of installed construction.
8. Correction of the Work.

B. Related Sections include the following:

1. Section 011000 "Summary" for limits on use of Project site.
2. Section 013300 "Submittal Procedures" for submitting surveys.
3. Section 013516 “Alteration Project Procedures” for cutting, patching, and renovating work performed with existing spaces or on existing surfaces.
4. Section 017700 "Closeout Procedures" for submitting final property survey with Project Record Documents, recording of Owner-accepted deviations from indicated lines and levels, replacing defective work, and final cleaning.
5. Section 024119 "Selective Demolition" for demolition and removal of selected portions of the building.

1.3 SUBMITTALS

A. Landfill Receipts: Submit copy of receipts issued by a landfill facility, licensed to accept hazardous materials, for hazardous waste disposal.

1.4 QUALITY ASSURANCE

A. Manufacturer's Installation Instructions: Obtain and maintain on-site manufacturer's written recommendations and instructions for installation of products and equipment.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 EXAMINATION

A. Existing Conditions: The existence and location of, utilities, and other construction indicated as existing are not guaranteed. Before beginning work, investigate and verify the existence and location of mechanical and electrical systems and other construction affecting the Work.

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

B. Existing Utilities: The existence and location of underground and other utilities and construction indicated as existing are not guaranteed. Before beginning sitework, investigate and verify the existence and location of underground utilities and other construction affecting the Work.

1. Before construction, verify the location and invert elevation at points of connection of sanitary sewer, storm sewer, and water-service piping; and underground electrical services.

C. Acceptance of Conditions: Examine substrates, areas, and conditions, with Installer or Applicator present where indicated, for compliance with requirements for installation tolerances and other conditions affecting performance. Record observations.

1. Written Report: Where a written report listing conditions detrimental to performance of the Work is required by other Sections, include the following:

a. Description of the Work.
b. List of detrimental conditions, including substrates.
c. List of unacceptable installation tolerances.
d. Recommended corrections.

2. Verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.
3. Examine roughing-in for mechanical and electrical systems to verify actual locations of connections before equipment and fixture installation.
4. Examine walls, floors, and roofs for suitable conditions where products and systems are to be installed.
5. Proceed with installation only after unsatisfactory conditions have been corrected. Proceeding with the Work indicates acceptance of surfaces and conditions.

3.2 PREPARATION

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

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

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

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

3.3 CONSTRUCTION LAYOUT

A. Verification: Before proceeding to lay out the Work, verify layout information shown on Drawings, in relation to the property survey and existing benchmarks. If discrepancies are discovered, notify Architect promptly.

3.4 INSTALLATION

A. General: Locate the Work and components of the Work accurately, in correct alignment and elevation, as indicated.

1. Make vertical work plumb and make horizontal work level.
2. Where space is limited, install components to maximize space available for maintenance and ease of removal for replacement.
3. Conceal pipes, ducts, and wiring in finished areas, unless otherwise indicated.

B. Comply with manufacturer's written instructions and recommendations for installing products in applications indicated.

C. Install products at the time and under conditions that will ensure the best possible results. Maintain conditions required for product performance until Substantial Completion.

D. Conduct construction operations so no part of the Work is subjected to damaging operations or loading in excess of that expected during normal conditions of occupancy.

E. Tools and Equipment: Do not use tools or equipment that produce harmful noise levels.

F. Templates: Obtain and distribute to the parties involved templates for work specified to be factory prepared and field installed. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing products to comply with indicated requirements.

G. Anchors and Fasteners: Provide anchors and fasteners as required to anchor each component securely in place, accurately located and aligned with other portions of the Work.

1. Mounting Heights: Where mounting heights are not indicated, mount components at heights directed by Architect.
2. Allow for building movement, including thermal expansion and contraction.
3. Coordinate installation of anchorages. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

H. Joints: Make joints of uniform width. Where joint locations in exposed work are not indicated, arrange joints for the best visual effect. Fit exposed connections together to form hairline joints.

I. Hazardous Materials: Use products, cleaners, and installation materials that are not considered hazardous.

3.5 PROGRESS CLEANING

A. General: Clean Project site and work areas daily, including common areas. Coordinate progress cleaning for joint-use areas where more than one installer has worked. Enforce requirements strictly. Dispose of materials lawfully.

1. Comply with requirements in NFPA 241 for removal of combustible waste materials and debris.
2. Do not hold materials more than 7 days during normal weather or 3 days if the temperature is expected to rise above 80 deg F (27 deg C).
3. Containerize hazardous and unsanitary waste materials separately from other waste. Mark containers appropriately and dispose of legally, according to regulations.

B. Site: Maintain Project site free of waste materials and debris.

C. Work Areas: Clean areas where work is in progress to the level of cleanliness necessary for proper execution of the Work.

1. Remove liquid spills promptly.
2. Where dust would impair proper execution of the Work, broom-clean or vacuum the entire work area, as appropriate.

D. Installed Work: Keep installed work clean. Clean installed surfaces according to written instructions of manufacturer or fabricator of product installed, using only cleaning materials specifically recommended. If specific cleaning materials are not recommended, use cleaning materials that are not hazardous to health or property and that will not damage exposed surfaces.

E. Concealed Spaces: Remove debris from concealed spaces before enclosing the space.

F. Exposed Surfaces in Finished Areas: Clean exposed surfaces and protect as necessary to ensure freedom from damage and deterioration at time of Substantial Completion.

G. Waste Disposal: Burying or burning waste materials on-site will not be permitted. Washing waste materials down sewers or into waterways will not be permitted.

H. During handling and installation, clean and protect construction in progress and adjoining materials already in place. Apply protective covering where required to ensure protection from damage or deterioration at Substantial Completion.

I. Clean and provide maintenance on completed construction as frequently as necessary through the remainder of the construction period. Adjust and lubricate operable components to ensure operability without damaging effects.

J. Limiting Exposures: Supervise construction operations to assure that no part of the construction, completed or in progress, is subject to harmful, dangerous, damaging, or otherwise deleterious exposure during the construction period.

3.6 STARTING AND ADJUSTING

A. Start equipment and operating components to confirm proper operation. Remove malfunctioning units, replace with new units, and retest.

B. Adjust operating components for proper operation without binding. Adjust equipment for proper operation.

C. Test each piece of equipment to verify proper operation. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

D. Manufacturer's Field Service: If a factory-authorized service representative is required to inspect field-assembled components and equipment installation, comply with qualification requirements in Division 01 Section "Quality Requirements."

3.7 PROTECTION OF INSTALLED CONSTRUCTION

A. Provide final protection and maintain conditions that ensure installed Work is without damage or deterioration at time of Substantial Completion.

B. Comply with manufacturer's written instructions for temperature and relative humidity.

3.8 CORRECTION OF THE WORK

A. Repair or remove and replace defective construction. Restore damaged substrates and finishes. Comply with requirements in Section 013516 “Alteration Project Procedures”.

1. Repairing includes replacing defective parts, refinishing damaged surfaces, touching up with matching materials, and properly adjusting operating equipment.

B. Restore permanent facilities used during construction to their specified condition.

C. Remove and replace damaged surfaces that are exposed to view if surfaces cannot be repaired without visible evidence of repair.

D. Repair components that do not operate properly. Remove and replace operating components that cannot be repaired.

E. Remove and replace chipped, scratched, and broken glass or reflective surfaces.

END OF SECTION 017300

SECTION 017400 - 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 01 specifies procedures for submitting warranties.
2. Division 01 specifies contract closeout procedures.
3. Divisions 02 through 49 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.

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 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.

2. 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. 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 tale of contents of the Project Manual.

D. 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 (Not Applicable)

END OF SECTION 017400

SECTION 017419 - CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL

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: Administrative and procedural requirements for construction waste management activities.

1.3 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.

1.4 SUBMITTALS

A. Contractor shall develop a Waste Management Plan: Submit within 14 days of date established for the Notice to Proceed.

1.5 PERFORMANCE REQUIREMENTS

A. General: Target diverting 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. Plastic film (sheeting, shrink wrap, packaging)
13. Window glass
14. Wood
15. Field office waste, including office paper, aluminum cans, glass, plastic, and office cardboard.

1.6 QUALITY ASSURANCE

A. Waste Management Coordinator Qualifications: Experienced firm, with a record of successful waste management coordination of projects with similar requirements, that employs a LEED Accredited Professional, certified by the USGBC as waste management coordinator.

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

C. Regulatory Requirements: Conduct construction waste management activities in accordance with hauling and disposal regulations of all authorities having jurisdiction and all other applicable laws and ordinances.

D. Preconstruction Conference: Schedule and conduct meeting at Project site prior to construction activities.

1. Attendees: Inform the following individuals, whose presence is required, of date and time of meeting.

   a. Owner
   b. Architect
   c. Contractor's superintendent
   d. Major subcontractors
   e. ‘Waste Management Coordinator
   f. Other concerned parties

2. Agenda Items: Review methods and procedures related to waste management including, but not limited to, the following:

   a. Review and discuss waste management plan including responsibilities of Waste Management Coordinator.
   b. Review requirements for documenting quantities of each type of waste and its disposition.
   c. Review and finalize procedures for materials separation and verify availability of containers and bins needed to avoid delays.
   d. Review procedures for periodic waste collection and transportation to recycling and disposal facilities.
   e. Review waste management requirements for each trade.

3. Minutes: Record discussion. Distribute meeting minutes to all participants. Note: If there is a Project Architect, they will perform this role.

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% nonrecyclable material, by volume.

C. Provide containers for CDL waste that is disposed in a landfill clearly labeled as such.

D. Use detailed material estimates to reduce risk of unplanned and potentially wasteful cuts.

E. To the greatest extent possible, include in material purchasing agreements a waste reduction provision requesting that materials and equipment be delivered in packaging made of recyclable material, that they reduce the amount of packaging, that packaging be taken back for reuse or recycling, and to take back all unused product. Insure that subcontractors require the same provisions in their purchase agreements.

F. Conduct regular visual inspections of dumpsters and recycling bins to remove contaminants.

3.2 SOURCE SEPARATION

A. General: Contractor shall separate recyclable materials from CDL waste to the maximum extent possible.

Separate recyclable materials by type.

1. Provide containers, clearly labeled, by type of separated materials or provide other storage method for managing recyclable materials until they are removed from Project site.
2. Stockpile processed materials on-site without intermixing with other materials. Place, grade, and shape stockpiles to drain surface water and to minimize pest attraction. Cover to prevent windblown dust.\
3. Stockpile materials away from demolition area. Do not store within drip line of remaining trees.
4. Store components off the ground and protect from weather.

3.3 CO-MINGLED RECYCLING

A. General: Do not put CDL waste that will be disposed in a landfill into a co-mingled CDL waste recycling container.

3.4 REMOVAL OF CONSTRUCTION WASTE MATERIALS

A. Remove CDL waste materials from project site on a regular basis. Do not allow CDL waste to accumulate on-site.

B. Transport CDL waste materials off Owner's property and legally dispose of them.

C. Burning of CDL waste is not permitted.

END OF SECTION 017419

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 01 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. Warranties.
3. Final cleaning.
4. Repair of the Work.

B. Related Sections include the following:

1. Section 012900 "Payment Procedures" for requirements for Applications for Payment for Substantial and Final Completion.
2. Section 013233 "Photographic Documentation" for submitting final completion construction photographic documentation.
3. Section 017823 "Operation and Maintenance Data" for additional operation and maintenance manual requirements.
4. Section 017839 "Project Record Documents" for submitting Record Drawings, Record Specifications, and Record Product Data.
5. Divisions 02 through 49 Sections for specific closeout and special cleaning requirements for the Work in those Sections.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of cleaning agent.

B. Contractor's List of Incomplete Items: Initial submittal at Substantial Completion.

C. Certified List of Incomplete Items: Final submittal at final completion.

1.4 CLOSEOUT SUBMITTALS

A. Certificates of Release: From authorities having jurisdiction.

B. Certificate of Insurance: For continuing coverage.

1.5 MAINTENANCE MATERIAL SUBMITTALS

A. Schedule of Maintenance Material Items: For maintenance material submittal items specified in other Sections.

1.6 SUBSTANTIAL COMPLETION PROCEDURES

A. 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 detailed list of items to be completed and corrected (punch list), the value of items on the list, and reasons why the Work is not complete.
2. Advise Owner of pending insurance changeover requirements.
3. Submit specific warranties, workmanship bonds, maintenance service agreements, final certifications, and similar documents.
4. Obtain and submit releases permitting Owner unrestricted use of the Work and access to services and utilities. Include occupancy permits, operating certificates, and similar releases.
5. Prepare and submit Project Record Documents, operation and maintenance manuals, Final Completion construction photographs, damage or settlement surveys, property surveys, and similar final record information.
6. Deliver tools, spare parts, extra materials, and similar items to location designated by Owner. Label with manufacturer's name and model number where applicable.
7. Make final changeover of permanent locks and deliver keys to Owner. Advise Owner's personnel of changeover in security provisions.
8. Complete startup testing of systems.
9. Submit test/adjust/balance records.
10. Terminate and remove temporary facilities from Project site, along with mockups, construction tools, and similar elements.
11. Advise Owner of changeover in heat and other utilities.
12. Submit changeover information related to Owner's occupancy, use, operation, and maintenance.
13. Complete final cleaning requirements, including touchup painting.
14. Touch up and otherwise repair and restore marred exposed finishes to eliminate visual defects.

B. Inspection: Submit a written request for inspection for Substantial Completion. On receipt of request, Architect will either proceed with inspection or notify Contractor of unfulfilled requirements. Architect will prepare the Certificate of Substantial Completion after inspection or will notify Contractor of items, either on Contractor's list or additional items identified by Architect, that must be completed or corrected before certificate will be issued.

1. Reinspection: Request reinspection when the Work identified in previous inspections as incomplete is completed or corrected. General Contractor shall initial each item after contractor has verified each outstanding item has been completed or corrected.
2. Results of completed inspection will form the basis of requirements for Final Completion.

1.7 FINAL COMPLETION PROCEDURES

A. Preliminary Procedures: Before requesting final inspection for determining date of Final Completion, complete the following:

1. Submit a final Application for Payment according to Division 01 Section "Payment Procedures."
2. Submit certified copy of Architect's Substantial Completion inspection list of items to be completed or corrected (punch list), endorsed and dated by Architect. The certified copy of the list shall state that each item has been completed or otherwise resolved for acceptance.
3. Submit evidence of final, continuing insurance coverage complying with insurance requirements.
4. Instruct Owner's personnel in operation, adjustment, and maintenance of products, equipment, and systems.

B. Inspection: Submit a written request for final inspection for acceptance. On receipt of request, Architect will either proceed with inspection or notify Contractor of unfulfilled requirements. Architect will prepare a final Certificate for Payment after inspection or will notify Contractor of construction that must be completed or corrected before certificate will be issued.

1. Reinspection: Request reinspection when the Work identified in previous inspection as incomplete is completed or corrected. General Contractor shall initial each item after contractor has verified each outstanding item has been completed or corrected.
2. Architect reserves the right to charge Contractor for additional reinspections required beyond initial inspection and one (1) reinspection per area.

1.8 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.
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.

1.9 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 (215-by-280-mm) paper.
2. Provide heavy paper dividers with plastic-covered tabs for each separate warranty. Mark tab to identify the product or installation. Provide a typed description of the product or installation, including the name of the product and the name, address, and telephone number of Installer.
3. Identify each binder on the front and spine with the typed or printed title "WARRANTIES," Project name, and name of Contractor.

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 FINAL CLEANING

A. General: Provide final cleaning. Conduct cleaning and waste-removal operations to comply with local laws and ordinances and Federal and local environmental and antipollution regulations.

B. Cleaning: Employ experienced workers or professional cleaners for final cleaning. Clean each surface or unit to condition expected in an average commercial building cleaning and maintenance program. Comply with manufacturer's written instructions.

1. Complete the following cleaning operations before requesting inspection for certification of Substantial Completion for entire Project or for a portion of Project:

    a. Clean Project site, yard, and grounds, in areas disturbed by construction activities, including landscape development areas, of rubbish, waste material, litter, and other foreign substances.
    b. Sweep paved areas broom clean. Remove petrochemical spills, stains, and other foreign deposits.
    c. Rake grounds that are neither planted nor paved to a smooth, even-textured surface.
    d. Remove tools, construction equipment, machinery, and surplus material from Project site.
    e. Remove snow and ice to provide safe access to building.
    f. Clean exposed exterior and interior hard-surfaced finishes to a dirt-free condition, free of stains, films, and similar foreign substances. Avoid disturbing natural weathering of exterior surfaces. Restore reflective surfaces to their original condition.
    g. Remove debris and surface dust from limited access spaces, including roofs, plenums, shafts, trenches, equipment vaults, manholes, attics, and similar spaces.
    h. Sweep concrete floors broom clean in unoccupied spaces.
    i. Vacuum carpet and similar soft surfaces, removing debris and excess nap; shampoo if visible soil or stains remain.
    j. Clean transparent materials, including mirrors and glass in doors and windows. Remove glazing compounds and other noticeable, vision-obscuring materials. Replace chipped or broken glass and other damaged transparent materials. Polish mirrors and glass, taking care not to scratch surfaces.
    k. Remove labels that are not permanent.
    l. Touch up and otherwise repair and restore marred, exposed finishes and surfaces. Replace finishes and surfaces that cannot be satisfactorily repaired or restored or that already show evidence of repair or restoration.

        1) Do not paint over "UL" and similar labels, including mechanical and electrical nameplates.

    m. Leave Project clean and ready for occupancy.

C. Comply with safety standards for cleaning. Do not burn waste materials. Do not bury debris or excess materials on Owner's property. Do not discharge volatile, harmful, or dangerous materials into drainage systems. Remove waste materials from Project site and dispose of lawfully.

3.2 REPAIR OF THE WORK

A. Complete repair and restoration operations before requesting inspection for determination of Substantial Completion.

B. Repair, or remove and replace, defective construction. Repairing includes replacing defective parts, refinishing damaged surfaces, touching up with matching materials, and properly adjusting operating equipment. Where damaged or worn items cannot be repaired or restored,

provide replacements. Remove and replace operating components that cannot be repaired. Restore damaged construction and permanent facilities used during construction to specified condition.

1. Remove and replace chipped, scratched, and broken glass, reflective surfaces, and other damaged transparent materials.
2. Touch up and otherwise repair and restore marred or exposed finishes and surfaces. Replace finishes and surfaces that that already show evidence of repair or restoration.

    a. Do not paint over "UL" and other required labels and identification, including mechanical and electrical nameplates. Remove paint applied to required labels and identification.

END OF SECTION 017700

SECTION 017823 - OPERATION AND MAINTENANCE DATA

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes administrative and procedural requirements for preparing operation and maintenance manuals, including the following:

1. Operation and maintenance documentation directory manuals.
2. Product maintenance manuals.

B. Related Requirements:

1. Section 013300 "Submittal Procedures" for submitting copies of submittals for operation and maintenance manuals.

1.3 DEFINITIONS

A. System: An organized collection of parts, equipment, or subsystems united by regular interaction.

B. Subsystem: A portion of a system with characteristics similar to a system.

1.4 CLOSEOUT SUBMITTALS

A. Submit operation and maintenance manuals indicated. Provide content for each manual as specified in individual Specification Sections, and as reviewed and approved at the time of Section submittals. Submit reviewed manual content formatted and organized as required by this Section.

1. Architect will comment on whether content of operation and maintenance submittals is acceptable.
2. Where applicable, clarify and update reviewed manual content to correspond to revisions and field conditions.

B. Format: Submit operations and maintenance manuals in the following format:

1. PDF electronic file by uploading to web-based project software site. Assemble each manual into a composite electronically indexed file. Submit on digital media acceptable to Architect.

    a. Name each indexed document file in composite electronic index with applicable item name. Include a complete electronically linked operation and maintenance directory.
    b. Enable inserted reviewer comments on draft submittals.

C. Initial Manual Submittal: Submit draft copy of each manual at least 15 days before commencing demonstration and training. Architect and Commissioning Authority will comment on whether general scope and content of manual are acceptable.

D. Final Manual Submittal: Submit each manual in final form prior to requesting inspection for Substantial Completion and at least 15 days before commencing demonstration and training. Architect and Commissioning Authority will return copy with comments.

1. Correct or revise each manual to comply with Architect's and Commissioning Authority comments. Submit copies of each corrected manual within 15 days of receipt of Architect's comments and prior to commencing demonstration and training.

E. Comply with Section 017700 "Closeout Procedures" for schedule for submitting operation and maintenance documentation.

1.5 FORMAT OF OPERATION AND MAINTENANCE MANUALS

A. Manuals, Electronic Files: Submit manuals in the form of a multiple file composite electronic PDF file for each manual type required.

1. Electronic Files: Use electronic files prepared by manufacturer where available. Where scanning of paper documents is required, configure scanned file for minimum readable file size.
2. File Names and Bookmarks: Bookmark individual documents based on file names. Name document files to correspond to system, subsystem, and equipment names used in manual directory and table of contents. Group documents for each system and subsystem into individual composite bookmarked files, then create composite manual, so that resulting bookmarks reflect the system, subsystem, and equipment names in a readily navigated file tree. Configure electronic manual to display bookmark panel on opening file.

B. Manuals, Paper Copy: Submit manuals in the form of hard-copy, bound and labeled volumes.

1. Binders: Heavy-duty, three-ring, vinyl-covered, loose-leaf binders, in thickness necessary to accommodate contents, sized to hold 8-1/2-by-11-inch (215-by-280-mm) paper; with clear plastic sleeve on spine to hold label describing contents and with pockets inside covers to hold folded oversize sheets.

    a. If two or more binders are necessary to accommodate data of a system, organize data in each binder into groupings by subsystem and related components. Cross-

reference other binders if necessary to provide essential information for proper operation or maintenance of equipment or system.

b. Identify each binder on front and spine, with printed title "OPERATION AND MAINTENANCE MANUAL," Project title or name, and subject matter of contents, and indicate Specification Section number on bottom of spine. Indicate volume number for multiple-volume sets.

2. Dividers: Heavy-paper dividers with plastic-covered tabs for each section of the manual. Mark each tab to indicate contents. Include typed list of products and major components of equipment included in the section on each divider, cross-referenced to Specification Section number and title of Project Manual.
3. Protective Plastic Sleeves: Transparent plastic sleeves designed to enclose diagnostic software storage media for computerized electronic equipment. Enclose title pages and directories in clear plastic sleeves.
4. Supplementary Text: Prepared on 8-1/2-by-11-inch (215-by-280-mm) white bond paper.
5. Drawings: Attach reinforced, punched binder tabs on drawings and bind with text.

a. If oversize drawings are necessary, fold drawings to same size as text pages and use as foldouts.
b. If drawings are too large to be used as foldouts, fold and place drawings in labeled envelopes and bind envelopes in rear of manual. At appropriate locations in manual, insert typewritten pages indicating drawing titles, descriptions of contents, and drawing locations.

1.6 REQUIREMENTS FOR EMERGENCY, OPERATION, AND MAINTENANCE MANUALS

A. Organization of Manuals: Unless otherwise indicated, organize each manual into a separate section for each system and subsystem, and a separate section for each piece of equipment not part of a system. Each manual shall contain the following materials, in the order listed:

1. Title page.
2. Table of contents.
3. Manual contents.

B. Title Page: Include the following information:

1. Subject matter included in manual.
2. Name and address of Project.
3. Name and address of Owner.
4. Date of submittal.
5. Name and contact information for Contractor.
6. Name and contact information for Architect.
7. Name and contact information for Commissioning Authority.
8. Names and contact information for major consultants to the Architect that designed the systems contained in the manuals.
9. Cross-reference to related systems in other operation and maintenance manuals.

C. Table of Contents: List each product included in manual, identified by product name, indexed to the content of the volume, and cross-referenced to Specification Section number in Project Manual.

1. If operation or maintenance documentation requires more than one volume to accommodate data, include comprehensive table of contents for all volumes in each volume of the set.

D. Manual Contents: Organize into sets of manageable size. Arrange contents alphabetically by system, subsystem, and equipment. If possible, assemble instructions for subsystems, equipment, and components of one system into a single binder.

E. Identification: In the documentation directory and in each operation and maintenance manual, identify each system, subsystem, and piece of equipment with same designation used in the Contract Documents. If no designation exists, assign a designation according to ASHRAE Guideline 4, "Preparation of Operating and Maintenance Documentation for Building Systems."

1.7 OPERATION AND MAINTENANCE DOCUMENTATION DIRECTORY MANUAL

A. Operation and Maintenance Documentation Directory: Prepare a separate manual that provides an organized reference to emergency, operation, and maintenance manuals. List items and their location to facilitate ready access to desired information. Include the following:

1. List of Systems and Subsystems: List systems alphabetically. Include references to operation and maintenance manuals that contain information about each system.
2. List of Equipment: List equipment for each system, organized alphabetically by system. For pieces of equipment not part of system, list alphabetically in separate list.
3. Tables of Contents: Include a table of contents for each emergency, operation, and maintenance manual.

1.8 SYSTEMS AND EQUIPMENT OPERATION MANUALS

A. Systems and Equipment Operation Manual: Assemble a complete set of data indicating operation of each system, subsystem, and piece of equipment not part of a system. Include information required for daily operation and management, operating standards, and routine and special operating procedures.

1. Engage a factory-authorized service representative to assemble and prepare information for each system, subsystem, and piece of equipment not part of a system.
2. Prepare a separate manual for each system and subsystem, in the form of an instructional manual for use by Owner's operating personnel.

B. Content: In addition to requirements in this Section, include operation data required in individual Specification Sections and the following information:

1. System, subsystem, and equipment descriptions. Use designations for systems and equipment indicated on Contract Documents.

2. Performance and design criteria if Contractor has delegated design responsibility.
3. Operating standards.
4. Operating procedures.
5. Operating logs.
6. Wiring diagrams.
7. Control diagrams.
8. Piped system diagrams.
9. Precautions against improper use.
10. License requirements including inspection and renewal dates.

C. Descriptions: Include the following:

1. Product name and model number. Use designations for products indicated on Contract Documents.
2. Manufacturer's name.
3. Equipment identification with serial number of each component.
4. Equipment function.
5. Operating characteristics.
6. Limiting conditions.
7. Performance curves.
8. Engineering data and tests.
9. Complete nomenclature and number of replacement parts.

D. Operating Procedures: Include the following, as applicable:

1. Startup procedures.
2. Equipment or system break-in procedures.
3. Routine and normal operating instructions.
4. Regulation and control procedures.
5. Instructions on stopping.
6. Normal shutdown instructions.
7. Seasonal and weekend operating instructions.
8. Required sequences for electric or electronic systems.
9. Special operating instructions and procedures.

E. Systems and Equipment Controls: Describe the sequence of operation, and diagram controls as installed.

F. Piped Systems: Diagram piping as installed, and identify color coding where required for identification.

1.9 PRODUCT MAINTENANCE MANUALS

A. Product Maintenance Manual: Assemble a complete set of maintenance data indicating care and maintenance of each product, material, and finish incorporated into the Work.

B. Content: Organize manual into a separate section for each product, material, and finish. Include source information, product information, maintenance procedures, repair materials and sources, and warranties and bonds, as described below.

C. Source Information: List each product included in manual, identified by product name and arranged to match manual's table of contents. For each product, list name, address, and telephone number of Installer or supplier and maintenance service agent, and cross-reference Specification Section number and title in Project Manual and drawing or schedule designation or identifier where applicable.

D. Product Information: Include the following, as applicable:

1. Product name and model number.
2. Manufacturer's name.
3. Color, pattern, and texture.
4. Material and chemical composition.
5. Reordering information for specially manufactured products.

E. Maintenance Procedures: Include manufacturer's written recommendations and the following:

1. Inspection procedures.
2. Types of cleaning agents to be used and methods of cleaning.
3. List of cleaning agents and methods of cleaning detrimental to product.
4. Schedule for routine cleaning and maintenance.
5. Repair instructions.

F. Repair Materials and Sources: Include lists of materials and local sources of materials and related services.

G. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.

1. Include procedures to follow and required notifications for warranty claims.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 017823

SECTION 017839 - PROJECT RECORD DOCUMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes administrative and procedural requirements for Project Record Documents, including the following:

1. Record Drawings.
2. Record Specifications.
3. Record Product Data.

B. Related Sections include the following:

1. Section 017700 "Closeout Procedures" for general closeout procedures.
2. Section 017823 "Operation and Maintenance Data" for operation and maintenance manual requirements Divisions 02 through 49 Sections for specific requirements for Project Record Documents of the Work in those Sections.

1.3 SUBMITTALS

A. Record Drawings: Comply with the following:

1. Number of Copies: Submit one set(s) of marked-up Record Prints.

B. Record Product Data: Submit one copy of each Product Data submittal.

1. Where Record Product Data is required as part of operation and maintenance manuals, submit marked-up Product Data as an insert in manual instead of submittal as Record Product Data.

PART 2 - PRODUCTS

2.1 RECORD DRAWINGS

A. Record Prints: Maintain one set of blue- or black-line white prints of the Contract Drawings and Shop Drawings.

1. Preparation: Mark Record Prints to show the actual installation where installation varies from that shown originally. Require individual or entity who obtained record data, whether individual or entity is Installer, subcontractor, or similar entity, to prepare the marked-up Record Prints.

    a. Give particular attention to information on concealed elements that would be difficult to identify or measure and record later.
    b. 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.

2. Content: Types of items requiring marking include, but are not limited to, the following:

    a. Dimensional changes to Drawings.
    b. Revisions to details shown on Drawings.
    c. Depths of foundations below first floor.
    d. Revisions to routing of piping and conduits.
    e. Revisions to electrical circuitry.
    f. Actual equipment locations.
    g. Changes made by Change Order or Construction Change Directive.
    h. Changes made following Architect's written orders.
    i. Details not on the original Contract Drawings.
    j. Field records for variable and concealed conditions.
    k. Record information on the Work that is shown only schematically.

3. Mark the Contract Drawings or Shop Drawings, whichever is most capable of showing actual physical conditions, completely and accurately. If Shop Drawings are marked, show cross-reference on the Contract Drawings.
4. Mark record sets with erasable, red-colored pencil. Use other colors to distinguish between changes for different categories of the Work at same location.
5. Mark important additional information that was either shown schematically or omitted from original Drawings.
6. Note Construction Change Directive numbers, alternate numbers, Change Order numbers, and similar identification, where applicable.

B. Format: Identify and date each Record Drawing; include the designation "PROJECT RECORD DRAWING" in a prominent location.

1. Record Prints: Organize Record Prints into manageable sets. Bind each set with durable paper cover sheets. Include identification on cover sheets.
2. Identification: As follows:

    a. Project name.
    b. Date.
    c. Designation "PROJECT RECORD DRAWINGS."
    d. Name of Architect.
    e. Name of Contractor.

2.2 RECORD PRODUCT DATA

A. Preparation: Mark Product Data to indicate the actual product installation where installation varies substantially from that indicated in Product Data submittal.

1. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.
2. Include significant changes in the product delivered to Project site and changes in manufacturer's written instructions for installation.
3. Note related Change Orders, Record Specifications, and Record Drawings where applicable.

2.3 MISCELLANEOUS RECORD SUBMITTALS

A. Assemble miscellaneous records required by other Specification Sections for miscellaneous record keeping and submittal in connection with actual performance of the Work. Bind or file miscellaneous records and identify each, ready for continued use and reference.

PART 3 - EXECUTION

3.1 RECORDING AND MAINTENANCE

A. Recording: Maintain one copy of each submittal during the construction period for Project Record Document purposes. Post changes and modifications to Project Record Documents as they occur; do not wait until the end of Project.

B. Maintenance of Record Documents and Samples: Store Record Documents and Samples in the field office apart from the Contract Documents used for construction. Do not use Project Record Documents for construction purposes. Maintain Record Documents in good order and in a clean, dry, legible condition, protected from deterioration and loss. Provide access to Project Record Documents for Architect's reference during normal working hours.

END OF SECTION 017839

SECTION 024119 - 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.
2. Salvage of existing items to be reused or recycled.

B. Related Requirements:

1. Section 011000 "Summary" for restrictions on use of the premises, Owner-occupancy requirements, and phasing requirements.
2. Sections 013516 “Alteration Project Procedures” and 017300 "Execution" for cutting and patching procedures.
3. Section 013516 "Alteration Project Procedures" for general protection and work procedures for alteration projects.

1.3 DEFINITIONS

A. Remove: Detach items from existing construction and dispose of them off-site unless indicated to be salvaged or reinstalled.

B. Remove and Reinstall: Detach items from existing construction, in a manner to prevent damage, prepare for reuse, and reinstall where indicated.

C. Existing to Remain: Leave existing items that are not to be removed and that are not otherwise indicated to be salvaged or reinstalled.

D. Dismantle: To remove by disassembling or detaching an item from a surface, using gentle methods and equipment to prevent damage to the item and surfaces; disposing of items unless indicated to be salvaged or reinstalled.

1.4 MATERIALS OWNERSHIP

A. Unless otherwise indicated, demolition waste becomes property of Contractor.

B. Items identified for salvage shall 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. Proposed Protection Measures: Submit report that indicates the measures proposed for protecting individuals and property, for dust control. Indicate proposed locations and construction of barriers.

B. 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.

C. Predemolition Photographs or Video: Show existing conditions of rooftop equipment and adjoining construction, including finish surfaces, that might be misconstrued as damage caused by demolition operations. Comply with Section 013233 "Photographic Documentation." Submit before Work begins.

1.7 CLOSEOUT SUBMITTALS

A. Inventory: Submit a list of items that have been removed and salvaged.

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. Notify Architect of discrepancies between existing conditions and Drawings before proceeding with selective demolition.

C. Hazardous Materials: It is not expected that hazardous materials will be encountered in the Work..

1. 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.

D. 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 COORDINATION

A. Arrange selective demolition schedule so as not to interfere with Owner's operations.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Regulatory Requirements: Comply with governing EPA notification regulations before beginning selective demolition. Comply with hauling and disposal regulations of authorities having jurisdiction.

B. Standards: Comply with 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 Project Record Documents of existing construction or other existing condition and hazardous material information provided by Owner. Owner does not guarantee that existing conditions are same as those indicated in Project Record Documents.

C. Verify that hazardous materials have been remediated before proceeding with building demolition operations.

D. Survey of Existing Conditions: Record existing conditions by use of measured drawings and preconstruction photographs or video.

1. Comply with requirements specified in Section 013233 "Photographic Documentation."
2. Inventory and record the condition of items to be removed and salvaged. Provide photographs or video of conditions that might be misconstrued as damage caused by salvage operations.
3. Before selective demolition or removal of existing building elements that will be reproduced or duplicated in final Work, make permanent record of measurements, materials, and construction details required to make exact reproduction.

3.2 PREPARATION

A. Refrigerant: Before starting demolition, remove refrigerant from mechanical equipment according to 40 CFR 82 and regulations of authorities having jurisdiction.

3.3 UTILITY SERVICES AND MECHANICAL/ELECTRICAL SYSTEMS

A. Existing Services/Systems to Remain: Maintain services/systems indicated to remain and protect them against damage.

A. Existing Services/Systems to Be Removed, Relocated, or Abandoned: Locate, identify, disconnect, and seal or cap off 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 on Drawings 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 and leave in place.
    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 and leave in place.

3.4 PROTECTION

A. Temporary Protection: 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. Protect walls, ceilings, floors, and other existing finish work that are to remain or that are exposed during selective demolition operations.
3. Cover and protect furniture, furnishings, and equipment that have not been removed.
4. Comply with requirements for temporary enclosures, dust control specified in Section 015000 "Temporary Facilities and Controls."

B. Temporary Shoring: Design, 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.

C. Remove temporary barricades and protections where hazards no longer exist.

3.5 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. 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 portable fire-suppression devices during flame-cutting operations.
5. Maintain fire watch during and for at least two hours after flame-cutting operations.
6. Maintain adequate ventilation when using cutting torches.
7. Remove decayed, vermin-infested, or otherwise dangerous or unsuitable materials and promptly dispose of off-site.

8. Remove structural framing members and lower to ground by method suitable to avoid free fall and to prevent ground impact or dust generation.
9. Locate selective demolition equipment and remove debris and materials so as not to impose excessive loads on supporting walls, floors, or framing.
10. Dispose of demolished items and materials promptly. Comply with requirements in Section 017419 "Construction Waste Management and Disposal."

B. 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.

C. Removed and Salvaged Items:

1. Clean salvaged items.
2. Transport items to Owner's storage area on-site designated by Owner.
3. Protect items from damage during transport and storage.

D. Removed and Reinstalled Items:

1. Protect items from damage during transport and storage.
2. 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.

3.6 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. Masonry: Demolish in small sections. Cut masonry at junctures with construction to remain, using power-driven saw, and then remove masonry between saw cuts.

C. Concrete Slabs-on-Grade: Saw-cut perimeter of area to be demolished, and then break up and remove.

D. Resilient Floor Coverings: Remove floor coverings and adhesive according to recommendations in RFCI's "Recommended Work Practices for the Removal of Resilient Floor Coverings."

3.7 DISPOSAL OF DEMOLISHED MATERIALS

A. Remove demolition waste materials from Project site and recycle or dispose of them according to Section 017419 "Construction Waste Management and Disposal."

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.

3.8 CLEANING

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

3.9 SELECTIVE DEMOLITION SCHEDULE

A. See construction drawings and specification for scope of work.

END OF SECTION 024119

SECTION 042200 - CONCRETE UNIT MASONRY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Concrete masonry units.
2. Mortar and grout.
3. Steel reinforcing bars.
4. Masonry-joint reinforcement.

1.3 DEFINITIONS

A. CMU(s): Concrete masonry unit(s).

B. Reinforced Masonry: Masonry containing reinforcing steel in grouted cells.

1.4 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For the following:

1. Masonry Units: Show sizes, profiles, coursing, and locations of special shapes.
2. Reinforcing Steel: Detail bending, lap lengths, and placement of unit masonry reinforcing bars. Comply with ACI 315. Show elevations of reinforced walls.

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For testing agency.

B. Material Certificates: For each type and size of the following:

1. Masonry units.

a. Include material test reports substantiating compliance with requirements.
b. For masonry units, include data and calculations establishing average net-area compressive strength of units.

C. Mix Designs: For each type of mortar. Include description of type and proportions of ingredients.

1. Include test reports for mortar mixes required to comply with property specification. Test according to ASTM C 109/C 109M for compressive strength, ASTM C 1506 for water retention, and ASTM C 91/C 91M for air content.
2. Include test reports, according to ASTM C 1019, for grout mixes required to comply with compressive strength requirement.

D. Statement of Compressive Strength of Masonry: For each combination of masonry unit type and mortar type, provide statement of average net-area compressive strength of masonry units, mortar type, and resulting net-area compressive strength of masonry determined according to TMS 602/ACI 530.1/ASCE 6.

E. Cold-Weather and Hot-Weather Procedures: Detailed description of methods, materials, and equipment to be used to comply with requirements.

1.7 QUALITY ASSURANCE

A. Testing Agency Qualifications: Qualified according to ASTM C 1093 for testing indicated.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Store masonry units on elevated platforms in a dry location. If units are not stored in an enclosed location, cover tops and sides of stacks with waterproof sheeting, securely tied. If units become wet, do not install until they are dry.

B. Store cementitious materials on elevated platforms, under cover, and in a dry location. Do not use cementitious materials that have become damp.

C. Store aggregates where grading and other required characteristics can be maintained and contamination avoided.

D. Deliver preblended, dry mortar mix in moisture-resistant containers. Store preblended, dry mortar mix in delivery containers on elevated platforms in a dry location or in covered weatherproof dispensing silos.

E. Store masonry accessories, including metal items, to prevent corrosion and accumulation of dirt and oil.

1.9 FIELD CONDITIONS

A. Do not apply uniform floor or roof loads for at least 12 hours and concentrated loads for at least three days after building masonry walls or columns.

B. Stain Prevention: Prevent grout, mortar, and soil from staining the face of masonry to be left exposed or painted. Immediately remove grout, mortar, and soil that come in contact with such masonry.

1. Protect base of walls from mortar splatter by spreading coverings on floor 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.

C. Cold-Weather Requirements: Do not use frozen materials or materials mixed or coated with ice or frost. Do not build on frozen substrates. Remove and replace unit masonry damaged by frost or by freezing conditions. Comply with cold-weather construction requirements contained in TMS 602/ACI 530.1/ASCE 6.

1. Cold-Weather Cleaning: Use liquid cleaning methods only when air temperature is 40 deg F (4 deg C) and higher and will remain so until masonry has dried, but not less than seven days after completing cleaning.

D. Hot-Weather Requirements: Comply with hot-weather construction requirements contained in TMS 602/ACI 530.1/ASCE 6.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Source Limitations for Masonry Units: Obtain exposed masonry units of a uniform texture and color, or a uniform blend within the ranges accepted for these characteristics, from single source from single manufacturer for each product required.

B. Source Limitations for Mortar Materials: Obtain mortar ingredients of a uniform quality, including color for exposed masonry, from single manufacturer for each cementitious component and from single source or producer for each aggregate.

2.2 UNIT MASONRY, GENERAL

A. Masonry Standard: Comply with TMS 602/ACI 530.1/ASCE 6 except as modified by requirements in the Contract Documents.

B. Defective Units: Referenced masonry unit standards may allow a certain percentage of units to contain chips, cracks, or other defects exceeding limits stated. Do not use units where such defects are exposed in the completed Work.

C. Fire-Resistance Ratings: Comply with requirements for fire-resistance-rated assembly designs indicated.

1. Where fire-resistance-rated construction is indicated, units shall be listed and labeled by a qualified testing agency acceptable to authorities having jurisdiction.

2.3 CONCRETE MASONRY UNITS

A. Shapes: Provide shapes indicated and as follows, with exposed surfaces matching exposed faces of adjacent units unless otherwise indicated.

1. Provide special shapes for lintels, corners, jambs, sashes, movement joints, headers, bonding, and other special conditions.
2. Provide square-edged and bullnose units for outside corners as indicated.

B. CMUs: ASTM C 90.

1. Unit Compressive Strength: Provide units with minimum average net-area compressive strength of 2150 psi Use higher strength masonry as required to meet minimum f′m strength indicated.
2. Density Classification: Normal weight unless otherwise indicated.
3. Size (Width): Manufactured to dimensions 3/8 inch (10 mm) less-than-nominal dimensions.

2.4 MORTAR AND GROUT MATERIALS

A. Portland Cement: ASTM C 150/C 150M, Type I or II, except Type III may be used for cold-weather construction. Provide natural color or white cement as required to produce mortar color indicated.

1. Alkali content shall not be more than 0.1 percent when tested according to ASTM C 114.

B. Hydrated Lime: ASTM C 207, Type S.

C. Portland Cement-Lime Mix: Packaged blend of portland cement and hydrated lime containing no other ingredients.

D. Masonry Cement: ASTM C 91/C 91M.

E. Mortar Cement: ASTM C 1329/C 1329M.

F. Aggregate for Mortar: ASTM C 144.

1. For mortar that is exposed to view, use washed aggregate consisting of natural sand or crushed stone.
2. White-Mortar Aggregates: Natural white sand or crushed white stone.
3. Colored-Mortar Aggregates: Natural sand or crushed stone of color necessary to produce required mortar color.

G. Aggregate for Grout: ASTM C 404.

H. Cold-Weather Admixture: Nonchloride, noncorrosive, accelerating admixture complying with ASTM C 494/C 494M, Type C, and recommended by manufacturer for use in masonry mortar of composition indicated.

I. Water: Potable.

2.5 REINFORCEMENT

A. Uncoated Steel Reinforcing Bars: ASTM A 615/A 615M or ASTM A 996/A 996M, Grade 60 (Grade 420).

B. Reinforcing Bar Positioners: Wire units designed to fit into mortar bed joints spanning masonry unit cells and to hold reinforcing bars in center of cells. Units are formed from 0.148-inch (3.77-mm) steel wire, hot-dip galvanized after fabrication. Provide units designed for number of bars indicated.

C. Masonry-Joint Reinforcement, General: ASTM A 951/A 951M.

1. Interior Walls: Hot-dip galvanized carbon steel.
2. Exterior Walls: Hot-dip galvanized carbon steel.
3. Wire Size for Side Rods: 0.187-inch diameter.
4. Wire Size for Cross Rods: 9 gauge thickness.
5. Wire Size for Veneer Ties: 0.187-inch diameter.
6. Spacing of Cross Rods, Tabs, and Cross Ties: Not more than 16 inches o.c.
7. Provide in lengths of not less than 10 feet , with prefabricated corner and tee units.

D. Masonry-Joint Reinforcement for Single-Wythe Masonry: Truss type with single pair of side rods.

2.6 TIES AND ANCHORS

A. General: Ties and anchors shall extend at least 1-1/2 inches (38 mm) into masonry but with at least a 5/8-inch (16-mm) cover on outside face.

B. Materials: Provide ties and anchors specified in this article that are made from materials that comply with the following unless otherwise indicated:

1. Hot-Dip Galvanized, Carbon-Steel Wire: ASTM A 82/A 82M, with ASTM A 153/A 153M, Class B-2 coating.
2. Steel Sheet, Galvanized after Fabrication: ASTM A 1008/A 1008M, Commercial Steel, with ASTM A 153/A 153M, Class B coating.
3. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.

C. Adjustable Masonry-Veneer Anchors:

1. General: Provide anchors that allow vertical adjustment but resist a 100-lbf load in both tension and compression perpendicular to plane of wall without deforming or developing play in excess of 1/16 inch.
2. Fabricate sheet metal anchor sections and other sheet metal parts from 0.075-inch thick steel sheet, galvanized after fabrication.
3. Fabricate wire ties from 0.187-inch diameter, hot-dip galvanized-steel wire unless otherwise indicated.
4. Contractor's Option: Unless otherwise indicated, provide any of the adjustable masonry-veneer anchors specified.
5. Screw-Attached, Masonry-Veneer Anchors: Wire tie and a rib-stiffened, sheet metal anchor section with screw holes top and bottom, with a projecting vertical tab having a slotted hole for inserting wire tie.

6. Screw-Attached, Masonry-Veneer Anchors: Wire tie and a rib-stiffened, sheet metal anchor section with screw holes top and bottom, with projecting tabs having holes for inserting vertical legs of wire tie formed to fit anchor section.

7. Screw-Attached, Masonry-Veneer Anchors: Wire tie and a sheet metal anchor section, 1-1/4 inches wide by 9 inches long, with screw holes top and bottom and with raised rib-stiffened strap, 5/8 inch wide by 5-1/2 inches long, stamped into center to provide a slot between strap and base for inserting wire tie.

8. Screw-Attached, Masonry-Veneer Anchors: Wire tie and a sheet metal anchor section, 1-1/4 inches (32 mm) wide by 6 inches (152 mm) long, with screw holes top and bottom and with raised rib-stiffened strap, 5/8 inch (16 mm) wide by 3-5/8 inches (92 mm) long, stamped into center to provide a slot between strap and base for inserting wire tie.

9. Polymer-Coated, Steel Drill Screws for Steel Studs: ASTM C 954 except manufactured with hex washer head and neoprene or EPDM washer, No. 10 (4.83-mm) diameter by length required to penetrate steel stud flange with not less than three exposed threads, and with organic polymer coating with salt-spray resistance to red rust of more than 800 hours according to ASTM B 117.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

1. For the record, prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.
2. Verify that foundations are within tolerances specified.
3. Verify that reinforcing dowels are properly placed.
4. Verify that substrates are free of substances that would impair mortar bond.

B. Before installation, examine rough-in and built-in construction for piping systems to verify actual locations of piping.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

A. Thickness: Build cavity and composite walls and other masonry construction to full thickness shown. Build single-wythe walls to actual widths of masonry units, using units of widths indicated.

B. Build chases and recesses to accommodate items specified in this and other Sections.

C. Leave openings for equipment to be installed before completing masonry. After installing equipment, complete masonry to match construction immediately adjacent to opening.

D. Use full-size units without cutting if possible. If cutting is required to provide a continuous pattern or to fit adjoining construction, cut units with motor-driven saws; provide clean, sharp, unchipped edges. Allow units to dry before laying unless wetting of units is specified. Install cut units with cut surfaces and, where possible, cut edges concealed.

E. Matching Existing Masonry: Match coursing, bonding, color, and texture of existing masonry.

3.3 TOLERANCES

A. Dimensions and Locations of Elements:

1. For dimensions in cross section or elevation, do not vary by more than plus 1/2 inch (12 mm) or minus 1/4 inch (6 mm).
2. For location of elements in plan, do not vary from that indicated by more than plus or minus 1/2 inch (12 mm).
3. For location of elements in elevation, do not vary from that indicated by more than plus or minus 1/4 inch (6 mm) in a story height or 1/2 inch (12 mm) total.

B. Lines and Levels:

1. For bed joints and top surfaces of bearing walls, do not vary from level by more than 1/4 inch in 10 feet (6 mm in 3 m), or 1/2-inch (12-mm) maximum.
2. For conspicuous horizontal lines, such as lintels, sills, parapets, and reveals, do not vary from level by more than 1/8 inch in 10 feet (3 mm in 3 m), 1/4 inch in 20 feet (6 mm in 6 m), or 1/2-inch (12-mm) maximum.
3. For vertical lines and surfaces do not vary from plumb by more than 1/4 inch in 10 feet (6 mm in 3 m), 3/8 inch in 20 feet (9 mm in 6 m), or 1/2-inch (12-mm) maximum.
4. For conspicuous vertical lines, such as external corners, door jambs, reveals, and expansion and control joints, do not vary from plumb by more than 1/8 inch in 10 feet (3 mm in 3 m), 1/4 inch in 20 feet (6 mm in 6 m), or 1/2-inch (12-mm) maximum.
5. For lines and surfaces, do not vary from straight by more than 1/4 inch in 10 feet (6 mm in 3 m), 3/8 inch in 20 feet (9 mm in 6 m), or 1/2-inch (12-mm) maximum.
6. For vertical alignment of exposed head joints, do not vary from plumb by more than 1/4 inch in 10 feet (6 mm in 3 m), or 1/2-inch (12-mm) maximum.

7. For faces of adjacent exposed masonry units, do not vary from flush alignment by more than 1/16 inch (1.5 mm).

C. Joints:

1. For bed joints, do not vary from thickness indicated by more than plus or minus 1/8 inch (3 mm), with a maximum thickness limited to 1/2 inch (12 mm).
2. For exposed bed joints, do not vary from bed-joint thickness of adjacent courses by more than 1/8 inch (3 mm).
3. For head and collar joints, do not vary from thickness indicated by more than plus 3/8 inch (9 mm) or minus 1/4 inch (6 mm).
4. For exposed head joints, do not vary from thickness indicated by more than plus or minus 1/8 inch (3 mm).
5. For exposed bed joints and head joints of stacked bond, do not vary from a straight line by more than 1/16 inch from one masonry unit to the next.

3.4 LAYING MASONRY WALLS

A. Lay out walls in advance for accurate spacing of surface bond patterns with uniform joint thicknesses and for accurate location of openings, movement-type joints, returns, and offsets. Avoid using less-than-half-size units, particularly at corners, jambs, and, where possible, at other locations.

B. Bond Pattern for Exposed Masonry: Unless otherwise indicated, lay exposed masonry in bond pattern matching existing; do not use units with less-than-nominal 4-inch (100-mm) horizontal face dimensions at corners or jambs.

C. Lay concealed masonry with all units in a wythe in running bond or bonded by lapping not less than 2 inches (50 mm). Bond and interlock each course of each wythe at corners. Do not use units with less-than-nominal 4-inch (100-mm) horizontal face dimensions at corners or jambs.

D. Stopping and Resuming Work: Stop work by stepping back units in each course from those in course below; do not tooth. When resuming work, clean masonry surfaces that are to receive mortar, remove loose masonry units and mortar, and wet brick if required before laying fresh masonry.

E. Built-in Work: As construction progresses, build in items specified in this and other Sections. Fill in solidly with masonry around built-in items.

F. Fill space between steel frames and masonry solidly with mortar unless otherwise indicated.

G. Where built-in items are to be embedded in cores of hollow masonry units, place a layer of metal lath, wire mesh, or plastic mesh in the joint below, and rod mortar or grout into core.

H. Fill cores in hollow CMUs with grout 24 inches (600 mm) under bearing plates, beams, lintels, posts, and similar items unless otherwise indicated.

3.5 MORTAR BEDDING AND JOINTING

A. Lay hollow CMUs as follows:

1. Bed face shells in mortar and make head joints of depth equal to bed joints.
2. Bed webs in mortar in all courses of piers, columns, and pilasters.
3. Bed webs in mortar in grouted masonry, including starting course on footings.
4. Fully bed entire units, including areas under cells, at starting course on footings where cells are not grouted.
5. Fully bed units and fill cells with mortar at anchors and ties as needed to fully embed anchors and ties in mortar.

B. Lay solid CMUs with completely filled bed and head joints; butter ends with sufficient mortar to fill head joints and shove into place. Do not deeply furrow bed joints or slush head joints.

C. Tool exposed joints slightly concave when thumbprint hard, using a jointer larger than joint thickness unless otherwise indicated.

D. Cut joints flush for masonry walls to receive plaster or other direct-applied finishes (other than paint) unless otherwise indicated.

3.6 MASONRY-JOINT REINFORCEMENT

A. General: Install entire length of longitudinal side rods in mortar with a minimum cover of 5/8 inch on exterior side of walls, 1/2 inch elsewhere. Lap reinforcement a minimum of 6 inches.

1. Space reinforcement not more than 16 inches o.c.
2. Space reinforcement not more than 8 inches o.c. in foundation walls and parapet walls.
3. Provide reinforcement not more than 8 inches above and below wall openings and extending 12 inches beyond openings.

B. Interrupt joint reinforcement at control and expansion joints unless otherwise indicated.

C. Provide continuity at wall intersections by using prefabricated T-shaped units.

D. Provide continuity at corners by using prefabricated L-shaped units.

E. Cut and bend reinforcing units as directed by manufacturer for continuity at corners, returns, offsets, column fireproofing, pipe enclosures, and other special conditions.

3.7 CONTROL AND EXPANSION JOINTS

A. General: Install control- and expansion-joint materials in unit masonry as masonry progresses. Do not allow materials to span control and expansion joints without provision to allow for in-plane wall or partition movement.

B. Form control joints in concrete masonry using one of the following methods:

1. Fit bond-breaker strips into hollow contour in ends of CMUs on one side of control joint. Fill resultant core with grout, and rake out joints in exposed faces for application of sealant.
2. Install preformed control-joint gaskets designed to fit standard sash block.
3. Install interlocking units designed for control joints. Install bond-breaker strips at joint. Keep head joints free and clear of mortar, or rake out joint for application of sealant.
4. Install temporary foam-plastic filler in head joints, and remove filler when unit masonry is complete for application of sealant.

3.8 REINFORCED UNIT MASONRY INSTALLATION

A. Temporary Formwork and Shores: Construct formwork and shores as needed to support reinforced masonry elements during construction.

1. Construct formwork to provide shape, line, and dimensions of completed masonry as indicated. Make forms sufficiently tight to prevent leakage of mortar and grout. Brace, tie, and support forms to maintain position and shape during construction and curing of reinforced masonry.
2. Do not remove forms and shores until reinforced masonry members have hardened sufficiently to carry their own weight and other loads that may be placed on them during construction.

B. Placing Reinforcement: Comply with requirements in TMS 602/ACI 530.1/ASCE 6.

C. Grouting: Do not place grout until entire height of masonry to be grouted has attained enough strength to resist grout pressure.

1. Comply with requirements in TMS 602/ACI 530.1/ASCE 6 for cleanouts and for grout placement, including minimum grout space and maximum pour height.
2. Limit height of vertical grout pours to not more than 60 inches (1520 mm).

3.9 REPAIRING, POINTING, AND CLEANING

A. Remove and replace masonry units that are loose, chipped, broken, stained, or otherwise damaged or that do not match adjoining units. Install new units to match adjoining units; install in fresh mortar, pointed to eliminate evidence of replacement.

B. Pointing: During the tooling of joints, enlarge voids and holes, except weep holes, and completely fill with mortar. Point up joints, including corners, openings, and adjacent construction, to provide a neat, uniform appearance. Prepare joints for sealant application, where indicated.

C. In-Progress Cleaning: Clean unit masonry as work progresses by dry brushing to remove mortar fins and smears before tooling joints.

D. Final Cleaning: After mortar is thoroughly set and cured, clean exposed masonry as follows:

1. Remove large mortar particles by hand with wooden paddles and nonmetallic scrape hoes or chisels.
2. Test cleaning methods on sample wall panel; leave one-half of panel uncleaned for comparison purposes. Obtain Architect's approval of sample cleaning before proceeding with cleaning of masonry.
3. Protect adjacent stone and nonmasonry surfaces from contact with cleaner by covering them with liquid strippable masking agent or polyethylene film and waterproof masking tape.
4. Wet wall surfaces with water before applying cleaners; remove cleaners promptly by rinsing surfaces thoroughly with clear water.
5. Clean concrete masonry by applicable cleaning methods indicated in NCMA TEK 8-4A.

3.10 MASONRY WASTE DISPOSAL

A. Salvageable Materials: Unless otherwise indicated, excess masonry materials are Contractor's property. At completion of unit masonry work, remove from Project site.

B. Excess Masonry Waste: Remove excess clean masonry waste that cannot be used as fill, as described above or recycled, and other masonry waste, and legally dispose of off Owner's property.

END OF SECTION 042200

SECTION 061053 - MISCELLANEOUS ROUGH CARPENTRY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:
   1. Wood blocking and nailers.
   2. Wood sleepers.

1.3 DEFINITIONS

A. Boards or Strips: Lumber of less than 2 inches nominal (38 mm actual) size in least dimension.

B. Dimension Lumber: Lumber of 2 inches nominal (38 mm actual) or greater size but less than 5 inches nominal (114 mm actual) size in least dimension.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of process and factory-fabricated product. Indicate component materials and dimensions and include construction and application details.

   1. Include data for wood-preservative treatment from chemical treatment manufacturer and certification by treating plant that treated materials comply with requirements. Indicate type of preservative used and net amount of preservative retained.
   2. Include data for fire-retardant treatment from chemical treatment manufacturer and certification by treating plant that treated materials comply with requirements. Include physical properties of treated materials based on testing by a qualified independent testing agency.
   3. For fire-retardant treatments, include physical properties of treated lumber both before and after exposure to elevated temperatures, based on testing by a qualified independent testing agency according to ASTM D 5664.
   4. For products receiving a waterborne treatment, include statement that moisture content of treated materials was reduced to levels specified before shipment to Project site.

1.5 INFORMATIONAL SUBMITTALS

A. Evaluation Reports: For the following, from ICC-ES:

1. Preservative-treated wood.
2. Fire-retardant-treated wood.
3. Power-driven fasteners.
4. Powder-actuated fasteners.
5. Expansion anchors.
6. Metal framing anchors.

1.6 QUALITY ASSURANCE

A. Testing Agency Qualifications: For testing agency providing classification marking for fire-retardant-treated material, an inspection agency acceptable to authorities having jurisdiction that periodically performs inspections to verify that the material bearing the classification marking is representative of the material tested.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Stack lumber flat with spacers beneath and between each bundle to provide air circulation. Protect lumber from weather by covering with waterproof sheeting, securely anchored. Provide for air circulation around stacks and under coverings.

PART 2 - PRODUCTS

2.1 WOOD PRODUCTS, GENERAL

A. Lumber: DOC PS 20 and applicable rules of grading agencies indicated. If no grading agency is indicated, provide lumber that complies with the applicable rules of any rules-writing agency certified by the ALSC Board of Review. Provide lumber graded by an agency certified by the ALSC Board of Review to inspect and grade lumber under the rules indicated.

1. Factory mark each piece of lumber with grade stamp of grading agency.
2. For exposed lumber indicated to receive a stained or natural finish, mark grade stamp on end or back of each piece or omit grade stamp and provide certificates of grade compliance issued by grading agency.
3. Dress lumber, S4S, unless otherwise indicated.

B. Maximum Moisture Content of Lumber: 19 percent unless otherwise indicated.

2.2 WOOD-PRESERVATIVE-TREATED MATERIALS

A. Preservative Treatment by Pressure Process: AWPA U1; Use Category UC2 for interior construction not in contact with ground, Use Category UC3b for exterior construction not in contact with ground, and Use Category UC4a for items in contact with ground.

1. Preservative Chemicals: Acceptable to authorities having jurisdiction and containing no arsenic or chromium. Do not use inorganic boron (SBX) for sill plates.

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.

1. For exposed lumber indicated to receive a stained or natural finish, mark end or back of each piece or omit marking and provide certificates of treatment compliance issued by inspection agency.

D. Application: Treat items indicated on Drawings, and the following:

1. Wood cants, nailers, curbs, equipment support bases, blocking, stripping, and similar members in connection with roofing, flashing, vapor barriers, and waterproofing.
2. Wood sills, sleepers, blocking, and similar concealed members in contact with masonry or concrete.
3. Wood framing and furring attached directly to the interior of below-grade exterior masonry or concrete walls.

2.3 MISCELLANEOUS LUMBER

A. General: Provide miscellaneous lumber indicated and lumber for support or attachment of other construction, including the following:

1. Blocking.
2. Nailers.

B. Dimension Lumber Items: Construction or No. 2grade lumber of any of the following species:

1. Hem-fir (north); NLGA.
2. Mixed southern pine or southern pine; SPIB.
3. Spruce-pine-fir; NLGA.
4. Hem-fir; WCLIB or WWPA.
5. Spruce-pine-fir (south); NeLMA, WCLIB, or WWPA.

C. Concealed Boards: 19 percent maximum moisture content of any of the following species and grades:

1. Mixed southern pine or southern pine, No. 2 grade; SPIB.
2. Hem-fir or hem-fir (north), Construction or No. 2 Common grade; NLGA, WCLIB, or WWPA.
3. Spruce-pine-fir (south) or spruce-pine-fir, Construction or No. 2 Common grade; NeLMA, NLGA, WCLIB, or WWPA.

D. For blocking and nailers used for attachment of other construction, select and cut lumber to eliminate knots and other defects that will interfere with attachment of other work.

2.4 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 with hot-dip zinc coating complying with ASTM A 153/A 153M or of Type 304 stainless steel.

B. Nails, Brads, and Staples: ASTM F 1667.

C. Screws for Fastening to Metal Framing: ASTM C 1002 at non-load-bearing partitions and ASTM C 954 at cold formed metal framing, length as recommended by screw manufacturer for material being fastened.

D. Power-Driven Fasteners: Fastener systems with an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC70.

E. Wood Screws: ASME B18.6.1.

F. Screws for Fastening to Metal Framing: ASTM C 1002 at non-load-bearing partitions and ASTM C 954 at cold formed metal framing, length as recommended by screw manufacturer for material being fastened.

G. Lag Bolts: ASME B18.2.1 (ASME B18.2.3.8M).

H. Bolts: Steel bolts complying with ASTM A 307, Grade A (ASTM F 568M, Property Class 4.6); with ASTM A 563 (ASTM A 563M) hex nuts and, where indicated, flat washers.

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 (ASTM F 738M and ASTM F 836M, Grade A1 or A4).

2.5 METAL FRAMING ANCHORS

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. Cleveland Steel Specialty Co.
2. KC Metals Products, Inc.

3. Phoenix Metal Products, Inc.
4. Simpson Strong-Tie Co., Inc.
5. USP Structural Connectors.
6. or equal.

B. Galvanized-Steel Sheet: Hot-dip, zinc-coated steel sheet complying with ASTM A 653/A 653M, G60 (Z180) coating designation.

1. Use for interior locations unless otherwise indicated.

C. Hot-Dip, Heavy-Galvanized Steel Sheet: ASTM A 653/A 653M; Structural Steel (SS), high-strength low-alloy steel Type A (HSLAS Type A), or high-strength low-alloy steel Type B (HSLAS Type B); G185 (Z550) coating designation; and not less than 0.036 inch (0.9 mm) thick.

1. Use for wood-preservative-treated lumber and where indicated.

D. Stainless-Steel Sheet: ASTM A 666, Type 304.

1. Use for exterior locations and where indicated.

2.6 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. Flexible Flashing: Composite, self-adhesive, flashing product consisting of a pliable, butyl rubber or rubberized-asphalt compound, bonded to a high-density polyethylene film, aluminum foil, or spunbonded polyolefin to produce an overall thickness of not less than 0.025 inch (0.6 mm).

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Framing Standard: Comply with AF&PA's WCD 1, "Details for Conventional Wood Frame Construction," unless otherwise indicated.

B. Set carpentry to required levels and lines, with members plumb, true to line, cut, and fitted. Fit carpentry accurately to other construction. Locate nailers, blocking, and similar supports to comply with requirements for attaching other construction.

C. Install metal framing anchors to comply with manufacturer's written instructions. Install fasteners through each fastener hole.

D. Do not splice structural members between supports unless otherwise indicated.

E. Provide blocking and framing as indicated and as required to support facing materials, fixtures, specialty items, and trim.

1. Provide metal clips for fastening gypsum board or lath at corners and intersections where framing or blocking does not provide a surface for fastening edges of panels. Space clips not more than 16 inches (406 mm) o.c.

F. Sort and select lumber so that natural characteristics do 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.

G. 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.

H. Where wood-preservative-treated lumber is installed adjacent to metal decking, install continuous flexible flashing separator between wood and metal decking.

I. 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.
3. ICC-ES evaluation report for fastener.

J. Use steel common nails unless otherwise indicated. Select fasteners of size that will not fully penetrate members where opposite side will be exposed to view or will receive finish materials. Make tight connections between members. Install fasteners without splitting wood. Drive nails snug but do not countersink nail heads unless otherwise indicated.

3.2 WOOD BLOCKING AND NAILER INSTALLATION

A. Install where indicated and where required for attaching other work. Form to shapes indicated and cut as required for true line and level of attached work. Coordinate locations with other work involved.

B. Attach items to substrates to support applied loading. Recess bolts and nuts flush with surfaces unless otherwise indicated.

C. Provide additional thickness and/or number of courses required to provide continuous full-depth blocking at edges of tapered roof insulation and other locations where depth of blocking may vary to suit conditions.

3.3 PROTECTION

A. Protect miscellaneous rough carpentry from weather. If, despite protection, miscellaneous rough carpentry becomes wet, apply EPA-registered borate treatment. Apply borate solution by spraying to comply with EPA-registered label.

END OF SECTION 061053

SECTION 078413 - PENETRATION FIRESTOPPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Penetrations in fire-resistance-rated walls.
2. Penetrations in horizontal assemblies.
3. Penetrations in smoke barriers.

B. Related Requirements:

1. Division 21, 22, 23, 26, 27, and 28 Sections for penetrations in smoke- or fire-rated assemblies related to mechanical and electrical systems.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Product Schedule: For each penetration firestopping system. Include location, illustration of firestopping system, and design designation of qualified testing and inspecting agency.

1. Engineering Judgments: Where Project conditions require modification to a qualified testing and inspecting agency's illustration for a particular penetration firestopping system, submit illustration, with modifications marked, approved by penetration firestopping system manufacturer's fire-protection engineer as an engineering judgment or equivalent fire-resistance-rated assembly. Obtain approval of authorities having jurisdiction prior to submittal.

1.4 INFORMATIONAL SUBMITTALS

A. Product Test Reports: For each penetration firestopping system, for tests performed by a qualified testing agency.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: A firm that has been approved by FM Global according to FM Global 4991, "Approval of Firestop Contractors," or been evaluated by UL and found to comply with its "Qualified Firestop Contractor Program Requirements."

1.6 PROJECT CONDITIONS

A. Environmental Limitations: Do not install penetration firestopping system when ambient or substrate temperatures are outside limits permitted by penetration firestopping system manufacturers or when substrates are wet because of rain, frost, condensation, or other causes.

B. Install and cure penetration firestopping materials per manufacturer's written instructions using natural means of ventilations or, where this is inadequate, forced-air circulation.

1.7 COORDINATION

A. Coordinate construction of openings and penetrating items to ensure that penetration firestopping systems can be installed according to specified firestopping system design.

B. Coordinate sizing of sleeves, openings, core-drilled holes, or cut openings to accommodate penetration firestopping systems.

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. Grace Construction Products.
2. Hilti, Inc.
3. Johns Manville.
4. Nelson Firestop Products.
5. NUCO Inc.
6. 3M Fire Protection Products.
7. Tremco, Inc.; Tremco Fire Protection Systems Group.
8. USG Corporation.
9. or equal.

2.2 PERFORMANCE REQUIREMENTS

A. Fire-Test-Response Characteristics:

a. Penetration firestopping systems shall bear classification marking of a qualified testing agency.

1) UL in its "Fire Resistance Directory."
2) Intertek Group in its "Directory of Listed Building Products."
3) FM Global in its "Building Materials Approval Guide."

2.3 PENETRATION FIRESTOPPING SYSTEMS

A. Penetration Firestopping Systems: Systems that resist spread of fire, passage of smoke and other gases, and maintain original fire-resistance rating of construction penetrated. Penetration firestopping systems shall be compatible with one another, with the substrates forming openings, and with penetrating items if any.

B. Penetrations in Fire-Resistance-Rated Walls: Penetration firestopping systems with ratings determined per ASTM E 814 or UL 1479, based on testing at a positive pressure differential of 0.01-inch wg (2.49 Pa).

1. F-Rating: Not less than the fire-resistance rating of constructions penetrated.

C. Penetrations in Horizontal Assemblies: Penetration firestopping systems with ratings determined per ASTM E 814 or UL 1479, based on testing at a positive pressure differential of 0.01-inch wg (2.49 Pa).

1. F-Rating: At least one hour, but not less than the fire-resistance rating of constructions penetrated.
2. T-Rating: At least one hour, but not less than the fire-resistance rating of constructions penetrated except for floor penetrations within the cavity of a wall.
3. W-Rating: Provide penetration firestopping systems showing no evidence of water leakage when tested according to UL 1479.

D. Penetrations in Smoke Barriers: Penetration firestopping systems with ratings determined per UL 1479, based on testing at a positive pressure differential of 0.30-inch wg (74.7 Pa).

1. L-Rating: Not exceeding 5.0 cfm/sq. ft. (0.025 cu. m/s per sq. m) of penetration opening at and no more than 50-cfm (0.024-cu. m/s) cumulative total for any 100 sq. ft. (9.3 sq. m) at both ambient and elevated temperatures.

E. Exposed Penetration Firestopping Systems: Flame-spread and smoke-developed indexes of less than 25 and 450, respectively, per ASTM E 84.

F. Accessories: Provide components for each penetration firestopping system that are needed to install fill materials and to maintain ratings required. Use only those components specified by penetration firestopping system manufacturer and approved by qualified testing and inspecting agency for conditions indicated.

1. Permanent forming/damming/backing materials.

a. Slag-wool-fiber or rock-wool-fiber insulation.
b. Sealants used in combination with other forming/damming/backing materials to prevent leakage of fill materials in liquid state.
c. Fire-rated form board.

d. Fillers for sealants.

2. Temporary forming materials.
3. Substrate primers.
4. Collars.
5. Steel sleeves.

2.4 FILL MATERIALS

A. Cast-in-Place Firestop Devices: Factory-assembled devices for use in cast-in-place concrete floors and consisting of an outer sleeve lined with an intumescent strip, a flange attached to one end of the sleeve for fastening to concrete formwork, and a neoprene gasket.

B. Latex Sealants: Single-component latex formulations that do not re-emulsify after cure during exposure to moisture.

C. Firestop Devices: Factory-assembled collars formed from galvanized steel and lined with intumescent material sized to fit specific diameter of penetrant.

D. Intumescent Composite Sheets: Rigid panels consisting of aluminum-foil-faced intumescent elastomeric sheet bonded to galvanized-steel sheet.

E. Intumescent Putties: Nonhardening, water-resistant, intumescent putties containing no solvents or inorganic fibers.

F. Intumescent Wrap Strips: Single-component intumescent elastomeric sheets with aluminum foil on one side.

G. Mortars: Prepackaged dry mixes consisting of a blend of inorganic binders, hydraulic cement, fillers and lightweight aggregate formulated for mixing with water at Project site to form a nonshrinking, homogeneous mortar.

H. Pillows/Bags: Reusable heat-expanding pillows/bags consisting of glass-fiber cloth cases filled with a combination of mineral-fiber, water-insoluble expansion agents, and fire-retardant additives. Where exposed, cover openings with steel-reinforcing wire mesh to protect pillows/bags from being easily removed.

I. Silicone Foams: Multicomponent, silicone-based liquid elastomers that, when mixed, expand and cure in place to produce a flexible, nonshrinking foam.

J. Silicone Sealants: Single-component, silicone-based, neutral-curing elastomeric sealants.

1. Grade: Pourable (self-leveling) formulation for openings in floors and other horizontal surfaces, and nonsag formulation for openings in vertical and sloped surfaces, unless indicated firestopping limits use of nonsag grade for both opening conditions.

2.5 MIXING

A. Penetration Firestopping Materials: For those products requiring mixing before application, comply with penetration firestopping system manufacturer's written instructions for accurate proportioning of materials, water (if required), type of mixing equipment, selection of mixer speeds, mixing containers, mixing time, and other items or procedures needed to produce products of uniform quality with optimum performance characteristics for application indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Installer present, for compliance with requirements for opening configurations, penetrating items, substrates, and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

C. 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.

D. Coordinate an inspection of all Mechanical Firestopping systems with the Fire Marshal prior to installation of ceilings, walls, etc.

3.2 PREPARATION

A. Surface Cleaning: Before installing penetration firestopping systems, clean out openings immediately to comply with manufacturer's written instructions and with the following requirements:

1. Remove from surfaces of opening substrates and from penetrating items foreign materials that could interfere with adhesion of penetration firestopping materials.
2. Clean opening substrates and penetrating items to produce clean, sound surfaces capable of developing optimum bond with penetration firestopping materials. Remove loose particles remaining from cleaning operation.
3. Remove laitance and form-release agents from concrete.

B. Prime substrates where recommended in writing by manufacturer using that manufacturer's recommended products and methods. Confine primers to areas of bond; do not allow spillage and migration onto exposed surfaces.

C. Masking Tape: Use masking tape to prevent penetration firestopping from contacting adjoining surfaces that will remain exposed on completion of the Work and that would otherwise be permanently stained or damaged by such contact or by cleaning methods used to remove stains. Remove tape as soon as possible without disturbing firestopping's seal with substrates.

3.3 INSTALLATION

A. General: Install penetration firestopping systems to comply with manufacturer's written installation instructions and published drawings for products and applications.

B. Install forming materials and other accessories of types required to support fill materials during their application and in the position needed to produce cross-sectional shapes and depths required to achieve fire ratings.

1. After installing fill materials and allowing them to fully cure, remove combustible forming materials and other accessories not forming permanent components of firestopping.

C. Install fill materials by proven techniques to produce the following results:

1. Fill voids and cavities formed by openings, forming materials, accessories and penetrating items to achieve required fire-resistance ratings.
2. Apply materials so they contact and adhere to substrates formed by openings and penetrating items.
3. For fill materials that will remain exposed after completing the Work, finish to produce smooth, uniform surfaces that are flush with adjoining finishes.

3.4 IDENTIFICATION

A. Wall Identification: Permanently label walls containing penetration firestopping systems with the words "FIRE AND/OR SMOKE BARRIER - PROTECT ALL OPENINGS," using lettering not less than 3 inches (76 mm) high and with minimum 0.375-inch (9.5-mm) strokes.

1. Locate in accessible concealed floor, floor-ceiling, or attic space at 15 feet (4.57 m) from end of wall and at intervals not exceeding 30 feet (9.14 m).

B. Penetration Identification: Identify each penetration firestopping system with legible metal or plastic labels. Attach labels permanently to surfaces adjacent to and within 6 inches (150 mm) of penetration firestopping system edge so labels are visible to anyone seeking to remove penetrating items or firestopping systems. Use mechanical fasteners or self-adhering-type labels with adhesives capable of permanently bonding labels to surfaces on which labels are placed. Include the following information on labels:

1. The words "Warning - Penetration Firestopping - Do Not Disturb. Notify Building Management of Any Damage."

3.5 FIELD QUALITY CONTROL

A. Where deficiencies are found or penetration firestopping system is damaged or removed because of testing, repair or replace penetration firestopping system to comply with requirements.

B. Proceed with enclosing penetration firestopping systems with other construction only after inspection reports are issued and installations comply with requirements.

3.6 CLEANING AND PROTECTION

A. Clean off excess fill materials adjacent to openings as the Work progresses by methods and with cleaning materials that are approved in writing by penetration firestopping system manufacturers and that do not damage materials in which openings occur.

B. Provide final protection and maintain conditions during and after installation that ensure that penetration firestopping systems are without damage or deterioration at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, immediately cut out and remove damaged or deteriorated penetration firestopping material and install new materials to produce systems complying with specified requirements.

END OF SECTION 078413

SECTION 079200 - JOINT SEALANTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Silicone joint sealants.
2. Urethane joint sealants.
3. Mildew-resistant joint sealants.
4. Butyl joint sealants.

B. Related Requirements:

1. Section 079219 "Acoustical Joint Sealants" for sealing joints in sound-rated construction.

1.3 ACTION SUBMITTALS

A. Product Data: For each joint-sealant product.

B. Samples for Initial Selection: Manufacturer's color charts consisting of strips of cured sealants showing the full range of colors available for each product exposed to view.

C. Samples for Verification: For each kind and color of joint sealant required, provide Samples with joint sealants in 1/2-inch- (13-mm-) wide joints formed between two 6-inch- (150-mm-) long strips of material matching the appearance of exposed surfaces adjacent to joint sealants.

D. Joint-Sealant Schedule: Include the following information:

1. Joint-sealant application, joint location, and designation.
2. Joint-sealant manufacturer and product name.
3. Joint-sealant formulation.
4. Joint-sealant color.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified testing agency.

B. Product Test Reports: For each kind of joint sealant, for tests performed by a qualified testing agency.

C. Preconstruction Laboratory Test Reports: From sealant manufacturer, indicating the following:

1. Materials forming joint substrates and joint-sealant backings have been tested for compatibility and adhesion with joint sealants.
2. Interpretation of test results and written recommendations for primers and substrate preparation are needed for adhesion.

D. Preconstruction Field-Adhesion-Test Reports: Indicate which sealants and joint preparation methods resulted in optimum adhesion to joint substrates based on testing specified in "Preconstruction Testing" Article.

E. Field-Adhesion-Test Reports: For each sealant application tested.

F. Sample Warranties: For special warranties.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: An authorized representative who is trained and approved by manufacturer.

B. Product Testing: Test joint sealants using a qualified testing agency.

1. Testing Agency Qualifications: Qualified according to ASTM C 1021 to conduct the testing indicated.

1.6 PRECONSTRUCTION TESTING

A. Preconstruction Laboratory Testing: Submit to joint-sealant manufacturers, for testing indicated below, samples of materials that will contact or affect joint sealants.

1. Adhesion Testing: Use ASTM C 794 to determine whether priming and other specific joint preparation techniques are required to obtain rapid, optimum adhesion of joint sealants to joint substrates.
2. Compatibility Testing: Use ASTM C 1087 to determine sealant compatibility when in contact with glazing and gasket materials.
3. Stain Testing: Use ASTM C 1248 to determine stain potential of sealant when in contact with masonry substrates.
4. Submit manufacturer's recommended number of pieces of each type of material, including joint substrates, joint-sealant backings, and miscellaneous materials.
5. Schedule sufficient time for testing and analyzing results to prevent delaying the Work.
6. For materials failing tests, obtain joint-sealant manufacturer's written instructions for corrective measures, including use of specially formulated primers.
7. Testing will not be required if joint-sealant manufacturers submit data that are based on previous testing, not older than 24 months, of sealant products for adhesion to, staining of, and compatibility with joint substrates and other materials matching those submitted.

B. Preconstruction Field-Adhesion Testing: Before installing sealants, field test their adhesion to Project joint substrates as follows:

1. Locate test joints where indicated on Project or, if not indicated, as directed by Architect.
2. Conduct field tests for each kind of sealant and joint substrate.
3. Notify Architect seven days in advance of dates and times when test joints will be erected.
4. Arrange for tests to take place with joint-sealant manufacturer's technical representative present.

    a. Test Method: Test joint sealants according to Method A, Field-Applied Sealant Joint Hand Pull Tab, in Appendix X1.1 in ASTM C 1193 or Method A, Tail Procedure, in ASTM C 1521.

        1) For joints with dissimilar substrates, verify adhesion to each substrate separately; extend cut along one side, verifying adhesion to opposite side. Repeat procedure for opposite side.

5. Report whether sealant failed to adhere to joint substrates or tore cohesively. Include data on pull distance used to test each kind of product and joint substrate. For sealants that fail adhesively, retest until satisfactory adhesion is obtained.
6. Evaluation of Preconstruction Field-Adhesion-Test Results: Sealants not evidencing adhesive failure from testing, in absence of other indications of noncompliance with requirements, will be considered satisfactory. Do not use sealants that fail to adhere to joint substrates during testing.

1.7 FIELD CONDITIONS

A. Do not proceed with installation of joint sealants under the following conditions:

1. When ambient and substrate temperature conditions are outside limits permitted by joint-sealant manufacturer or are below 40 deg F (5 deg C).
2. When joint substrates are wet.
3. Where joint widths are less than those allowed by joint-sealant manufacturer for applications indicated.
4. Where contaminants capable of interfering with adhesion have not yet been removed from joint substrates.

1.8 WARRANTY

A. Special Installer's Warranty: Installer agrees to repair or replace joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.

1. Warranty Period: Two years from date of Substantial Completion.

B. Special Manufacturer's Warranty: Manufacturer agrees to furnish joint sealants to repair or replace those joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.

1. Warranty Period: Five years from date of Substantial Completion.

C. Special warranties specified in this article exclude deterioration or failure of joint sealants from the following:

1. Movement of the structure caused by stresses on the sealant exceeding sealant manufacturer's written specifications for sealant elongation and compression.
2. Disintegration of joint substrates from causes exceeding design specifications.
3. Mechanical damage caused by individuals, tools, or other outside agents.
4. Changes in sealant appearance caused by accumulation of dirt or other atmospheric contaminants.

PART 2 - PRODUCTS

2.1 JOINT SEALANTS, GENERAL

A. Compatibility: Provide joint sealants, backings, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by joint-sealant manufacturer, based on testing and field experience.

B. VOC Content of Interior Sealants: Provide sealants and sealant primers for use inside the weatherproofing system that comply with the following limits for VOC content when calculated according to 40 CFR 59, Part 59, Subpart D (EPA Method 24):

1. Architectural Sealants: 250 g/L.
2. Sealant Primers for Nonporous Substrates: 250 g/L.
3. Sealant Primers for Porous Substrates: 775 g/L.

C. Liquid-Applied Joint Sealants: Comply with ASTM C 920 and other requirements indicated for each liquid-applied joint sealant specified, including those referencing ASTM C 920 classifications for type, grade, class, and uses related to exposure and joint substrates.

D. Stain-Test-Response Characteristics: Where sealants are specified to be nonstaining to porous substrates, provide products that have undergone testing according to ASTM C 1248 and have not stained porous joint substrates indicated for Project.

E. Suitability for Contact with Food: Where sealants are indicated for joints that will come in repeated contact with food, provide products that comply with 21 CFR 177.2600.

F. Colors of Exposed Joint Sealants: As selected by Architect from manufacturer's full range.

2.2 JOINT SEALANTS

A. Type A Sealant:

1. Manufacturers:

a. Euclid Chemical Company “Eucloastic II – Pourable”.
b. Mameco International “Vulkem 245”.
c. Pecora Corp. “DynaTred”
d. Sika Corp. “Sikaflex 2C-SL”.
e. Sonneborn Building Products “Sonolastic Paving Joint Sealant”.
f. or equal.

B. Type B Sealant:

1. Manufacturers:

a. Euclid Chemical Company “Eucolastic I or II – Gun Grade”.
b. Mameco International “Vulkem 921 or 922”.
c. Pecora Corp. “Dynaflex”.
d. Sika Corp. “Sikaflex 1Aor 2C-NS”.
e. Sonneborn Building Products “Sonolastic NP1 or NPII”.
f. Tremco “Dymonic or Dymeric”.
g. or equal.

C. Type C Sealant:

1. Manufacturers:

a. Adco Seal “No. B-100”
b. Pecora Corp. “BC-158”.
c. PTI Sealants “No. 707”.
d. Tremco “Butyl Sealant”
e. or equal.

D. Type D Sealant:

1. Manufacturers:

a. Pecora Corp. “AC-20”.
b. Sonneborn Building Products “Sonolac”.
c. Tremco “Acrylic Latex Caulk”
d. or equal.

E. Type E Sealant:

1. Manufacturers:

a. Dow Corning Corp. “No. 795”.
b. General Electric Co. “Silpruf”
c. Sonneborn Building Products “Omniseal”.
d. Tremco “Spectrem 1”.
e. or equal.

F. Type F Sealant:

1. Manufacturers:

a. Sika Chemical Corp. “51NS”.
b. or equal.

2. Flexiblized Epoxy Sealant: ASTM D 2240 Shore A hardness, 75 minimum, ASTM D 732 shear strength, minimum 800 psi at 14 days; ASTM C 82 bond strength, 800 psi minimum.

2.3 JOINT-SEALANT BACKING

A. Sealant Backing Material, General: Nonstaining; compatible with joint substrates, sealants, primers, and other joint fillers; and approved for applications indicated by sealant manufacturer based on field experience and laboratory testing.

B. Cylindrical Sealant Backings: ASTM C 1330, Type C (closed-cell material with a surface skin), and of size and density to control sealant depth and otherwise contribute to producing optimum sealant performance.

C. Bond-Breaker Tape: Polyethylene tape or other plastic tape recommended by sealant manufacturer for preventing sealant from adhering to rigid, inflexible joint-filler materials or joint surfaces at back of joint. Provide self-adhesive tape where applicable.

2.4 MISCELLANEOUS MATERIALS

A. Primer: Material recommended by joint-sealant manufacturer where required for adhesion of sealant to joint substrates indicated, as determined from preconstruction joint-sealant-substrate tests and field tests.

B. Cleaners for Nonporous Surfaces: Chemical cleaners acceptable to manufacturers of sealants and sealant backing materials, free of oily residues or other substances capable of staining or harming joint substrates and adjacent nonporous surfaces in any way, and formulated to promote optimum adhesion of sealants to joint substrates.

C. Masking Tape: Nonstaining, nonabsorbent material compatible with joint sealants and surfaces adjacent to joints.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine joints indicated to receive joint sealants, with Installer present, for compliance with requirements for joint configuration, installation tolerances, and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Surface Cleaning of Joints: Clean out joints immediately before installing joint sealants to comply with joint-sealant manufacturer's written instructions and the following requirements:

1. Remove all foreign material from joint substrates that could interfere with adhesion of joint sealant, including dust, paints (except for permanent, protective coatings tested and approved for sealant adhesion and compatibility by sealant manufacturer), old joint sealants, oil, grease, waterproofing, water repellents, water, surface dirt, and frost.
2. Clean porous joint substrate surfaces by brushing, grinding, mechanical abrading, or a combination of these methods to produce a clean, sound substrate capable of developing optimum bond with joint sealants. Remove loose particles remaining after cleaning operations above by vacuuming or blowing out joints with oil-free compressed air. Porous joint substrates include the following:

    a. Concrete.
    b. Masonry.
    c. Unglazed surfaces of ceramic tile.

3. Remove laitance and form-release agents from concrete.
4. Clean nonporous joint substrate surfaces with chemical cleaners or other means that do not stain, harm substrates, or leave residues capable of interfering with adhesion of joint sealants. Nonporous joint substrates include the following:

    a. Metal.
    b. Glass.
    c. Porcelain enamel.
    d. Glazed surfaces of ceramic tile.
    e. Laminates and solid surface materials.

B. Joint Priming: Prime joint substrates where recommended by joint-sealant manufacturer or as indicated by preconstruction joint-sealant-substrate tests or prior experience. Apply primer to comply with joint-sealant manufacturer's written instructions. Confine primers to areas of joint-sealant bond; do not allow spillage or migration onto adjoining surfaces.

C. Masking Tape: Use masking tape where required to prevent contact of sealant or primer with adjoining surfaces that otherwise would be permanently stained or damaged by such contact or by cleaning methods required to remove sealant smears. Remove tape immediately after tooling without disturbing joint seal.

3.3 INSTALLATION OF JOINT SEALANTS

A. General: Comply with joint-sealant manufacturer's written installation instructions for products and applications indicated, unless more stringent requirements apply.

B. Sealant Installation Standard: Comply with recommendations in ASTM C 1193 for use of joint sealants as applicable to materials, applications, and conditions indicated.

C. Locations: In addition to locations indicated in Drawings, install sealants in all joints between dissimilar materials, and where recommended by material, fixture, or equipment manufacturers.

D. Install sealant backings of kind indicated to support sealants during application and at position required to produce cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.

1. Do not leave gaps between ends of sealant backings.
2. Do not stretch, twist, puncture, or tear sealant backings.
3. Remove absorbent sealant backings that have become wet before sealant application, and replace them with dry materials.

E. Install bond-breaker tape behind sealants where sealant backings are not used between sealants and backs of joints.

F. Install sealants using proven techniques that comply with the following and at the same time backings are installed:

1. Place sealants so they directly contact and fully wet joint substrates.
2. Completely fill recesses in each joint configuration.
3. Produce uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability.

G. Tooling of Nonsag Sealants: Immediately after sealant application and before skinning or curing begins, tool sealants according to requirements specified in subparagraphs below to form smooth, uniform beads of configuration indicated; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint.

1. Remove excess sealant from surfaces adjacent to joints.
2. Use tooling agents that are approved in writing by sealant manufacturer and that do not discolor sealants or adjacent surfaces.
3. Provide concave joint profile per Figure 8A in ASTM C 1193 unless otherwise indicated.
4. Provide flush joint profile where indicated according to Figure 8B in ASTM C 1193.
5. Provide recessed joint configuration of recess depth and at locations indicated according to Figure 8C in ASTM C 1193.

a. Use masking tape to protect surfaces adjacent to recessed tooled joints.

3.4 FIELD QUALITY CONTROL

A. Field-Adhesion Testing: Field test joint-sealant adhesion to joint substrates as follows:

1. Extent of Testing: Test completed and cured sealant joints as follows:

   a. Perform 10 tests for the first 1000 feet (300 m) of joint length for each kind of sealant and joint substrate.
   b. Perform one test for each 1000 feet (300 m) of joint length thereafter or one test per each floor per elevation.

2. Test Method: Test joint sealants according to Method A, Field-Applied Sealant Joint Hand Pull Tab, in Appendix X1 in ASTM C 1193 or Method A, Tail Procedure, in ASTM C 1521.

   a. For joints with dissimilar substrates, verify adhesion to each substrate separately; extend cut along one side, verifying adhesion to opposite side. Repeat procedure for opposite side.

3. Inspect tested joints and report on the following:

   a. Whether sealants filled joint cavities and are free of voids.
   b. Whether sealant dimensions and configurations comply with specified requirements.
   c. Whether sealants in joints connected to pulled-out portion failed to adhere to joint substrates or tore cohesively. Include data on pull distance used to test each kind of product and joint substrate. Compare these results to determine if adhesion complies with sealant manufacturer's field-adhesion hand-pull test criteria.

4. Record test results in a field-adhesion-test log. Include dates when sealants were installed, names of persons who installed sealants, test dates, test locations, whether joints were primed, adhesion results and percent elongations, sealant material, sealant configuration, and sealant dimensions.
5. Repair sealants pulled from test area by applying new sealants following same procedures used originally to seal joints. Ensure that original sealant surfaces are clean and that new sealant contacts original sealant.

B. Evaluation of Field-Adhesion-Test Results: Sealants not evidencing adhesive failure from testing or noncompliance with other indicated requirements will be considered satisfactory. Remove sealants that fail to adhere to joint substrates during testing or to comply with other requirements. Retest failed applications until test results prove sealants comply with indicated requirements.

3.5 CLEANING

A. Clean off excess sealant or sealant smears adjacent to joints as the Work progresses by methods and with cleaning materials approved in writing by manufacturers of joint sealants and of products in which joints occur.

3.6 PROTECTION

A. Protect joint sealants during and after curing period from contact with contaminating substances and from damage resulting from construction operations or other causes so sealants are without deterioration or damage at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, cut out, remove, and repair damaged or deteriorated joint sealants immediately so installations with repaired areas are indistinguishable from original work.

3.7 JOINT-SEALANT SCHEDUL

A. Type A:

1. Joints in concrete and tile floors, and paved surfaces subject to foot traffic.

B. Type B:

1. Exterior and interior vertical joints in concrete, except as otherwise specified.
2. Exterior Joints in masonry.
3. Around metal door, window and louver frames penetrating exterior concrete and masonry.
4. Interior vertical joint between steel column/beam and CMU wall. (wall is vertical surface)
5. Do not use single-component sealants when excessive movement is expected within the curing time of the sealant.

C. Type C:

1. Interior wall penetrations for pipe and conduit that will be concealed by escutcheons and other trim and plate, and for lap joints in sheet metal.

D. Type D:

1. Joints, voids and penetrations not otherwise specified for interior surfaces exposed to view and requiring painting.
2. Bedding of fixtures, partitions, equipment and accessories fastened to walls and floors, flanges and escutcheons of items penetrating surfaces in kitchens, dining rooms, toilet rooms, changing rooms, and other areas requiring sanitary conditions to eliminate any open joints between contact surfaces.

E. Type E:

1. Exterior and interior joints in contact with organically-coated aluminum and for joints between concrete masonry.

F. Type F:

1. Construction joints, window and hollow metal frame perimeters, furnishings and equipment at wall, ceiling, and floor surfaces adjacent to concrete or masonry.

3.8 CONFLICTS

A. In the event of conflict between the above schedule and sealant type indicated on drawings, notify the architect.

B. Architect shall determine sealant type to be installed in location in question.

C. Install sealant type directed by architect, complete with all necessary joint preparation and accessories.

3.9 EXTRA STOCK

A. Deliver stack of maintenance material to Owner. Furnish maintenance material matching products installed, packaged with protective covering for storage and identified with appropriate labels.

1. Provide ten (10) percent, or a minimum of five (5) tubes of each type of sealant used.

END OF SECTION 079200

SECTION 081213 - HOLLOW METAL 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. Interior standard steel frames.

B. Related Requirements:

1. Section 081416 "Flush Wood Doors" for wood door panels.
2. Section 087100 "Door Hardware" for door hardware for hollow-metal doors.

1.3 DEFINITIONS

A. Minimum Thickness: Minimum thickness of base metal without coatings according to NAAMM-HMMA 803 or SDI A250.8.

1.4 COORDINATION

A. Coordinate anchorage installation for hollow-metal frames. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors. Deliver such items to Project site in time for installation.

B. Coordinate requirements for installation of door hardware, electrified door hardware, and access control and security systems.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, and finishes.

B. Shop Drawings: Include the following:

1. Elevations of each frame type.
2. Frame details for each frame type, including dimensioned profiles and metal thicknesses.

3. Locations of reinforcement and preparations for hardware.
4. Details of each different wall opening condition.
5. Details of anchorages, joints, field splices, and connections.
6. Details of accessories.

C. Product Schedule: For hollow-metal frames, prepared by or under the supervision of supplier, using same reference numbers for details and openings as those on Drawings. Coordinate with final door hardware schedule.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver hollow-metal frames palletized, packaged, or crated to provide protection during transit and Project-site storage. Do not use nonvented plastic.

1. Provide additional protection to prevent damage to factory-finished units.

B. Deliver welded frames with two removable spreader bars across bottom of frames, tack welded to jambs and mullions.

C. Store hollow-metal frames vertically under cover at Project site with head up. Place on minimum 4-inch- (102-mm-) high wood blocking. Provide minimum 1/4-inch (6-mm) space between each stacked door to permit air circulation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Ceco Door; ASSA ABLOY.
2. Curries Company; ASSA ABLOY.
3. Pioneer Industries.
4. Republic Doors and Frames.
5. Steelcraft; an Allegion brand.

2.2 PERFORMANCE REQUIREMENTS

A. Fire-Rated Assemblies: Complying with NFPA 80 and listed and labeled by a qualified testing agency acceptable to authorities having jurisdiction for fire-protection ratings and temperature-rise limits indicated, based on testing at positive pressure according to NFPA 252 or UL 10C.

1. Smoke- and Draft-Control Assemblies: Provide assemblies with gaskets listed and labeled for smoke and draft control by a qualified testing agency acceptable to authorities having jurisdiction, based on testing according to UL 1784 and installed in compliance with NFPA 105.

2. Oversize Fire-Rated Door Assemblies: For units exceeding sizes of tested assemblies, provide certification by a qualified testing agency that doors comply with standard construction requirements for tested and labeled fire-rated door assemblies except for size.

2.3 STANDARD STEEL FRAMES

A. Construct hollow-metal frames to comply with standards indicated for materials, fabrication, hardware locations, hardware reinforcement, tolerances, and clearances, and as specified.

B. Interior Frames: SDI A250.8. At locations indicated in the Door and Frame Schedule.

1. Materials: Metallic-coated steel sheet, minimum thickness of 0.067 inch (1.7 mm).
2. Construction: Slip-on drywall or Face welded.
3. Exposed Finish: Prime.

2.4 FRAME ANCHORS

A. Jamb Anchors:

1. Type: Anchors of minimum size and type required by applicable door and frame standard, and suitable for performance level indicated.
2. Quantity: Minimum of three anchors per jamb, with one additional anchor for frames with no floor anchor. Provide one additional anchor for each 24 inches (610 mm) of frame height above 7 feet (2.1 m).
3. Postinstalled Expansion Anchor: Minimum 3/8-inch- (9.5-mm-) diameter bolts with expansion shields or inserts, with manufacturer's standard pipe spacer.

B. Floor Anchors: Provide floor anchors for each jamb and mullion that extends to floor.

C. Material: ASTM A 879/A 879M, Commercial Steel (CS), 04Z (12G) coating designation; mill phosphatized.

2.5 MATERIALS

A. Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, Commercial Steel (CS), Type B; suitable for exposed applications.

B. Hot-Rolled Steel Sheet: ASTM A 1011/A 1011M, Commercial Steel (CS), Type B; free of scale, pitting, or surface defects; pickled and oiled.

C. Metallic-Coated Steel Sheet: ASTM A 653/A 653M, Commercial Steel (CS), Type B.

D. Inserts, Bolts, and Fasteners: Hot-dip galvanized according to ASTM A 153/A 153M.

E. 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 hollow-metal frames of type indicated.

F. Glazing: Comply with requirements in Section 088000 "Glazing."

2.6 FABRICATION

A. Hollow-Metal Frames: Fabricate in one piece except where handling and shipping limitations require multiple sections. Where frames are fabricated in sections, provide alignment plates or angles at each joint, fabricated of metal of same or greater thickness as frames.

1. Provide countersunk, flat- or oval-head exposed screws and bolts for exposed fasteners unless otherwise indicated.
2. Door Silencers: Except on weather-stripped frames, drill stops to receive door silencers as follows. Keep holes clear during construction.

a. Single-Door Frames: Drill stop in strike jamb to receive three door silencers.
b. Double-Door Frames: Drill stop in head jamb to receive two door silencers.

B. Hardware Preparation: Factory prepare hollow-metal frames to receive templated mortised hardware, and electrical wiring; include cutouts, reinforcement, mortising, drilling, and tapping according to SDI A250.6, the Door Hardware Schedule, and templates.

1. Reinforce frames to receive nontemplated, mortised, and surface-mounted door hardware.
2. Comply with BHMA A156.115 for preparing hollow-metal frames for hardware.

2.7 STEEL FINISHES

A. Prime Finish: Clean, pretreat, and apply manufacturer's standard primer.

1. Shop Primer: Manufacturer's standard, fast-curing, lead- and chromate-free primer complying with SDI A250.10; recommended by primer manufacturer for substrate; compatible with substrate and field-applied coatings despite prolonged exposure.

PART 3 - EXECUTION

3.1 PREPARATION

A. Remove welded-in shipping spreaders installed at factory. Restore exposed finish by grinding, filling, and dressing, as required to make repaired area smooth, flush, and invisible on exposed faces. Touch up factory-applied finishes where spreaders are removed.

B. Drill and tap frames to receive nontemplated, mortised, and surface-mounted door hardware.

3.2 INSTALLATION

A. General: Install hollow-metal frames plumb, rigid, properly aligned, and securely fastened in place. Comply with approved Shop Drawings and with manufacturer's written instructions. Comply with SDI A250.11 or NAAMM-HMMA 840.

B. Set frames accurately in position; plumbed, aligned, and braced securely until permanent anchors are set. After wall construction is complete, remove temporary braces without damage to completed Work.

1. Where frames are fabricated in sections, field splice at approved locations by welding face joint continuously; grind, fill, dress, and make splice smooth, flush, and invisible on exposed faces. Touch-up finishes.
2. Install frames with removable stops located on secure side of opening.

C. Fire-Rated Openings: Install frames according to NFPA 80.

D. Floor Anchors: Secure with postinstalled expansion anchors.

1. Floor anchors may be set with power-actuated fasteners instead of postinstalled expansion anchors if so indicated and approved on Shop Drawings.

E. Solidly pack mineral-fiber insulation inside frames.

F. Masonry Walls: Coordinate installation of frames to allow for solidly filling space between frames and masonry with grout or mortar.

G. In-Place Concrete or Masonry Construction: Secure frames in place with postinstalled expansion anchors. Countersink anchors.

H. Installation Tolerances: Adjust hollow-metal frames to the following tolerances:

1. Squareness: Plus or minus 1/16 inch (1.6 mm), measured at door rabbet on a line 90 degrees from jamb perpendicular to frame head.
2. Alignment: Plus or minus 1/16 inch (1.6 mm), measured at jambs on a horizontal line parallel to plane of wall.
3. Twist: Plus or minus 1/16 inch (1.6 mm), measured at opposite face corners of jambs on parallel lines, and perpendicular to plane of wall.
4. Plumbness: Plus or minus 1/16 inch (1.6 mm), measured at jambs at floor.

I. Glazing: Comply with installation requirements in Section 088000 "Glazing" and with hollow-metal manufacturer's written instructions.

3.3 CLEANING AND TOUCHUP

A. Prime-Coat Touchup: Immediately after erection, sand smooth rusted or damaged areas of prime coat and apply touchup of compatible air-drying, rust-inhibitive primer.

B. Metallic-Coated Surface Touchup: Clean abraded areas and repair with galvanizing repair paint according to manufacturer's written instructions.

C. Factory-Finish Touchup: Clean abraded areas and repair with same material used for factory finish according to manufacturer's written instructions.

D. Touchup Painting: Cleaning and touchup painting of abraded areas of paint are specified in painting Sections.

END OF SECTION 081213

SECTION 081416 - FLUSH WOOD DOORS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Solid-core doors with wood-veneer faces.
2. Factory finishing flush wood doors.
3. Factory fitting flush wood doors to frames and factory machining for hardware.

B. Related Requirements:
1. Section 081216 "Hollow Metal Frames" for hollow metal frames for flush wood doors.
2. Section 87100 "Door Hardware" for preparation and installation of hardware in flush wood doors.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of door. Include details of core and edge construction and trim for openings. Include factory-finishing specifications.

B. Shop Drawings: Indicate location, size, and hand of each door; elevation of each kind of door; construction details not covered in Product Data; and the following:

1. Dimensions and locations of blocking.
2. Dimensions and locations of mortises and holes for hardware.
3. Dimensions and locations of cutouts.
4. Undercuts.
5. Doors to be factory finished and finish requirements.
6. Fire-protection ratings for fire-rated doors.

C. Samples for Initial Selection: For factory-finished doors.

1.4 INFORMATIONAL SUBMITTALS

A. Sample Warranty: For special warranty.

B. Quality Standard Compliance Certificates: AWI Quality Certification Program certificates.

1.5 QUALITY ASSURANCE

1.6 DELIVERY, STORAGE, AND HANDLING

A. Comply with requirements of referenced standard and manufacturer's written instructions.

B. Package doors individually in plastic bags or cardboard cartons.

C. Mark each door on top and bottom rail with opening number used on Shop Drawings.

1.7 FIELD CONDITIONS

A. Environmental Limitations: Do not deliver or install doors until spaces are enclosed and weathertight, wet work in spaces is complete and dry, and HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during remainder of construction period.

B. Environmental Limitations: Do not deliver or install doors until spaces are enclosed and weathertight, wet work in spaces is complete and dry, and HVAC system is operating and maintaining temperature between 60 and 90 deg F (16 and 32 deg C) and relative humidity between 25 and 55 percent during remainder of construction period.

1.8 WARRANTY

A. A. Special Warranty: Manufacturer agrees to repair or replace doors that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Warping (bow, cup, or twist) more than 1/4 inch (6.4 mm) in a 42-by-84-inch (1067-by-2134-mm) section.
b. Telegraphing of core construction in face veneers exceeding 0.01 inch in a 3-inch (0.25 mm in a 76.2-mm) span.

2. Warranty shall also include installation and finishing that may be required due to repair or replacement of defective doors.
3. Warranty Period for Solid-Core Interior Doors: Life of installation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Algoma Hardwoods, Inc.

2. Eggers Industries.
3. Graham Wood Doors; ASSA ABLOY Group company.
4. Mohawk Flush Doors, Inc.
5. VT Industries Inc.

B. Source Limitations: Obtain flush wood doors from single manufacturer.

2.2 FLUSH WOOD DOORS, GENERAL

A. Quality Standard: In addition to requirements specified, comply with AWI's, AWMAC's, and WI's "Architectural Woodwork Standards."

1. Provide AWI Quality Certification Labels indicating that doors comply with requirements of grades specified.
2. Contract Documents contain selections chosen from options in quality standard and additional requirements beyond those of quality standard. Comply with those selections and requirements in addition to quality standard.

B. WDMA I.S.1-A Performance Grade: Extra Heavy Duty.

C. Fire-Rated Wood Doors: Doors complying with NFPA 80 that are listed and labeled by a qualified testing agency, for fire-protection ratings indicated, based on testing at positive pressure according to NFPA 252 or UL 10C.
1. Temperature-Rise Limit: At vertical exit enclosures and exit passageways, provide doors that have a maximum transmitted temperature end point of not more than 450 deg F (250 deg C) above ambient after 30 minutes of standard fire-test exposure.
2. Cores: Provide core specified or mineral core as needed to provide fire-protection rating indicated.
3. Edge Construction: Provide edge construction with intumescent seals concealed by outer stile. Comply with specified requirements for exposed edges.
4. Pairs: Provide fire-retardant stiles that are listed and labeled for applications indicated without formed-steel edges and astragals. Provide stiles with concealed intumescent seals. Comply with specified requirements for exposed edges.
5. Pairs: Provide formed-steel edges and astragals with intumescent seals.

a. Finish steel edges and astragals with baked enamel.
b. Finish steel edges and astragals to match door hardware (locksets or exit devices).

D. Smoke- and Draft-Control Door Assemblies: Listed and labeled for smoke and draft control, based on testing according to UL 1784.

E. Particleboard-Core Doors:

1. Particleboard: ANSI A208.1, Grade LD-1 or Grade LD-2.
2. Blocking: Provide wood blocking in particleboard-core doors as follows:

a. 5-inch (125-mm) top-rail blocking, in doors indicated to have closers.

b. 5-inch (125-mm) bottom-rail blocking, in exterior doors and doors indicated to have kick, mop, or armor plates.
c. 5-inch (125-mm) midrail blocking, in doors indicated to have exit devices.

3. Provide doors with glued-wood-stave or structural-composite-lumber cores instead of particleboard cores for doors indicated to receive exit devices.

F. Structural-Composite-Lumber-Core Doors:

1. Structural Composite Lumber: WDMA I.S.10.

a. Screw Withdrawal, Face: 700 lbf (3100 N).
b. Screw Withdrawal, Edge: 400 lbf (1780 N).

G. Mineral-Core Doors:

1. Core: Noncombustible mineral product complying with requirements of referenced quality standard and testing and inspecting agency for fire-protection rating indicated.
2. Blocking: Provide composite blocking with improved screw-holding capability approved for use in doors of fire-protection ratings indicated as follows:

a. 5-inch (125-mm) top-rail blocking.
b. 5-inch (125-mm) bottom-rail blocking, in doors indicated to have protection plates.
c. 5-inch (125-mm) midrail blocking, in doors indicated to have armor plates.
d. 4-1/2-by-10-inch (114-by-250-mm) lock blocks, in doors indicated to have exit devices.

3. Edge Construction: At hinge stiles, provide laminated-edge construction with improved screw-holding capability and split resistance. Comply with specified requirements for exposed edges.

a. Screw-Holding Capability: 550 lbf (2440 N) per WDMA T.M.-10.

2.3 VENEER-FACED DOORS FOR TRANSPARENT FINISH

A. Interior Solid-Core Doors:

1. Grade: Premium, with Grade A faces.
2. Species: Select white maple.
3. Cut: Rotary cut or Plain sliced (flat sliced).
4. Match between Veneer Leaves: Pleasing match.
5. Assembly of Veneer Leaves on Door Faces: Center-balance match.
6. Pair and Set Match: Provide for doors hung in same opening or separated only by mullions.
7. Room Match: Match door faces within each separate room or area of building. Corridor-door faces do not need to match where they are separated by 10 feet (3 m) or more.
8. Room Match: Provide door faces of compatible color and grain within each separate room or area of building.
9. Exposed Vertical Edges: Same species as faces or a compatible species - edge Type A.

10. Core: Particleboard or either glued wood stave or structural composite lumber for doors indicated to receive exit devices.
11. Construction: Five or seven plies. Stiles and rails are bonded to core, then entire unit is abrasive planed before veneering.
12. WDMA I.S.1-A Performance Grade: Extra Heavy Duty.

2.4 FABRICATION

A. Factory fit doors to suit frame-opening sizes indicated. Comply with clearance requirements of referenced quality standard for fitting unless otherwise indicated.

1. Comply with NFPA 80 requirements for fire-rated doors.

B. Factory machine doors for hardware that is not surface applied. Locate hardware to comply with DHI-WDHS-3. Comply with final hardware schedules, door frame Shop Drawings, BHMA-156.115-W, and hardware templates.

1. Coordinate with hardware mortises in metal frames to verify dimensions and alignment before factory machining.
2. Metal Astragals: Factory machine astragals and formed-steel edges for hardware for pairs of fire-rated doors.

C. Openings: Factory cut and trim openings through doors.

1. Light Openings: Trim openings with moldings of material and profile indicated.
2. Glazing: Factory install glazing in doors indicated to be factory finished. Comply with applicable requirements in Section 088000 "Glazing."
3. Louvers: Factory install louvers in prepared openings.

2.5 FACTORY FINISHING

A. General: Comply with referenced quality standard for factory finishing. Complete fabrication, including fitting doors for openings and machining for hardware that is not surface applied, before finishing.

1. Finish faces, all four edges, edges of cutouts, and mortises. Stains and fillers may be omitted on bottom edges, edges of cutouts, and mortises.

B. Factory finish doors.

C. Transparent Finish:

1. Grade: Premium.
2. Finish: AWI's, AWMAC's, and WI's "Architectural Woodwork Standards" System 10, UV curable, water based or System 11, catalyzed polyurethane.
3. Staining: As selected by Architect from manufacturer's full range.
4. Effect: Semifilled finish, produced by applying an additional finish coat to partially fill the wood pores.

5. Sheen: Semigloss.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine doors and installed door frames, with Installer present, before hanging doors.

1. Verify that installed frames comply with indicated requirements for type, size, location, and swing characteristics and have been installed with level heads and plumb jambs.
2. Reject doors with defects.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Hardware: For installation, see Section 087100 "Door Hardware."

B. Installation Instructions: Install doors to comply with manufacturer's written instructions and referenced quality standard, and as indicated.

1. Install fire-rated doors according to NFPA 80.
2. Install smoke- and draft-control doors according to NFPA 105.

C. Job-Fitted Doors: Align and fit doors in frames with uniform clearances and bevels as indicated below; do not trim stiles and rails in excess of limits set by manufacturer or permitted for fire-rated doors. Machine doors for hardware. Seal edges of doors, edges of cutouts, and mortises after fitting and machining.

1. Clearances: Provide 1/8 inch (3.2 mm) at heads, jambs, and between pairs of doors. Provide 1/8 inch (3.2 mm) from bottom of door to top of decorative floor finish or covering unless otherwise indicated. Where threshold is shown or scheduled, provide1/4 inch (6.4 mm) from bottom of door to top of threshold unless otherwise indicated.

a. Comply with NFPA 80 for fire-rated doors.
b. Bevel non-fire-rated doors 1/8 inch in 2 inches (3-1/2 degrees) at lock and hinge edges.

2. Bevel fire-rated doors 1/8 inch in 2 inches (3-1/2 degrees) at lock edge; trim stiles and rails only to extent permitted by labeling agency.

D. Factory-Fitted Doors: Align in frames for uniform clearance at each edge.

E. Factory-Finished Doors: Restore finish before installation if fitting or machining is required at Project site.

3.3 ADJUSTING

A. Operation: Rehang or replace doors that do not swing or operate freely.

B. Finished Doors: Replace doors that are damaged or that do not comply with requirements. Doors may be repaired or refinished if Work complies with requirements and shows no evidence of repair or refinishing.

END OF SECTION 081416

SECTION 084113 - ALUMINUM-FRAMED ENTRANCES AND STOREFRONTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Storefront framing.
2. Manual-swing entrance doors.

B. Related Requirements:
1. Section 087100 "Door Hardware" for operating hardware.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.

B. Shop Drawings: For aluminum-framed entrances and storefronts. Include plans, elevations, sections, full-size details, and attachments to other work.

1. Include details of provisions for assembly expansion and contraction and for draining moisture occurring within the assembly to the exterior.

2. Show connection to and continuity with adjacent thermal, weather, air, and vapor barriers.
3. Include point-to-point wiring diagrams showing the following:

a. Power requirements for each electrically operated door hardware.
b. Location and types of switches, signal device, conduit sizes, and number and size of wires.

C. Samples for Initial Selection: For units with factory-applied color finishes.

D. Entrance Door Hardware Schedule: Prepared by or under supervision of supplier, detailing fabrication and assembly of entrance door hardware, as well as procedures and diagrams. Coordinate final entrance door hardware schedule with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish of entrance door hardware.

E. Delegated-Design Submittal: For aluminum-framed entrances and storefronts indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Energy Performance Certificates: For aluminum-framed entrances and storefronts, accessories, and components, from manufacturer.

1. Basis for Certification: NFRC-certified energy performance values for each aluminum-framed entrance and storefront.

C. Product Test Reports: For aluminum-framed entrances and storefronts, for tests performed by manufacturer and witnessed by a qualified testing agency or performed by a qualified testing agency.

D. Sample Warranties: For special warranties.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: For aluminum-framed entrances and storefronts to include in maintenance manuals.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.

1.7 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of aluminum-framed entrances and storefronts that do not comply with requirements or that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Structural failures, including, but not limited to, excessive deflection.
b. Noise or vibration created by wind and thermal and structural movements.
c. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
d. Water penetration through fixed glazing and framing areas.
e. Failure of operating components.

2. Warranty Period: Five years from date of Substantial Completion.

B. Special Finish Warranty: Standard form in which manufacturer agrees to repair finishes or replace aluminum that shows evidence of deterioration of factory-applied finishes within specified warranty period.

1. Deterioration includes, but is not limited to, the following:

a. Color fading more than 5 Hunter units when tested according to ASTM D 2244.
b. Chalking in excess of a No. 8 rating when tested according to ASTM D 4214.
c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.

2. Warranty Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Source Limitations: Obtain all components of aluminum-framed entrance and storefront system, including framing and accessories, from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design aluminum-framed entrances and storefronts.

B. General Performance: Comply with performance requirements specified, as determined by testing of aluminum-framed entrances and storefronts representing those indicated for this Project without failure due to defective manufacture, fabrication, installation, or other defects in construction.

1. Aluminum-framed entrances and storefronts shall withstand movements of supporting structure, including, but not limited to, twist, column shortening, long-term creep, and deflection from uniformly distributed and concentrated live loads.
2. Failure also includes the following:

a. Thermal stresses transferring to building structure.
b. Glass breakage.
c. Noise or vibration created by wind and thermal and structural movements.
d. Loosening or weakening of fasteners, attachments, and other components.
e. Failure of operating units.

C. Structural Loads:

1. Wind Loads: As required by applicable building codes for building type and location.
2. Other Design Loads: As required by applicable building codes for building type and location.

D. Deflection of Framing Members: At design wind pressure, as follows:

1. Deflection Normal to Wall Plane: Limited to edge of glass in a direction perpendicular to glass plane not exceeding 1/175 of the glass edge length for each individual glazing lite or an amount that restricts edge deflection of individual glazing lites to 3/4 inch (19.1 mm), whichever is less.
2. Deflection Parallel to Glazing Plane: Limited to 1/360 of clear span or 1/8 inch (3.2 mm), whichever is smaller.

    a. Operable Units: Provide a minimum 1/16-inch (1.6-mm) clearance between framing members and operable units.

3. Cantilever Deflection: Where framing members overhang an anchor point, as follows:

    a. Perpendicular to Plane of Wall: No greater than 1/240 of clear span plus 1/4 inch (6.35 mm) for spans greater than 11 feet 8-1/4 inches (3.6 m) or 1/175 times span, for spans of less than 11 feet 8-1/4 inches (3.6 m).

E. Structural: Test according to ASTM E 330/E 330M as follows:

1. When tested at positive and negative wind-load design pressures, storefront assemblies, including entrance doors, do not evidence deflection exceeding specified limits.
2. When tested at 150 percent of positive and negative wind-load design pressures, storefront assemblies, including entrance doors and anchorage, do not evidence material failures, structural distress, or permanent deformation of main framing members exceeding percent of span.
3. Test Durations: As required by design wind velocity, but not less than 10 seconds.

F. Air Infiltration: Test according to ASTM E 283 for infiltration as follows:

1. Fixed Framing and Glass Area:

    a. Maximum air leakage of 0.06 cfm/sq. ft. (0.30 L/s per sq. m) at a static-air-pressure differential of 1.57 lbf/sq. ft. (75 Pa).

2. Entrance Doors:

    a. Single Doors: Maximum air leakage of 0.5 cfm/sq. ft. (2.54 L/s per sq. m) at a static-air-pressure differential of 1.57 lbf/sq. ft. (75 Pa).

G. Water Penetration under Static Pressure: Test according to ASTM E 331 as follows:

1. No evidence of water penetration through fixed glazing and framing areas, including entrance doors, when tested according to a minimum static-air-pressure differential of 20 percent of positive wind-load design pressure, but not less than 10 lbf/sq. ft. (480 Pa).

H. Water Penetration under Dynamic Pressure: Test according to AAMA 501.1 as follows:

1. No evidence of water penetration through fixed glazing and framing areas when tested at dynamic pressure equal to 20 percent of positive wind-load design pressure, but not less than 10 lbf/sq. ft. (480 Pa).

2. Maximum Water Leakage: According to AAMA 501.1. Water leakage does not include water controlled by flashing and gutters, or water that is drained to exterior.

I. Energy Performance: Certify and label energy performance according to NFRC as follows:

1. Thermal Transmittance (U-factor): Fixed glazing and framing areas as a system shall have U-factor of not more than 0.41 Btu/sq. ft. x h x deg F (2.33 W/sq. m x K) as determined according to NFRC 100.
2. Solar Heat Gain Coefficient (SHGC): Fixed glazing and framing areas as a system shall have SHGC of no greater than 0.26 as determined according to NFRC 200.
3. Condensation Resistance: Fixed glazing and framing areas as a system shall have an NFRC-certified condensation resistance rating of no less than 45 as determined according to NFRC 500.

J. Thermal Movements: Allow for thermal movements resulting from ambient and surface temperature changes.

1. Temperature Change: 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.
2. Thermal Cycling: No buckling; stress on glass; sealant failure; excess stress on framing, anchors, and fasteners; or reduction of performance when tested according to AAMA 501.5.

a. High Exterior Ambient-Air Temperature: That which produces an exterior metal-surface temperature of 180 deg F (82 deg C).
b. Low Exterior Ambient-Air Temperature: 0 deg F (minus 18 deg C).
c. Interior Ambient-Air Temperature: 75 deg F (24 deg C).

2.3 STOREFRONT SYSTEMS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. EFCO Corporation.
2. Kawneer North America, an Arconic company.
3. Pittco Architectural Metals, Inc.
4. U.S. Aluminum; a brand of C.R. Laurence.
5. YKK AP America Inc.

B. Framing Members: Manufacturer's extruded- or formed-aluminum framing members of thickness required and reinforced as required to support imposed loads.

1. Exterior Framing Construction: Thermally broken.
2. Interior Vestibule Framing Construction: Nonthermal.
3. Glazing System: Retained mechanically with gaskets on four sides.
4. Glazing Plane: Front.
5. Finish: Clear anodic finish.
6. Fabrication Method: Field-fabricated stick system.

7. Aluminum: Alloy and temper recommended by manufacturer for type of use and finish indicated.
8. Steel Reinforcement: As required by manufacturer.

C. Backer Plates: Manufacturer's standard, continuous backer plates for framing members, if not integral, where framing abuts adjacent construction.

D. Brackets and Reinforcements: Manufacturer's standard high-strength aluminum with nonstaining, nonferrous shims for aligning system components.

E. Insulated Metal Panels: Laminated, metal-faced flat panels with no deviations in plane exceeding 0.8 percent of panel dimension in width or length.

1. Overall Panel Thickness: 1 inch (25.4 mm).
2. Exterior Skin: Aluminum.

   a. Thickness: Manufacturer's standard for finish and texture indicated.
   b. Finish: Match framing system.
   c. Texture: Embossed.
   d. Backing Sheet: 1/8-inch- (3.2-mm-) thick tempered hardboard or 0.157-inch- (4-mm-) thick cement board.

3. Interior Skin: Aluminum.

   a. Thickness: Manufacturer's standard for finish and texture indicated.
   b. Finish: Matching storefront framing.
   c. Texture: Embossed.
   d. Backing Sheet: 1/8-inch- (3.2-mm-) thick tempered hardboard or 0.157-inch- (4-mm-) thick cement board.

4. Thermal Insulation Core: Manufacturer's standard rigid, closed-cell, polyisocyanurate board or extruded-polystyrene board.
5. Surface-Burning Characteristics: Comply with ASTM E 84; 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.

2.4 ENTRANCE DOOR SYSTEMS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. EFCO Corporation.
2. Kawneer North America, an Arconic company.
3. Pittco Architectural Metals, Inc.
4. U.S. Aluminum; a brand of C.R. Laurence.
5. YKK AP America Inc.

B. Entrance Doors: Manufacturer's standard glazed entrance doors for manual-swing or automatic 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.

a. Thermal Construction: High-performance plastic connectors separate aluminum members exposed to the exterior from members exposed to the interior.

2. Door Design: Wide stile; 5-inch (127-mm) nominal width.
3. Glazing Stops and Gaskets: Beveled, snap-on, extruded-aluminum stops and preformed gaskets.

a. Provide nonremovable glazing stops on outside of door.

2.5 ENTRANCE DOOR HARDWARE

A. Entrance Door Hardware: Hardware not specified in this Section is specified in Section 087100 "Door Hardware."

B. General: Provide entrance door hardware and entrance door hardware sets indicated in door and frame schedule for each entrance door, to comply with requirements in this Section.

1. Entrance Door Hardware Sets: Provide quantity, item, size, finish or color indicated, and products complying with BHMA standard referenced.
2. Sequence of Operation: Provide electrified door hardware function, sequence of operation, and interface with other building control systems indicated.
3. Opening-Force Requirements:

a. Egress Doors: Not more than 15 lbf (67 N) to release the latch and not more than 30 lbf (133 N) to set the door in motion and not more than 15 lbf (67 N) to open the door to its minimum required width.
b. Accessible Interior Doors: Not more than 5 lbf (22.2 N) to fully open door.

C. Designations: Requirements for design, grade, function, finish, quantity, size, and other distinctive qualities of each type of entrance door hardware are indicated in "Entrance Door Hardware Sets" Article. Products are identified by using entrance door hardware designations as follows:

1. Named Manufacturers' Products: Manufacturer and product designation are listed for each door hardware type required for the purpose of establishing minimum requirements. Manufacturers' names are abbreviated in "Entrance Door Hardware Sets" Article.
2. References to BHMA Standards: Provide products complying with these standards and requirements for description, quality, and function.

D. Continuous-Gear Hinges: BHMA A156.26.

E. Removable Mullions: BHMA A156.3 extruded aluminum.

1. When used with panic exit devices, provide keyed removable mullions listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for panic protection, based on testing according to UL 305. Use only mullions that have been tested with exit devices to be used.

F. Weather Stripping: Manufacturer's standard replaceable components.

1. Compression Type: Made of ASTM D 2000 molded neoprene or ASTM D 2287 molded PVC.

G. Weather Sweeps: Manufacturer's standard exterior-door bottom sweep with concealed fasteners on mounting strip.

2.6 GLAZING

A. Glazing: Comply with Section 088000 "Glazing" for glass glazing materials.

B. Glazing Gaskets: Manufacturer's standard sealed-corner pressure-glazing system of black, resilient elastomeric glazing gaskets, setting blocks, and shims or spacers.

C. Glazing Sealants: As recommended by manufacturer.

2.7 MATERIALS

A. Sheet and Plate: ASTM B 209 (ASTM B 209M).

B. Extruded Bars, Rods, Profiles, and Tubes: ASTM B 221 (ASTM B 221M).

C. Extruded Structural Pipe and Tubes: ASTM B 429/B 429M.

D. Structural Profiles: ASTM B 308/B 308M.

E. Steel Reinforcement:

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.
4. Primer: 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.

2.8 ACCESSORIES

A. Fasteners and Accessories: Manufacturer's standard corrosion-resistant, nonstaining, nonbleeding fasteners and accessories compatible with adjacent materials.

1. Use self-locking devices where fasteners are subject to loosening or turning out from thermal and structural movements, wind loads, or vibration.
2. Reinforce members as required to receive fastener threads.
3. Use exposed fasteners with countersunk Phillips screw heads, finished to match framing system.

B. Anchors: Three-way adjustable anchors with minimum adjustment of 1 inch (25.4 mm) that accommodate fabrication and installation tolerances in material and finish compatible with adjoining materials and recommended by manufacturer.

1. Concrete and Masonry Inserts: Hot-dip galvanized cast-iron, malleable-iron, or steel inserts complying with ASTM A 123/A 123M or ASTM A 153/A 153M requirements.

C. Concealed Flashing: Manufacturer's standard corrosion-resistant, nonstaining, nonbleeding flashing compatible with adjacent materials.

D. Bituminous Paint: Cold-applied asphalt-mastic paint containing no asbestos, formulated for 30-mil (0.762-mm) thickness per coat.

E. Rigid PVC Filler.

2.9 FABRICATION

A. Form or extrude aluminum shapes before finishing.

B. Weld in concealed locations to greatest extent possible to minimize distortion or discoloration of finish. Remove weld spatter and welding oxides from exposed surfaces by descaling or grinding.

C. Fabricate components that, when assembled, have the following characteristics:

1. Profiles that are sharp, straight, and free of defects or deformations.
2. Accurately fitted joints with ends coped or mitered.
3. Physical and thermal isolation of glazing from framing members.
4. Accommodations for thermal and mechanical movements of glazing and framing to maintain required glazing edge clearances.
5. Provisions for field replacement of glazing from exterior.
6. Fasteners, anchors, and connection devices that are concealed from view to greatest extent possible.

D. Mechanically Glazed Framing Members: Fabricate for flush glazing without projecting stops.

E. Structural-Sealant-Glazed Framing Members: Include accommodations for using temporary support device to retain glazing in place while structural sealant cures.

F. Storefront Framing: Fabricate components for assembly using shear-block system or screw-spline system.

G. Entrance Door Frames: Reinforce as required to support loads imposed by door operation and for installing entrance door hardware.

1. At interior and exterior doors, provide compression weather stripping at fixed stops.

H. 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.

I. 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.

J. After fabrication, clearly mark components to identify their locations in Project according to Shop Drawings.

2.10 ALUMINUM FINISHES

A. Clear Anodic Finish: AAMA 611, AA-M12C22A41, Class I, 0.018 mm or thicker.

2.11 SOURCE QUALITY CONTROL

A. Structural Sealant: Perform quality-control procedures complying with ASTM C 1401 recommendations, including, but not limited to, assembly material qualification procedures, sealant testing, and assembly fabrication reviews and checks.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Prepare surfaces that are in contact with structural sealant according to sealant manufacturer's written instructions, to ensure compatibility and adhesion. Preparation includes, but is not limited to, cleaning and priming surfaces.

3.3 INSTALLATION

A. General:

1. Comply with manufacturer's written instructions.
2. Do not install damaged components.
3. Fit joints to produce hairline joints free of burrs and distortion.
4. Rigidly secure nonmovement joints.
5. Install anchors with separators and isolators to prevent metal corrosion and electrolytic deterioration and to prevent impeding movement of moving joints.
6. Seal perimeter and other joints watertight unless otherwise indicated.

B. Metal Protection:

1. Where aluminum is in contact with dissimilar metals, protect against galvanic action by painting contact surfaces with materials recommended by manufacturer for this purpose or by installing nonconductive spacers.
2. Where aluminum is in contact with concrete or masonry, protect against corrosion by painting contact surfaces with bituminous paint.

C. Set continuous sill members and flashing in full sealant bed, as specified in Section 079200 "Joint Sealants," to produce weathertight installation.

D. Install components plumb and true in alignment with established lines and grades.

E. Install operable units level and plumb, securely anchored, and without distortion. Adjust weather-stripping contact and hardware movement to produce proper operation.

F. Install glazing as specified in Section 088000 "Glazing."

G. Install weatherseal sealant according to Section 079200 "Joint Sealants" and according to sealant manufacturer's written instructions to produce weatherproof joints. Install joint filler behind sealant as recommended by sealant manufacturer.

H. Entrance Doors: Install doors to produce smooth operation and tight fit at contact points.

1. Exterior Doors: Install to produce weathertight enclosure and tight fit at weather stripping.
2. Field-Installed Entrance Door Hardware: Install surface-mounted entrance door hardware according to entrance door hardware manufacturers' written instructions using concealed fasteners to greatest extent possible.

3.4 ERECTION TOLERANCES

A. Erection Tolerances: Install aluminum-framed entrances and storefronts to comply with the following maximum tolerances:

1. Plumb: 1/8 inch in 10 feet (3.2 mm in 3 m); 1/4 inch in 40 feet (6.35 mm in 12.2 m).
2. Level: 1/8 inch in 20 feet (3.2 mm in 6 m); 1/4 inch in 40 feet (6.35 mm in 12.2 m).

3. Alignment:

   a. Where surfaces abut in line or are separated by reveal or protruding element up to 1/2 inch (12.7 mm) wide, limit offset from true alignment to 1/16 inch (1.6 mm).
   b. Where surfaces are separated by reveal or protruding element from 1/2 to 1 inch (12.7 to 25.4 mm) wide, limit offset from true alignment to 1/8 inch (3.2 mm).
   c. Where surfaces are separated by reveal or protruding element of 1 inch (25.4 mm) wide or more, limit offset from true alignment to 1/4 inch (6 mm).

4. Location: Limit variation from plane to 1/8 inch in 12 feet (3.2 mm in 3.6 m); 1/2 inch (12.7 mm) over total length.

3.5 MAINTENANCE SERVICE

A. Entrance Door Hardware:

1. Maintenance Tools and Instructions: Furnish a complete set of specialized tools and maintenance instructions as needed for Owner's continued adjustment, maintenance, and removal and replacement of entrance door hardware.
2. Initial Maintenance Service: Beginning at Substantial Completion, provide six months' full maintenance by skilled employees of entrance door hardware Installer. Include quarterly preventive maintenance, repair or replacement of worn or defective components, lubrication, cleaning, and adjusting as required for proper entrance door hardware operation at rated speed and capacity. Use parts and supplies that are the same as those used in the manufacture and installation of original equipment.

3.6 ENTRANCE DOOR HARDWARE SETS

A. Provide hardware sets as indicated on Drawings.

END OF SECTION 084113

SECTION 087100 - DOOR HARDWARE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Mechanical door hardware for the following:

   a. Swinging doors.

2. Cylinders for door hardware specified in other Sections.
3. Electrified door hardware.

B. Related Requirements:

1. Section 081213 "Hollow Metal Frames" for astragals provided as part of labeled fire-rated assemblies and for door silencers provided as part of hollow-metal frames.
2. Section 081416 "Flush Wood Doors" for astragals provided as part of labeled fire-rated assemblies.
3. Section 084113 "Aluminum-Framed Entrances and Storefronts" for entrance door hardware, including aluminum removable mullions, weatherstripping, and other items.

1.3 COORDINATION

A. Installation Templates: Distribute for doors, frames, and other work specified to be factory prepared. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing door hardware to comply with indicated requirements.

B. Security: Coordinate installation of door hardware, keying, and access control with Owner's security consultant.

C. Electrical System Roughing-In: Coordinate layout and installation of electrified door hardware with connections to power supplies and building safety and security systems.

D. Existing Openings: Where hardware components are scheduled for application to existing construction or where modifications to existing door hardware are required, field verify existing conditions and coordinate installation of door hardware to suit opening conditions and to provide proper door operation.

E. Keying Conference: Coordinate conference with Owner.

1. Conference participants shall include Installer's Architectural Hardware Consultant and Owner's security consultant.
2. Incorporate conference decisions into keying schedule after reviewing door hardware keying system including, but not limited to, the following:

a. Flow of traffic and degree of security required.
b. Preliminary key system schematic diagram.
c. Requirements for key control system.
d. Requirements for access control.
e. Address for delivery of keys.

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.

B. Shop Drawings: For electrified door hardware.

1. Include diagrams for power, signal, and control wiring.
2. Include details of interface of electrified door hardware and building safety and security systems.

C. Door Hardware Schedule: Prepared by or under the supervision of Installer's Architectural Hardware Consultant. Coordinate door hardware schedule with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish of door hardware.

1. Submittal Sequence: Submit door hardware schedule concurrent with submissions of Product Data, Samples, and Shop Drawings. Coordinate submission of door hardware schedule with scheduling requirements of other work to facilitate the fabrication of other work that is critical in Project construction schedule.
2. Format: Use same scheduling sequence and format and use same door numbers as in door hardware schedule in the Contract Documents.
3. Content: Include the following information:

a. Identification number, location, hand, fire rating, size, and material of each door and frame.
b. Locations of each door hardware set, cross-referenced to Drawings on floor plans and to door and frame schedule.
c. Complete designations, including name and manufacturer, type, style, function, size, quantity, function, and finish of each door hardware product.
d. Description of electrified door hardware sequences of operation and interfaces with other building control systems.
e. Fastenings and other installation information.
f. Explanation of abbreviations, symbols, and designations contained in door hardware schedule.

g. Mounting locations for door hardware.
h. List of related door devices specified in other Sections for each door and frame.

D. Keying Schedule: Prepared by or under the supervision of Installer's Architectural Hardware Consultant, detailing Owner's final keying instructions for locks. Include schematic keying diagram and index each key set to unique door designations that are coordinated with the Contract Documents.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Product Certificates: For each type of electrified door hardware.

1. Certify that door hardware for use on each type and size of labeled fire-rated doors complies with listed fire-rated door assemblies.

C. Product Test Reports: For compliance with accessibility requirements, for tests performed by manufacturer and witnessed by a qualified testing agency, for door hardware on doors located in accessible routes.

D. Sample Warranty: For special warranty.

1.6 CLOSEOUT SUBMITTALS

A. Maintenance Data: For each type of door hardware to include in maintenance manuals.

B. Schedules: Final door hardware and keying schedule.

1.7 QUALITY ASSURANCE

A. Installer Qualifications: Supplier of products and an employer of workers trained and approved by product manufacturers and of an Architectural Hardware Consultant who is available during the course of the Work to consult Contractor, Architect, and Owner about door hardware and keying.

1. Warehousing Facilities: In Project's vicinity.
2. Scheduling Responsibility: Preparation of door hardware and keying schedule.
3. Engineering Responsibility: Preparation of data for electrified door hardware, including Shop Drawings, based on testing and engineering analysis of manufacturer's standard units in assemblies similar to those indicated for this Project.

B. Architectural Hardware Consultant Qualifications: A person who is experienced in providing consulting services for door hardware installations that are comparable in material, design, and extent to that indicated for this Project and who is currently certified by DHI as an Architectural Hardware Consultant (AHC) and an Electrified Hardware Consultant (EHC).

1.8 DELIVERY, STORAGE, AND HANDLING

A. Inventory door hardware on receipt and provide secure lock-up for door hardware delivered to Project site.

B. Tag each item or package separately with identification coordinated with the final door hardware schedule, and include installation instructions, templates, and necessary fasteners with each item or package.

C. Deliver keys to manufacturer of key control system for subsequent delivery to Owner.

D. Deliver keys and permanent cores to Owner by registered mail or overnight package service.

1.9 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of door hardware that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Structural failures including excessive deflection, cracking, or breakage.
b. Faulty operation of doors and door hardware.
c. Deterioration of metals, metal finishes, and other materials beyond normal weathering and use.

2. Warranty Period: Three years from date of Substantial Completion unless otherwise indicated below:

a. Electromagnetic Locks: Five years from date of Substantial Completion.
b. Exit Devices: Two years from date of Substantial Completion.
c. Manual Closers: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Source Limitations: Obtain each type of door hardware from single manufacturer.

1. Provide electrified door hardware from same manufacturer as mechanical door hardware unless otherwise indicated. Manufacturers that perform electrical modifications and that are listed by a testing and inspecting agency acceptable to authorities having jurisdiction are acceptable.

2.2 PERFORMANCE REQUIREMENTS

A. Fire-Rated Door Assemblies: Where fire-rated doors are indicated, provide door hardware complying with NFPA 80 that is listed and labeled by a qualified testing agency, for fire-

protection ratings indicated, based on testing at positive pressure according to NFPA 252 or UL 10C.

B. Smoke- and Draft-Control Door Assemblies: Where smoke- and draft-control door assemblies are required, provide door hardware that complies with requirements of assemblies tested according to UL 1784 and installed in compliance with NFPA 105.

1. Air Leakage Rate: Maximum air leakage of 0.3 cfm/sq. ft. (3 cu. m per minute/sq. m) at the tested pressure differential of 0.3-inch wg (75 Pa) of water.

C. Electrified Door Hardware: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

D. Means of Egress Doors: Latches do not require more than 15 lbf (67 N) to release the latch. Locks do not require use of a key, tool, or special knowledge for operation.

E. Accessibility Requirements: For door hardware on doors in an accessible route, comply with the DOJ's "2010 ADA Standards for Accessible Design".

1. Provide operating devices that do not require tight grasping, pinching, or twisting of the wrist and that operate with a force of not more than 5 lbf (22.2 N).
2. Comply with the following maximum opening-force requirements:

a. Interior, Non-Fire-Rated Hinged Doors: 5 lbf (22.2 N) applied perpendicular to door.
b. Sliding or Folding Doors: 5 lbf (22.2 N) applied parallel to door at latch.
c. Fire Doors: Minimum opening force allowable by authorities having jurisdiction.

3. Bevel raised thresholds with a slope of not more than 1:2. Provide thresholds not more than 1/2 inch (13 mm) high.
4. Adjust door closer sweep periods so that, from an open position of 90 degrees, the door will take at least 5 seconds to move to a position of 12 degrees from the latch.
5. Adjust spring hinges so that, from an open position of 70 degrees, the door will take at least 1.5 seconds to move to the closed position.

2.3 LOW ENERGY DOOR OPERATORS

A. General: Provide operators of size recommended by manufacturer for door size, weight, and movement; for condition of exposure; and for long-term, maintenance-free operation under normal traffic load for occupancy type indicated; and according to UL 325. Coordinate operator mechanisms with door operation, hinges, and activation and safety devices.

1. Emergency Breakaway: Where indicated for center-pivoted doors, provide emergency breakaway feature for reverse swing of doors. Equip system to discontinue power to automatic door operator when door is in emergency breakaway position, to return door to closed position after breakaway, and to automatically reset.
2. Fire-Rated Doors: Provide door operators for fire-rated door assemblies that comply with NFPA 80 for fire-rated door components and are listed and labeled by a qualified testing agency.

3. Wind Load: Provide door operators on exterior doors that will open and close doors and maintain them in fully closed position when subjected to wind load as required by building location and use.

B. Electrohydraulic Operating System: Self-contained, low-pressure unit; with separate cylinders for power and checking, connections for power and activation- and safety-device wiring, and manual operation including spring closing when power is off.

C. Standard: BHMA A156.19.

D. Performance Requirements:

1. Opening Force if Power Fails: Not more than 15 lbf (67 N) required to release latch if provided, not more than 30 lbf (133 N) required to manually set door in motion, and not more than 15 lbf (67 N) required to fully open door.
2. Entrapment-Prevention Force: Not more than 15 lbf (67 N) required to prevent stopped door from closing or opening.

E. Configuration: Operator to control single swinging door or pair of swinging doors as indicated on Drawings.

1. Traffic Pattern: One way.
2. Operator Mounting: Surface.

F. Operation: Power opening and power-assisted spring closing. Provide time delay for door to remain open before initiating closing cycle as required by BHMA A156.10.

G. Operating System: Electrohydraulic.

H. Microprocessor Control Unit: Solid-state controller.

I. Activation Device: Push-plate switch on each side of door to activate door operator. Coordinate activation of switch with access control system.

2.4 SCHEDULED DOOR HARDWARE

A. Provide products for each door that comply with requirements indicated in Part 2 and door hardware schedule.

1. Door hardware is scheduled on Drawings.

2.5 HINGES

A. Hinges: BHMA A156.1. Provide template-produced hinges for hinges installed on hollow-metal doors and hollow-metal frames.

2.6 CONTINUOUS HINGES

A. Continuous Hinges: BHMA A156.26; minimum 0.120-inch- (3.0-mm-) thick, hinge leaves with minimum overall width of 4 inches (102 mm); fabricated to full height of door and frame and to template screw locations; with components finished after milling and drilling are complete.

B. Continuous, Gear-Type Hinges: Extruded-aluminum, pinless, geared hinge leaves joined by a continuous extruded-aluminum channel cap; with concealed, self-lubricating thrust bearings.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Allegion plc.
b. Bommer Industries, Inc.
c. Hager Companies.
d. McKinney Products Company; an ASSA ABLOY Group company.
e. Pemko; an ASSA ABLOY Group Company.
f. Stanley Commercial Hardware; a division of Stanley Security Solutions.

2.7 MECHANICAL LOCKS AND LATCHES

A. Lock Functions: As indicated in door hardware schedule.

B. Lock Throw: Comply with testing requirements for length of bolts required for labeled fire doors, and as follows:

1. Bored Locks: Minimum 1/2-inch (13-mm) latchbolt throw.
2. Mortise Locks: Minimum 3/4-inch (19-mm) latchbolt throw.
3. Deadbolts: Minimum 1.25-inch (32-mm) bolt throw.

C. Lock Backset: 2-3/4 inches (70 mm) unless otherwise indicated.

D. Lock Trim:

1. Description: As indicated on Drawings.
2. Levers: Wrought or forged.
3. Escutcheons (Roses): Wrought or forged.
4. Dummy Trim: Match lever lock trim and escutcheons.

E. Strikes: Provide manufacturer's standard strike for each lock bolt or latchbolt complying with requirements indicated for applicable lock or latch and with strike box and curved lip extended to protect frame; finished to match lock or latch.

1. Flat-Lip Strikes: For locks with three-piece antifriction latchbolts, as recommended by manufacturer.
2. Extra-Long-Lip Strikes: For locks used on frames with applied wood casing trim.
3. Aluminum-Frame Strike Box: Manufacturer's special strike box fabricated for aluminum framing.
4. Rabbet Front and Strike: Provide on locksets for rabbeted meeting stiles.

F. Bored Locks: BHMA A156.2; Grade 2; Series 4000.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Allegion plc.
b. DORMA USA, Inc.
c. Hager Companies.
d. SARGENT Manufacturing Company; ASSA ABLOY.
e. Stanley Commercial Hardware; a division of Stanley Security Solutions.

2.8 AUXILIARY LOCKS

A. Bored Auxiliary Locks: BHMA A156.36: Grade 2; with strike that suits frame.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Allegion plc.
b. DORMA USA, Inc.
c. Hager Companies.
d. SARGENT Manufacturing Company; ASSA ABLOY.
e. Stanley Commercial Hardware; a division of Stanley Security Solutions.

2.9 ELECTRIC STRIKES

A. Electric Strikes: BHMA A156.31; Grade 1; with faceplate to suit lock and frame.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Allegion plc.
b. Dortronics Systems, Inc.
c. Hager Companies.
d. Securitron Magnalock Corporation; an ASSA ABLOY Group company.
e. Stanley Commercial Hardware; a division of Stanley Security Solutions.

2.10 ELECTROMECHANICAL EXIT DEVICES

A. Electromechanical Locks: BHMA A156.25; Grade 1; motor or solenoid driven; with strike that suits frame.

1. Basis-of-Design Product: Subject to compliance with requirements, provide Allegion plc; Von Duprin EL99 Series, or a comparable product by one of the following:

a. SARGENT Manufacturing Company; ASSA ABLOY.
b. Stanley Commercial Hardware; a division of Stanley Security Solutions.

2. Type: Rim exit device.

2.11 EXIT DEVICES AND AUXILIARY ITEMS

A. Exit Devices and Auxiliary Items: BHMA A156.3.

1. Basis-of-Design Product: Subject to compliance with requirements, provide Allegion plc; Von Duprin 99 Series, or a comparable product by one of the following:

a. SARGENT Manufacturing Company; ASSA ABLOY.
b. Stanley Commercial Hardware; a division of Stanley Security Solutions.

2.12 LOCK CYLINDERS

A. Standard Lock Cylinders: BHMA A156.5; Grade 1 permanent cores; face finished to match lockset.

1. Core Type: Interchangeable.
2. Match Owner's existing cores and keying system.

2.13 KEYING

A. Keying System: Factory registered, complying with guidelines in BHMA A156.28, appendix. Provide one extra key blank for each lock.[**Incorporate decisions made in keying conference.**]

1. Match Owner's existing cores and keying system.
2. Existing System:

a. Master key or grand master key locks to Owner's existing system.

B. Keys: Nickel silver or brass.

2.14 OPERATING TRIM

A. Operating Trim: BHMA A156.6; stainless steel unless otherwise indicated.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Allegion plc.
b. Burns Manufacturing Incorporated.
c. Hager Companies.
d. Rockwood Manufacturing Company; an ASSA ABLOY Group company.
e. Trimco.

2.15 LOW-ENERGY DOOR OPERATORS

A. Basis-of-Design Product: Subject to compliance with requirements, provide LCN; an Allegion brand; 9540 Series or a comparable product by one of the following:

1. DORMA USA, Inc.
2. Hager Companies.
3. Horton Automatics; a division of Overhead Door Corporation.
4. SARGENT Manufacturing Company; ASSA ABLOY.
5. Stanley Access Technologies.

2.16 SURFACE CLOSERS

A. Surface Closers: BHMA A156.4; rack-and-pinion hydraulic type with adjustable sweep and latch speeds controlled by key-operated valves and forged-steel main arm. Comply with manufacturer's written instructions for size of door closers depending on size of door, exposure to weather, and anticipated frequency of use. Provide factory-sized closers, adjustable to meet field conditions and requirements for opening force.

1. Basis-of-Design Product: Subject to compliance with requirements, provide Allegion plc; LCN 4040XP heavy-duty closer, or a comparable product by one of the following:

   a. DORMA USA, Inc.
   b. Hager Companies.
   c. SARGENT Manufacturing Company; ASSA ABLOY.
   d. Stanley Commercial Hardware; a division of Stanley Security Solutions.

2. Provide with heavy-duty, mechanically-fastened cover in lieu of snap-on trim.

2.17 MECHANICAL STOPS AND HOLDERS

A. Wall- and Floor-Mounted Stops: BHMA A156.16.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Allegion plc.
   b. Burns Manufacturing Incorporated.
   c. Hager Companies.
   d. Rockwood Manufacturing Company; an ASSA ABLOY Group company.
   e. Trimco.

2.18 OVERHEAD STOPS AND HOLDERS

A. Overhead Stops and Holders: BHMA A156.8.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Allegion plc.
   b. DORMA USA, Inc.
   c. Hager Companies.
   d. SARGENT Manufacturing Company; ASSA ABLOY.

2.19 DOOR GASKETING

A. Door Gasketing: BHMA A156.22; with resilient or flexible seal strips that are easily replaceable and readily available from stocks maintained by manufacturer.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Hager Companies.
   b. National Guard Products, Inc.
   c. Pemko; an ASSA ABLOY Group Company.
   d. Reese Enterprises, Inc.
   e. Zero International; an Allegion brand.

B. Maximum Air Leakage: When tested according to ASTM E 283 with tested pressure differential of 0.3-inch wg (75 Pa), as follows:

1. Smoke-Rated Gasketing: 0.3 cfm/sq. ft. (3 cu. m per minute/sq. m) of door opening.
2. Gasketing on Single Doors: 0.3 cfm/sq. ft. (3 cu. m per minute/sq. m) of door opening.
3. Gasketing on Double Doors: 0.50 cfm per foot (0.000774 cu. m/s per m) of door opening.

2.20 THRESHOLDS

A. Thresholds: BHMA A156.21; fabricated to full width of opening indicated.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Hager Companies.
   b. National Guard Products, Inc.
   c. Pemko; an ASSA ABLOY Group Company.
   d. Reese Enterprises, Inc.
   e. Zero International; an Allegion brand.

2. Provide ADA-compliant accessible threshold profiles.

2.21 METAL PROTECTIVE TRIM UNITS

A. Metal Protective Trim Units: BHMA A156.6; fabricated from 0.050-inch- (1.3-mm-) thick stainless steel; with manufacturer's standard machine or self-tapping screw fasteners.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Allegion plc.
   b. Burns Manufacturing Incorporated.
   c. Hager Companies.
   d. Rockwood Manufacturing Company; an ASSA ABLOY Group company.
   e. Trimco.

2.22 AUXILIARY DOOR HARDWARE

A. Auxiliary Hardware: BHMA A156.16.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Allegion plc.
   b. Hager Companies.
   c. Rockwood Manufacturing Company; an ASSA ABLOY Group company.
   d. Trimco.

2.23 AUXILIARY ELECTRIFIED DOOR HARDWARE

A. Auxiliary Electrified Door Hardware:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Allegion plc.
   b. DORMA USA, Inc.
   c. Hager Companies.
   d. Precision Hardware, Inc.; a Stanley company.
   e. SARGENT Manufacturing Company; ASSA ABLOY.
   f. Securitron Magnalock Corporation; an ASSA ABLOY Group company.

2.24 FABRICATION

A. Manufacturer's Nameplate: Do not provide products that have manufacturer's name or trade name displayed in a visible location except in conjunction with required fire-rating labels and as otherwise approved by Architect.

1. Manufacturer's identification is permitted on rim of lock cylinders only.

B. Base Metals: Produce door hardware units of base metal indicated, fabricated by forming method indicated, using manufacturer's standard metal alloy, composition, temper, and hardness. Furnish metals of a quality equal to or greater than that of specified door hardware units and BHMA A156.18.

C. Fasteners: Provide door hardware manufactured to comply with published templates prepared for machine, wood, and sheet metal screws. Provide screws that comply with commercially recognized industry standards for application intended, except aluminum fasteners are not permitted. Provide Phillips flat-head screws with finished heads to match surface of door hardware unless otherwise indicated.

1. Concealed Fasteners: For door hardware units that are exposed when door is closed, except for units already specified with concealed fasteners. Do not use through bolts for installation where bolt head or nut on opposite face is exposed unless it is the only means of securely attaching the door hardware. Where through bolts are used on hollow door and frame construction, provide sleeves for each through bolt.
2. Fire-Rated Applications:

a. Wood or Machine Screws: For the following:

1) Hinges mortised to doors or frames; use threaded-to-the-head wood screws for wood doors and frames.
2) Strike plates to frames.
3) Closers to doors and frames.

b. Steel Through Bolts: For the following unless door blocking is provided:

1) Surface hinges to doors.
2) Closers to doors and frames.
3) Surface-mounted exit devices.

3. Spacers or Sex Bolts: For through bolting of hollow-metal doors.
4. Gasketing Fasteners: Provide noncorrosive fasteners for exterior applications and elsewhere as indicated.

2.25 FINISHES

A. Provide finishes complying with BHMA A156.18. All door hardware finishes to be US32D satin stainless steel or US26D satin chrome plated unless noted otherwise.

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.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine doors and frames, with Installer present, for compliance with requirements for installation tolerances, labeled fire-rated door assembly construction, wall and floor construction, and other conditions affecting performance of the Work.

B. Examine roughing-in for electrical power systems to verify actual locations of wiring connections before electrified door hardware installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Steel Doors and Frames: For surface-applied door hardware, drill and tap doors and frames according to ANSI/SDI A250.6.

B. Wood Doors: Comply with door and hardware manufacturers' written instructions.

3.3 INSTALLATION

A. Mounting Heights: Mount door hardware units at heights to comply with the following unless otherwise indicated or required to comply with governing regulations.

1. Standard Steel Doors and Frames: ANSI/SDI A250.8.
2. Custom Steel Doors and Frames: HMMA 831.
3. Wood Doors: DHI's "Recommended Locations for Architectural Hardware for Wood Flush Doors."

B. Install each door hardware item to comply with manufacturer's written instructions. Where cutting and fitting are required to install door hardware onto or into surfaces that are later to be painted or finished in another way, coordinate removal, storage, and reinstallation of surface protective trim units with finishing work. Do not install surface-mounted items until finishes have been completed on substrates involved.

1. Set units level, plumb, and true to line and location. Adjust and reinforce attachment substrates as necessary for proper installation and operation.
2. Drill and countersink units that are not factory prepared for anchorage fasteners. Space fasteners and anchors according to industry standards.

C. Hinges: Install types and in quantities indicated in door hardware schedule, but not fewer than the number recommended by manufacturer for application indicated or one hinge for every 30 inches (750 mm) of door height, whichever is more stringent, unless other equivalent means of support for door, such as spring hinges or pivots, are provided.

D. Intermediate Offset Pivots: Where offset pivots are indicated, provide intermediate offset pivots in quantities indicated in door hardware schedule, but not fewer than one intermediate offset pivot per door and one additional intermediate offset pivot for every 30 inches (750 mm) of door height greater than 90 inches (2286 mm).

E. Lock Cylinders: Install construction cores to secure building and areas during construction period.

1. Replace construction cores with permanent cores as directed by Owner.

F. Boxed Power Supplies: Locate power supplies as indicated or, if not indicated, in coordination with Owner and Architect.

1. Configuration: Provide one power supply for each door opening with electrified door hardware.

G. Thresholds: Set thresholds for exterior doors and other doors indicated in full bed of sealant complying with requirements specified in Section 079200 "Joint Sealants."

H. Stops: Provide floor stops for doors unless wall or other type stops are indicated in door hardware schedule. Do not mount floor stops where they will impede traffic.

I. Perimeter Gasketing: Apply to head and jamb, forming seal between door and frame.

1. Do not notch perimeter gasketing to install other surface-applied hardware.

J. Meeting Stile Gasketing: Fasten to meeting stiles, forming seal when doors are closed.

K. Door Bottoms: Apply to bottom of door, forming seal with threshold when door is closed.

3.4 ADJUSTING

A. Initial Adjustment: Adjust and check each operating item of door hardware and each door to ensure proper operation or function of every unit. Replace units that cannot be adjusted to operate as intended. Adjust door control devices to compensate for final operation of heating and ventilating equipment and to comply with referenced accessibility requirements.

1. Door Closers: Adjust sweep period to comply with accessibility requirements and requirements of authorities having jurisdiction.
2. Spring Hinges: Adjust to achieve positive latching when door is allowed to close freely from an open position of 70 degrees and so that closing time complies with accessibility requirements of authorities having jurisdiction.
3. Electric Strikes: Adjust horizontal and vertical alignment of keeper to properly engage lock bolt.

B. Occupancy Adjustment: Approximately six months after date of Substantial Completion, Installer's Architectural Hardware Consultant shall examine and readjust each item of door hardware, including adjusting operating forces, as necessary to ensure function of doors, door hardware, and electrified door hardware.

3.5 CLEANING AND PROTECTION

A. Clean adjacent surfaces soiled by door hardware installation.

B. Clean operating items as necessary to restore proper function and finish.

C. Provide final protection and maintain conditions that ensure that door hardware is without damage or deterioration at time of Substantial Completion.

3.6 MAINTENANCE SERVICE

A. Maintenance Tools and Instructions: Furnish a complete set of specialized tools and maintenance instructions for Owner's continued adjustment, maintenance, and removal and replacement of door hardware.

B. Maintenance Service: Beginning at Substantial Completion, maintenance service shall include six months' full maintenance by skilled employees of door hardware Installer. Include quarterly preventive maintenance, repair or replacement of worn or defective components, lubrication, cleaning, and adjusting as required for proper door and door hardware operation. Parts and supplies shall be manufacturer's authorized replacement parts and supplies.

3.7 DEMONSTRATION

A. Train Owner's maintenance personnel to adjust, operate, and maintain door hardware.

END OF SECTION 087100

SECTION 088000 - GLAZING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes:

1. Glass for storefront framing and entrances.
2. Glazing sealants and accessories.

1.3 DEFINITIONS

A. Glass Manufacturers: 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. IBC: International Building Code.

D. Interspace: Space between lites of an insulating-glass unit.

1.4 COORDINATION

A. Coordinate glazing channel dimensions to provide necessary bite on glass, minimum edge and face clearances, and adequate sealant thicknesses, with reasonable tolerances.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Glazing Schedule: List glass types and thicknesses for each size opening and location. Use same designations indicated on Drawings.

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Product Certificates: For glass.

C. Product Test Reports: For insulating glass, for tests performed by a qualified testing agency.

D. Sample Warranties: For special warranties.

1.7 QUALITY ASSURANCE

A. Manufacturer Qualifications for Insulating-Glass Units with Sputter-Coated, Low-E Coatings: A qualified insulating-glass manufacturer who is approved by coated-glass manufacturer.

B. Installer Qualifications: A qualified installer who employs glass installers for this Project who are certified under the National Glass Association's Certified Glass Installer Program.

C. Glass Testing Agency Qualifications: A qualified independent testing agency accredited according to the NFRC CAP 1 Certification Agency Program.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Protect glazing materials according to manufacturer's written instructions. Prevent damage to glass and glazing materials from condensation, temperature changes, direct exposure to sun, or other causes.

B. Comply with insulating-glass manufacturer's written instructions for venting and sealing units to avoid hermetic seal ruptures due to altitude change.

1.9 FIELD 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 glazing sealants when ambient and substrate temperature conditions are outside limits permitted by sealant manufacturer or are below 40 deg F (4.4 deg C).

1.10 WARRANTY

A. Manufacturer's Special Warranty for Coated-Glass Products: Manufacturer agrees to replace coated-glass units that deteriorate within specified warranty period. Deterioration of coated glass is defined as defects developed from normal use that are not attributed to glass breakage or to maintaining and cleaning coated glass contrary to manufacturer's written instructions. Defects include peeling, cracking, and other indications of deterioration in coating.

1. Warranty Period: 10 years from date of Substantial Completion.

B. Manufacturer's Special Warranty for Laminated Glass: Manufacturer agrees to replace laminated-glass units that deteriorate within specified warranty period. Deterioration of

laminated glass is defined as defects developed from normal use that are not attributed to glass breakage or to maintaining and cleaning laminated glass contrary to manufacturer's written instructions. Defects include edge separation, delamination materially obstructing vision through glass, and blemishes exceeding those allowed by referenced laminated-glass standard.

1. Warranty Period: 10 years from date of Substantial Completion.

C. Manufacturer's Special Warranty for Insulating Glass: Manufacturer agrees to replace insulating-glass units that deteriorate within specified warranty period. Deterioration of insulating glass is defined as failure of hermetic seal under normal use that is not attributed to glass breakage or to 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.

1. Warranty Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Source Limitations for Glass: Obtain from single source from single manufacturer for each glass type.

B. Source Limitations for Glazing Accessories: Obtain from single source from single manufacturer for each product and installation method.

2.2 PERFORMANCE REQUIREMENTS

A. General: Installed glazing systems shall withstand normal thermal movement and wind and impact loads (where applicable) without failure, including loss or glass breakage attributable to the following: defective manufacture, fabrication, or installation; failure of sealants or gaskets to remain watertight and airtight; deterioration of glazing materials; or other defects in construction.

B. Structural Performance: Glazing shall withstand the following design loads within limits and under conditions indicated determined according to the IBC and ASTM E 1300.
   1. Design Wind Pressures: Determine design wind pressures applicable to Project according to ASCE/SEI 7, based on heights above grade indicated on Drawings.
   2. Maximum Lateral Deflection: For glass supported on all four edges, limit center-of-glass deflection at design wind pressure to not more than 1/50 times the short-side length or 1 inch (25 mm), whichever is less.
   3. Differential Shading: Design glass to resist thermal stresses induced by differential shading within individual glass lites.

C. Windborne-Debris-Impact Resistance: Exterior glazing shall comply with basic-protection testing requirements in ASTM E 1996 for Wind Zone 2 when tested according to

ASTM E 1886. Test specimens shall be no smaller in width and length than glazing indicated for use on Project and shall be installed in same manner as glazing indicated for use on Project.

1. Large-Missile Test: For glazing located within 30 feet (9.1 m) of grade.

D. Safety Glazing: Where safety glazing is indicated, provide glazing that complies with 16 CFR 1201, Category II.

E. Thermal and Optical Performance Properties: Provide glass with performance properties specified, as indicated in manufacturer's published test data, based on procedures indicated below:

1. For monolithic-glass lites, properties are based on units with lites 6 mm thick.
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. U-Factors: Center-of-glazing values, according to NFRC 100 and based on LBL's WINDOW 5.2 computer program, expressed as Btu/sq. ft. x h x deg F (W/sq. m x K).
5. Solar Heat-Gain Coefficient and Visible Transmittance: Center-of-glazing values, according to NFRC 200 and based on LBL's WINDOW 5.2 computer program.
6. Visible Reflectance: Center-of-glazing values, according to NFRC 300.

2.3 GLASS PRODUCTS, GENERAL

A. Glazing Publications: Comply with published recommendations 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. GANA Publications: "Laminated Glazing Reference Manual" and "Glazing Manual."
2. IGMA Publication for Insulating Glass: SIGMA TM-3000, "North American Glazing Guidelines for Sealed Insulating Glass Units for Commercial and Residential Use."

B. Safety Glazing Labeling: Where safety glazing is indicated, permanently mark glazing with certification label of the SGCC or another certification agency acceptable to authorities having jurisdiction. Label shall indicate manufacturer's name, type of glass, thickness, and safety glazing standard with which glass complies.

C. Insulating-Glass Certification Program: Permanently marked either on spacers or on at least one component lite of units with appropriate certification label of IGCC.

D. Thickness: Where glass thickness is indicated, it is a minimum. Provide glass that complies with performance requirements and is not less than the thickness indicated.

1. Minimum Glass Thickness for Exterior Lites: 6 mm.
2. Thickness of Tinted Glass: Provide same thickness for each tint color indicated throughout Project.

E. Strength: Where annealed float glass is indicated, provide annealed float glass, heat-strengthened float glass, or fully tempered float glass as needed to comply with "Performance

Requirements" Article. Where heat-strengthened float glass is indicated, provide heat-strengthened float glass or fully tempered float glass as needed to comply with "Performance Requirements" Article. Where fully tempered float glass is indicated, provide fully tempered float glass.

2.4 GLASS PRODUCTS

A. Fully Tempered Float Glass: ASTM C 1048, Kind FT (fully tempered), Condition A (uncoated) unless otherwise indicated, Type I, Class 1 (clear) or Class 2 (tinted) as indicated, Quality-Q3.

1. Fabrication Process: By horizontal (roller-hearth) process with roll-wave distortion parallel to bottom edge of glass as installed unless otherwise indicated.

2.5 INSULATING GLASS

A. Insulating-Glass Units: Factory-assembled units consisting of sealed lites of glass separated by a dehydrated interspace, qualified according to ASTM E 2190.

1. Sealing System: Dual seal, with manufacturer's standard primary and secondary sealants.
2. Perimeter Spacer: Manufacturer's standard spacer material and construction.

3. Desiccant: Molecular sieve or silica gel, or a blend of both.

2.6 GLAZING SEALANTS

A. General:

1. Compatibility: Compatible with one another and with other materials they 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. Glazing Sealant: Neutral-curing silicone glazing sealant complying with ASTM C 920, Type S, Grade NS, Class 100/50, Use NT or as recommended by manufacturer.

2.7 MISCELLANEOUS GLAZING MATERIALS

A. General: Provide products of material, size, and shape complying with referenced glazing standard, with 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 of 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).

F. Cylindrical Glazing Sealant Backing: ASTM C 1330, Type O (open-cell material), of size and density to control glazing sealant depth and otherwise produce optimum glazing sealant performance.

2.8 APPLIED SAFETY FILM

A. Provide field- or shop-applied security film on exterior face of all exterior glass glazing. Use material recommended by manufacturer for location and compatible with glass substrate. Install as recommended by manufacturer.

B. Basis of Design Product: subject to compliance with requirements, provide product indicated or comparable product approved by Architect:
   1. 3M Company, Safety & Security Window Film Exterior Safety Series, Type Safety S70.
      a. Thickness: 7 mil (0.18 mm)
      b. Tensile Strength: 25,000 psi (172 MPa)
      c. Break Strength: 175 lbs/in (778 N / 25 mm)

2.9 FABRICATION OF GLAZING UNITS

A. Fabricate glazing units in sizes required to fit 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.

   1. Allow for thermal movements from ambient and surface temperature changes acting on glass framing members and glazing components.

      a. Temperature Change: 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.

B. Clean-cut or flat-grind vertical edges of butt-glazed monolithic lites to produce square edges with slight chamfers at junctions of edges and faces.

C. Grind smooth and polish exposed glass edges and corners.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine framing, glazing channels, and stops, 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 systems.
3. Minimum required face and 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.

B. Examine glazing units to locate exterior and interior surfaces. Label or mark units as needed so that exterior and interior surfaces are readily identifiable. Do not use materials that leave visible marks in the completed Work.

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. Protect glass edges from damage during handling and installation. Remove damaged glass from Project site and legally dispose of off Project site. Damaged glass includes glass with edge damage or other imperfections that, when installed, could weaken glass, impair performance, or impair appearance.

C. Apply primers to joint surfaces where required for adhesion of sealants, as determined by preconstruction testing.

D. 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.

E. Do not exceed edge pressures stipulated by glass manufacturers for installing glass lites.

F. Provide spacers for glass lites where length plus width is larger than 50 inches (1270 mm).

1. Locate spacers directly opposite each other on both inside and outside faces of glass. Install correct size and spacing to preserve required face clearances, unless gaskets and glazing tapes are used that have demonstrated ability to maintain required face clearances and to comply with system performance requirements.
2. Provide 1/8-inch (3-mm) minimum bite of spacers on glass and use thickness equal to sealant width. With glazing tape, use thickness slightly less than final compressed thickness of tape.

G. 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.

H. Set glass lites in each series with uniform pattern, draw, bow, and similar characteristics.

I. Set glass lites with proper orientation so that coatings face exterior or interior as specified.

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 GASKET GLAZING (DRY)

A. Cut compression gaskets to 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. Installation with Drive-in Wedge Gaskets: 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. Installation with Pressure-Glazing Stops: Center glass lites in openings on setting blocks, and press firmly against soft compression gasket. Install dense compression gaskets and pressure-glazing stops, applying pressure uniformly to compression gaskets. Compress gaskets to produce a weathertight seal without developing bending stresses in glass. Seal gasket joints with sealant recommended by gasket manufacturer.

E. Install gaskets so they protrude past face of glazing stops.

3.5 CLEANING AND PROTECTION

A. Immediately after installation remove nonpermanent labels and clean surfaces.

B. Protect glass from contact with contaminating substances resulting from construction operations. 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.

1. If, despite such protection, contaminating substances do come into contact with glass, remove substances immediately as recommended in writing by glass manufacturer. Remove and replace glass that cannot be cleaned without damage to coatings.

C. Remove and replace glass that is damaged during construction period.

D. Wash glass on both exposed surfaces 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.

3.6 MONOLITHIC GLASS SCHEDULE

A. Glass Type GL-1: Clear fully tempered float glass.

1. Minimum Thickness: 6 mm.
2. Safety glazing required.
3. Provide applied safety film as specified.

3.7 INSULATING GLASS SCHEDULE

A. Glass Type GL-2: Low-E-coated, clear insulating glass.
1. Overall Unit Thickness: 1 inch (25 mm).
2. Minimum Thickness of Each Glass Lite: 6 mm.
3. Outdoor Lite: Fully tempered float glass.
4. Interspace Content: Argon.
5. Indoor Lite: Fully tempered float glass.
6. Low-E Coating: Pyrolytic or sputtered on second or third surface.
7. U-factor - Winter Nighttime: 0.68
8. U-factor - Summer Daytime: 0.53
9. Visible Light Transmittance: 69 percent minimum.
10. Solar Heat Gain Coefficient: 0.70 maximum.
11. Safety glazing required.
12. Provide applied safety film as specified.

3.8 INSULATED METAL PANELS

A. As specified in 084113 “Aluminum Entrances and Storefronts”.

END OF SECTION 088000

SECTION 092216 - NON-STRUCTURAL METAL FRAMING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Non-load-bearing steel framing systems for interior partitions.
2. Suspension systems for interior ceilings and soffits.
3. Grid suspension systems for gypsum board ceilings.

B. Related Requirements:

1. Section 054000 "Cold-Formed Metal Framing" for exterior and interior load-bearing and exterior non-load-bearing wall studs; floor joists; roof rafters and ceiling joists; and roof trusses.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1.4 INFORMATIONAL SUBMITTALS

A. Product Certificates: For each type of code-compliance certification for studs and tracks.

B. Evaluation Reports: For embossed steel studs and tracks and firestop tracks, from ICC-ES or other qualified testing agency acceptable to authorities having jurisdiction.

1.5 QUALITY ASSURANCE

A. Code-Compliance Certification of Studs and Tracks: Provide documentation that framing members are certified according to the product-certification program of the Certified Steel Stud Association, the Steel Framing Industry Association, or the Steel Stud Manufacturers Association.

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 on Drawings, according to ASTM E 90 and classified according to ASTM E 413 by an independent testing agency.

C. Horizontal Deflection: For wall assemblies, limited to 1/240 of the wall height based on horizontal loading of 10 lbf/sq. ft. (480 Pa).

2.2 FRAMING SYSTEMS

A. Framing Members, General: Comply with ASTM C 754 for conditions indicated.

1. Steel Sheet Components: Comply with ASTM C 645 requirements for metal unless otherwise indicated.
2. Protective Coating: Coating with equivalent corrosion resistance of ASTM A 653/A 653M, G40 (Z120), hot-dip galvanized unless otherwise indicated.

B. Studs and Tracks: ASTM C 645. Use either steel studs and tracks or embossed steel studs and tracks.

1. Steel Studs and Tracks:

a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1) ClarkDietrich Building Systems.
2) MarinoWARE.
3) MBA Building Supplies.
4) SCAFCO Steel Stud Company.
5) Steel Network, Inc. (The).

b. Minimum Base-Metal Thickness: As required by performance requirements for horizontal deflection, 0.0239 inch (0.607 mm) 24 gage minimum.
c. Depth: As indicated on Drawings.

2. Embossed Steel Studs and Tracks: Roll-formed and embossed with surface deformations to stiffen the framing members so that they are structurally equivalent to conventional ASTM C 645 steel studs and tracks.

a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1) ClarkDietrich Building Systems.
2) MarinoWARE.
3) MBA Building Supplies.
4) SCAFCO Steel Stud Company.
5) Steel Network, Inc. (The).

b. Minimum Base-Metal Thickness: As required by horizontal deflection performance requirements, 0.0179 inch (0.454 mm) 26 gage minimum.
c. Depth: As indicated on Drawings.

C. Slip-Type Head Joints: Where indicated, provide one of the following:
1. Double-Track System: ASTM C 645 top outer tracks, inside track with 2-inch- (51-mm-) deep flanges in thickness not less than indicated for studs and fastened to studs, and outer track sized to friction-fit over inner track.
2. Deflection Track: Steel sheet top track 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. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1) ClarkDietrich Building Systems.
2) MarinoWARE.
3) MBA Building Supplies.
4) SCAFCO Steel Stud Company.
5) Steel Network, Inc. (The).

D. Firestop Tracks: Top track manufactured to allow partition heads to expand and contract with movement of 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. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. ClarkDietrich Building Systems.
b. Fire Trak Corp.
c. MarinoWARE.
d. SCAFCO Steel Stud Company.
e. Steel Network, Inc. (The).

E. Flat Strap and Backing Plate: Steel sheet for blocking and bracing in length and width indicated.

1. Minimum Base-Metal Thickness: As indicated on Drawings, 0.0359 inch (0.912 mm) 20 gage minimum.

F. Cold-Rolled Channel Bridging: Steel, 0.0598-inch (1.518-mm) 16 gage minimum base-metal thickness, with minimum 1/2-inch- (13-mm-) wide flanges.

1. Depth: As indicated on Drawings, or 1-1/2 inches (38 mm) minimum.

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.

G. Hat-Shaped, Rigid Furring Channels: ASTM C 645.

1. Minimum Base-Metal Thickness: As required by horizontal deflection performance requirements, 0.0179 inch (0.454 mm) 26 gage minimum.
2. Depth: As indicated on Drawings.

H. Resilient Furring Channels: 1/2-inch- (13-mm-) deep, steel sheet members designed to reduce sound transmission.

1. Configuration: Asymmetrical or hat shaped.

I. Cold-Rolled Furring Channels: 0.0598-inch (1.518-mm) 16 gage uncoated-steel thickness, with minimum 1/2-inch- (13-mm-) wide flanges.

1. Depth: As indicated on Drawings, or 3/4 inch (19 mm) if no depth is given.
2. Furring Brackets: Adjustable, corrugated-edge-type steel sheet with minimum uncoated-steel thickness of 0.0359 inch (0.911 mm) 20 gage.
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.

J. 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 0.0179 inch (0.455 mm) 26 gage, 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. Post-Installed Anchors: Fastener systems with an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC01, AC193, AC58, or AC308 as appropriate for the substrate.

a. Uses: Securing hangers to structure.
b. 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.
c. Material for Exterior or Interior Locations and Where Stainless Steel Is Indicated: Alloy Group 1 (A1) or Group 2 (A4) stainless-steel bolts, ASTM F 593 (ASTM F 738M), and nuts, ASTM F 594 (ASTM F 836M).

2. Power-Actuated Anchors: Fastener systems with an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC70.

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, 1 by 3/16 inch (25 by 5 mm) by length indicated.

E. Carrying Channels (Main Runners): Cold-rolled, commercial-steel sheet with a base-metal thickness of 0.0598-inch (1.518-mm) 16 gage and minimum 1/2-inch- (13-mm-) wide flanges.

1. Depth: As indicated on Drawings, or 2 inches (51 mm) if no depth is given.

F. Furring Channels (Furring Members):

1. Cold-Rolled Channels: 0.0598-inch (1.518-mm) 16 gage uncoated-steel thickness, with minimum 1/2-inch- (13-mm-) wide flanges, 3/4 inch (19 mm) deep.
2. Steel Studs and Tracks: ASTM C 645.

a. Minimum Base-Metal Thickness: 0.0299 inch (0.752 mm) 22 gage.
b. Depth: As indicated on Drawings.

3. Embossed Steel Studs and Tracks: ASTM C 645.

a. Minimum Base-Metal Thickness: 0.0239 inch (0.607 mm) 24 gage.
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: 0.0299 inch (0.752 mm) 22 gage.

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. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Armstrong World Industries, Inc.
b. Chicago Metallic Corporation.
c. United States Gypsum Company.

2.4 AUXILIARY MATERIALS

A. General: Provide auxiliary materials that comply with referenced installation standards.

1. Fasteners for Steel 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/D 226M, 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. Coordination with Sprayed Fire-Resistive Materials:

1. Before sprayed fire-resistive materials are applied, attach offset anchor plates or ceiling tracks to surfaces indicated to receive sprayed fire-resistive materials. Where offset anchor plates are required, provide continuous plates fastened to building structure not more than 24 inches (610 mm) o.c.
2. After sprayed fire-resistive materials are applied, remove them only to extent necessary for installation of non-load-bearing steel framing. Do not reduce thickness of fire-resistive materials below that are required for fire-resistance ratings indicated. Protect adjacent fire-resistive materials from damage.

3.3 INSTALLATION, GENERAL

A. Installation Standard: ASTM C 754.

1. Gypsum Board Assemblies: Also comply with requirements in ASTM C 840 that apply to framing installation.

B. Install framing and accessories plumb, square, and true to line, with connections securely fastened.

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.

3.4 INSTALLING FRAMED ASSEMBLIES

A. Install framing system components according to spacings indicated, but not greater than spacings required by referenced installation standards for assembly types.

1. Single-Layer Application: As required by horizontal deflection performance requirements, or as indicated on Drawings.
2. Multilayer Application: As required by horizontal deflection performance requirements, or as indicated on Drawings.

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 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 that penetrate 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 track section (for cripple studs) at head and secure to jamb studs.

    a. Install two studs at each jamb unless otherwise indicated.
    b. Extend jamb studs through suspended ceilings and attach to underside of overhead structure.

3. Other Framed Openings: Frame openings other than door openings the same as required for door openings unless otherwise indicated. Install framing below sills of openings to match framing required above door heads.
4. Fire-Resistance-Rated Partitions: Install framing to comply with fire-resistance-rated assembly indicated and support closures and to make partitions continuous from floor to underside of solid structure.

    a. Firestop Track: Where indicated, install to maintain continuity of fire-resistance-rated assembly indicated.

5. Sound-Rated Partitions: Install framing to comply with sound-rated assembly indicated.
6. Curved Partitions:

    a. Bend track to uniform curve and locate straight lengths so they are tangent to arcs.
    b. Begin and end each arc with a stud, and space intermediate studs equally along arcs. On straight lengths of no fewer than two studs at ends of arcs, place studs 6 inches (150 mm) o.c.

E. Direct Furring:

1. Attach to concrete or masonry with stub nails, screws designed for masonry attachment, or powder-driven fasteners spaced 24 inches (610 mm) o.c.

F. Z-Shaped Furring Members:

1. Erect insulation, specified in Section 072100 "Thermal Insulation," vertically and hold in place with Z-shaped furring members spaced 24 inches (610 mm) o.c.
2. Except at exterior corners, securely attach narrow flanges of furring members to wall with concrete stub nails, screws designed for masonry attachment, or powder-driven fasteners spaced 24 inches (610 mm) o.c.
3. At exterior corners, attach wide flange of furring members to wall with short flange extending beyond corner; on adjacent wall surface, screw-attach short flange of furring channel to web of attached channel. At interior corners, space second member no more than 12 inches (305 mm) from corner and cut insulation to fit.

G. Installation Tolerance: Install each framing member so fastening surfaces vary not more than 1/8 inch (3 mm) from the plane formed by faces of adjacent framing.

3.5 INSTALLING CEILING 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): 24 inches (610 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 092216

SECTION 092900 - GYPSUM BOARD

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Interior gypsum board.
2. Tile backing panels.

B. Related Requirements:

1. Section 092216 "Non-Structural Metal Framing" for non-structural steel framing and suspension systems that support gypsum board panels.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1.4 DELIVERY, STORAGE AND HANDLING

A. Store materials inside under cover and keep them dry and protected against weather, condensation, direct sunlight, construction traffic, and other potential causes of damage. Stack panels flat and supported on risers on a flat platform to prevent sagging.

1.5 FIELD CONDITIONS

A. Environmental Limitations: Comply with ASTM C 840 requirements or gypsum board manufacturer's written instructions, 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, 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.

PART 2 - PRODUCTS

2.1 GYPSUM BOARD, GENERAL

A. Size: Provide maximum lengths and widths available that will minimize joints in each area and that correspond with support system indicated.

2.2 INTERIOR GYPSUM BOARD

A. Gypsum Wallboard: ASTM C 1396/C 1396M.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. CertainTeed Gypsum.
b. Georgia-Pacific Gypsum LLC.
c. National Gypsum Company.
d. USG Corporation.

2. Thickness: 5/8 inch (15.9 mm).
3. Long Edges: Tapered and featured (rounded or beveled) for prefilling.

B. Gypsum Board, Type X: ASTM C 1396/C 1396M.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. CertainTeed Gypsum.
b. Georgia-Pacific Gypsum LLC.
c. National Gypsum Company.
d. USG Corporation.

2. Thickness: 5/8 inch (15.9 mm).
3. Long Edges: Tapered and featured (rounded or beveled) for prefilling.

C. Mold-Resistant Gypsum Board: ASTM C 1396/C 1396M. With moisture- and mold-resistant core and paper surfaces.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. CertainTeed Gypsum.
b. Georgia-Pacific Gypsum LLC.
c. National Gypsum Company.
d. USG Corporation.

2. Core: 5/8 inch (15.9 mm), Type X.
3. Long Edges: Tapered.

4. Mold Resistance: ASTM D 3273, score of 10 as rated according to ASTM D 3274.

2.3 TILE BACKING PANELS

A. Glass-Mat, Water-Resistant Backing Board: ASTM C 1178/C 1178M, with manufacturer's standard edges.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. CertainTeed Corporation.
   b. Georgia-Pacific Gypsum LLC.
   c. National Gypsum Company.
   d. USG Corporation.

2. Core: 5/8 inch (15.9 mm), Type X.
3. Mold Resistance: ASTM D 3273, score of 10 as rated according to ASTM D 3274.

****** OR ******

B. Cementitious Backer Units: ANSI A118.9 and ASTM C 1288 or ASTM C 1325, with manufacturer's standard edges.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. CertainTeed Corporation.
   b. James Hardie Building Products, Inc.
   c. National Gypsum Company.
   d. USG Corporation.

2. Thickness: 5/8 inch (15.9 mm).
3. Mold Resistance: ASTM D 3273, score of 10 as rated according to ASTM D 3274.

2.4 TRIM ACCESSORIES

A. Interior Trim: ASTM C 1047.

1. Material: Galvanized or aluminum-coated steel sheet or rolled zinc.
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.

2.5 JOINT TREATMENT MATERIALS

A. General: Comply with ASTM C 475/C 475M.

B. Joint Tape:

1. Interior Gypsum Board: Paper.
2. Glass-Mat Gypsum Sheathing Board: 10-by-10 glass mesh.
3. 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 setting-type taping or drying-type, all-purpose compound.

   a. Use setting-type compound for installing paper-faced metal trim accessories.

3. Fill Coat: For second coat, use setting-type, sandable topping or drying-type, all-purpose compound.
4. Finish Coat: For third coat, use setting-type, sandable topping or drying-type, all-purpose compound.
5. Skim Coat: For final coat of Level 5 finish, use setting-type, sandable topping or drying-type, all-purpose compound.

D. 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.

2.6 AUXILIARY MATERIALS

A. General: Provide auxiliary materials that comply with referenced installation standards and manufacturer's written instructions.

B. Laminating Adhesive: Adhesive or joint compound recommended for directly adhering gypsum panels to continuous substrate.

C. Steel Drill Screws: ASTM C 1002 unless otherwise indicated.

1. Use screws complying with ASTM C 954 for fastening panels to steel members from 0.033 to 0.112 inch (0.84 to 2.84 mm) thick.
2. For fastening cementitious backer units, use screws of type and size recommended by panel manufacturer.

D. Sound-Attenuation Blankets: ASTM C 665, Type I (blankets without membrane facing) produced by combining thermosetting resins with mineral fibers manufactured from glass, slag wool, or rock wool.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and substrates including welded hollow-metal frames and support framing, with Installer present, for compliance with requirements and other conditions affecting performance of the Work.

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. 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 instructions 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. Mold-Resistant Type: Use in all areas of humidity and moisture, such as toilet rooms, food preparation areas, and custodial closets, not receiving ceramic tile finish.

B. Single-Layer Application:

1. On ceilings, apply gypsum panels before wall/partition board application to greatest extent possible and at right angles to framing unless otherwise indicated.
2. On partitions/walls, apply gypsum panels horizontally (perpendicular to framing) unless otherwise indicated or required by fire-resistance-rated assembly, and minimize end joints.

    a. Stagger abutting end joints not less than one framing member in alternate courses of panels.
    b. At stairwells and other high walls, install panels horizontally unless otherwise indicated or required by fire-resistance-rated assembly.

3. On Z-shaped 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-shaped 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 instructions and temporarily brace or fasten gypsum panels until fastening adhesive has set.

3.4 APPLYING TILE BACKING PANELS

A. Glass-Mat, Water-Resistant Backing Panels: Comply with manufacturer's written installation instructions and install at locations indicated to receive tile. Install with 1/4-inch (6.4-mm) gap where panels abut other construction or penetrations.

B. Cementitious Backer Units: ANSI A108.11, at locations indicated to receive tile.

C. Where tile backing panels abut other types of panels in same plane, shim surfaces to produce a uniform plane across panel surfaces.

3.5 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 in specific locations approved by Architect for visual effect.

C. Interior Trim: Install in the following locations:

1. Cornerbead: Use at outside corners.
2. LC-Bead: Use at exposed panel edges.
3. L-Bead: Use where indicated.

3.6 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 4: At panel surfaces that will be exposed to view unless otherwise indicated.

    a. Primer and its application to surfaces are specified in Section 099123 "Interior Painting."

E. Glass-Mat Faced Panels: Finish according to manufacturer's written instructions.

F. Cementitious Backer Units: Finish according to manufacturer's written instructions.

3.7 PROTECTION

A. Protect adjacent surfaces from drywall compound and promptly remove from floors and other non-drywall surfaces. Repair surfaces stained, marred, or otherwise damaged during drywall application.

B. Protect installed products from damage from weather, condensation, direct sunlight, construction, and other causes during remainder of the construction period.

C. Remove and replace panels that are wet, moisture damaged, and mold damaged.

1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

END OF SECTION 092900

SECTION 093013 - CERAMIC 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. Section Includes:
   1. Glazed wall tile.
   2. Porcelain tile.
   3. Stone thresholds.
   4. Metal edge strips.

B. Related Requirements:
   1. Section 079200 "Joint Sealants" for sealing of expansion, contraction, control, and isolation joints in tile surfaces.
   2. Section 092900 "Gypsum Board" for cementitious backer units and glass-mat, water-resistant backer board.

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 its "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.

B. Samples for Initial Selection: For tile, grout, and accessories involving color selection.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For 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.

1.6 QUALITY ASSURANCE

A. Installer Qualifications:
   1. Installer employs Ceramic Tile Education Foundation Certified Installers or installers recognized by the U.S. Department of Labor as Journeyman Tile Layers.

B. 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 mockup of wall tile installation.
   2. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

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.

1.8 FIELD 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 MANUFACTURERS

A. Source Limitations for Tile: Obtain tile of each type from single source or producer.

1. Obtain tile of each type and color or finish from same production run and of consistent quality in appearance and physical properties for each contiguous area.

B. Source Limitations for Setting and Grouting Materials: Obtain ingredients of a uniform quality for each mortar, adhesive, and grout component from single manufacturer and each aggregate from single source or producer.

1. Obtain setting and grouting materials, except for unmodified Portland cement and aggregate, from single manufacturer.

C. Source Limitations for Other Products: Obtain each of the following products specified in this Section from a single manufacturer:

1. Stone thresholds.
2. Crack isolation membrane.
3. Cementitious backer units.
4. Metal edge strips.

2.2 PRODUCTS, GENERAL

A. ANSI Ceramic Tile Standard: Provide tile that complies with ANSI A137.1 for types, compositions, and other characteristics indicated.

1. Provide tile complying with Standard grade requirements unless otherwise indicated.

B. ANSI Standards for Tile Installation Materials: Provide materials complying with ANSI A108.02, ANSI standards referenced in other Part 2 articles, ANSI standards referenced by TCNA installation methods specified in tile installation schedules, and other requirements specified.

C. Factory Blending: For tile exhibiting color variations within ranges, 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.

2.3 TILE PRODUCTS

A. Ceramic Tile Type CT-1: Glazed wall tile.

1. Products: Subject to compliance with requirements, provide the following:

   a. Daltile; Colour Scheme.
2. Module Size: 12 by 12 inches (304 by 304 mm).
3. Thickness: 5/16 inch (8 mm).
4. Face: Pattern of design indicated, with manufacturer's standard edges.
5. Finish: Semimatte, opaque glaze, textured finish.
6. Tile Color and Pattern: B926 “Arctic White Speckle”. See Finish Material Legend on Drawings.
7. Grout Color: As selected by Architect from manufacturer's full range.

8. Trim Units: Coordinated with sizes and coursing of adjoining flat tile where applicable. Provide shapes as follows, selected from manufacturer's standard shapes:
   a. Wainscot Cap for Thinset Mortar Installations: Surface bullnose, stainless-steel, ASTM A 666, 300 Series exposed-edge material, depth to match adjoining flat tile.
   b. External Corners for Thinset Mortar Installations: Surface bullnose, stainless-steel, ASTM A 666, 300 Series exposed-edge material, depth to match adjoining flat tile.
   c. Internal Corners: Field-butted square corners.

A. Ceramic Tile Type CT-2 / CT-3: Glazed porcelain wall tile.

1. Products: Subject to compliance with requirements, provide the following:

   a. Daltile; Colour Scheme.
2. Module Size: 4 by 12 inches (101 by 304 mm).
3. Thickness: 5/16 inch (8 mm).
4. Face: Pattern of design indicated, with manufacturer's standard edges.
5. Finish: Semimatte, opaque glaze, textured finish.
6. Tile Color and Pattern: B901 “Black” (CT-2), B907 “Galaxy” (CT-3). See Finish Material Legend on Drawings.
7. Grout Color: As selected by Architect from manufacturer's full range.
8. Trim Units: Coordinated with sizes and coursing of adjoining flat tile where applicable. Provide shapes as follows, selected from manufacturer's standard shapes:
   a. Wainscot Cap for Thinset Mortar Installations: Surface bullnose, stainless-steel, ASTM A 666, 300 Series exposed-edge material, depth to match adjoining flat tile.
   b. External Corners for Thinset Mortar Installations: Surface bullnose, stainless-steel, ASTM A 666, 300 Series exposed-edge material, depth to match adjoining flat tile.
   c. Internal Corners: Field-butted square corners.

B. Ceramic Tile Type CT-4 / CT-5: Glazed quarry wall tile.

1. Products: Subject to compliance with requirements, provide the following:

   a. Daltile; Natural Hues by Quarry Tile Company.
2. Module Size: 4 by 4 inches (101 by 101 mm).
3. Thickness: 5/16 inch (8 mm).
4. Face: Pattern of design indicated, with manufacturer's standard edges.
5. Finish: Bright, opaque glaze, smooth finish.
6. Tile Color and Pattern: QH92 “Sunburst” (CT-4), QH15 “Mist” (CT-5). See Finish Material Legend on Drawings.
7. Grout Color: As selected by Architect from manufacturer's full range.
8. Trim Units: Coordinated with sizes and coursing of adjoining flat tile where applicable. Provide shapes as follows, selected from manufacturer's standard shapes:
   a. Wainscot Cap for Thinset Mortar Installations: Surface bullnose, stainless-steel, ASTM A 666, 300 Series exposed-edge material, depth to match adjoining flat tile.
   b. External Corners for Thinset Mortar Installations: Surface bullnose, stainless-steel, ASTM A 666, 300 Series exposed-edge material, depth to match adjoining flat tile.
   c. Internal Corners: Field-butted square corners.

C. Ceramic Tile Type CTB-1: Glazed porcelain wall base tile.

1. Products: Subject to compliance with requirements, provide the following:

   a. Daltile; Colour Scheme.
2. Module Size: 6 by 12 inches (152 by 304 mm).
3. Thickness: 5/16 inch (8 mm).
4. Face: Pattern of design indicated, with manufacturer's standard edges.
5. Finish: Semimatte, opaque glaze, textured finish.
6. Tile Color and Pattern: B901 "Black". See Finish Material Legend on Drawings.
7. Grout Color: As selected by Architect from manufacturer's full range.
8. Trim Units: Coordinated with sizes and coursing of adjoining flat tile where applicable. Provide shapes as follows, selected from manufacturer's standard shapes:
   a. Wainscot Cap for Thinset Mortar Installations: Surface bullnose, stainless-steel, ASTM A 666, 300 Series exposed-edge material, depth to match adjoining flat tile.
   b. External Corners for Thinset Mortar Installations: Surface bullnose, stainless-steel, ASTM A 666, 300 Series exposed-edge material, depth to match adjoining flat tile.
   c. Internal Corners: Field-butted square corners.

2.4 THRESHOLDS

A. General: Fabricate to sizes and profiles indicated or required to provide transition between adjacent floor finishes.

   1. Bevel edges at 1:2 slope, with lower edge of bevel aligned with or up to 1/16 inch (1.5 mm) above adjacent floor surface. Finish bevel to match top surface of threshold. Limit height of threshold to 1/2 inch (12.7 mm) or less above adjacent floor surface.

B. Marble Thresholds: ASTM C 503/C 503M, with a minimum abrasion resistance of [**10**] [**12**] according to ASTM C 1353 or ASTM C 241/C 241M and with honed finish.

   1. Description: Uniform, fine- to medium-grained white stone with gray veining.

2.5 TILE BACKING PANELS

A. Cementitious Backer Units: As specified in 092900 "Gypsum Board".

B. Glass-Mat, Water-Resistant Backing Board: As specified in 092900 "Gypsum Board".

2.6 SETTING MATERIALS

A. Water-Cleanable, Tile-Setting Epoxy: ANSI A118.3, with a VOC content of 65 g/L or less.

   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

      a. Atlas Minerals & Chemicals, Inc.
      b. Bonsal American, an Oldcastle company.
      c. Bostik, Inc.

d. LATICRETE SUPERCAP, LLC.
e. MAPEI Corporation.

2. Provide product capable of withstanding continuous and intermittent exposure to temperatures of up to 140 and 212 deg F (60 and 100 deg C), respectively, and certified by manufacturer for intended use.

2.7 GROUT MATERIALS

A. Water-Cleanable Epoxy Grout: ANSI A118.3, with a VOC content of 65 g/L or less.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Atlas Minerals & Chemicals, Inc.
b. Bonsal American, an Oldcastle company.
c. Bostik, Inc.
d. LATICRETE SUPERCAP, LLC.
e. MAPEI Corporation.

2. Provide product capable of withstanding continuous and intermittent exposure to temperatures of up to 140 and 212 deg F (60 and 100 deg C), respectively, and certified by manufacturer for intended use.

2.8 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. 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.

2.9 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 the Work.

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 installation of grounds, anchors, recessed frames, electrical and mechanical units of work, and similar items located in or behind tile has been completed.
3. 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. Blending: For tile exhibiting color variations, 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.

3.3 CERAMIC TILE INSTALLATION

A. Comply with TCNA's "Handbook for Ceramic, Glass, and Stone Tile Installation" for TCNA 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 TCNA installation methods, specified in tile installation schedules, and apply to types of setting and grouting materials used.

B. 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.

C. 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.

D. Provide metal trim shapes as specified where necessary to eliminate exposed tile edges.

E. Where accent tile differs in thickness from field tile, vary setting-bed thickness so that tiles are flush.

F. 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.
   1. Where adjoining tiles on floor, base, walls, or trim are specified or indicated to be same size, align joints.
   2. Where tiles are specified or indicated to be whole integer multiples of adjoining tiles on floor, base, walls, or trim, align joints unless otherwise indicated.

G. Joint Widths: Unless otherwise indicated, install tile with the following joint widths:
   1. Wall Tile and Base: 1/4 inch (6.4 mm).

H. Lay out tile wainscots to dimensions indicated or to next full tile beyond dimensions indicated.

I. Stone Thresholds: Install stone thresholds in same type of setting bed as adjacent tile unless otherwise indicated.

3.4 TILE BACKING PANEL INSTALLATION

A. Install panels and treat joints according to ANSI A108.11 and manufacturer's written instructions for type of application indicated.

3.5 ADJUSTING AND CLEANING

A. Remove and replace tile that is damaged or that does not match adjoining tile. Provide new matching units, installed as specified and in a manner to eliminate evidence of replacement.

B. Cleaning: On completion of placement and grouting, clean all ceramic tile surfaces so they are free of foreign matter.

   1. Remove 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.

3.6 PROTECTION

A. Protect installed tile work with kraft paper or other heavy covering during construction period to prevent staining, damage, and wear. If recommended by tile manufacturer, apply coat of neutral protective cleaner to completed tile walls and floors.

B. Before final inspection, remove protective coverings and rinse neutral protective cleaner from tile surfaces.

END OF SECTION 093013

SECTION 096723 - RESINOUS FLOORING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes resinous flooring systems.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product. Include manufacturer's technical data, application instructions, and recommendations for each resinous flooring component required.

B. Samples for Initial Selection: For each type of exposed finish required.

1.4 INFORMATIONAL SUBMITTALS

A. Installer Certificates: Signed by manufacturer certifying that installers comply with specified requirements.

B. Material Certificates: For each resinous flooring component, from manufacturer.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: For resinous flooring to include in maintenance manuals.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: An authorized representative who is trained and approved by manufacturer.

B. Engage an installer who is certified in writing by resinous flooring manufacturer as qualified to apply resinous flooring systems indicated.

C. Mockups: Build mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.

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.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials in original packages and containers, with seals unbroken, bearing manufacturer's labels indicating brand name and directions for storage and mixing with other components.

1.8 FIELD CONDITIONS

A. Environmental Limitations: Comply with resinous flooring manufacturer's written instructions for substrate temperature, ambient temperature, moisture, ventilation, and other conditions affecting resinous flooring application.

B. Lighting: Provide permanent lighting or, if permanent lighting is not in place, simulate permanent lighting conditions during resinous flooring application.

C. Close spaces to traffic during resinous flooring application and for 24 hours after application unless manufacturer recommends a longer period.

PART 2 - PRODUCTS

2.1 PERORMANCE REQUIREMENTS

A. Flammability: Self-extinguishing according to ASTM D 635.

2.2 MANUFACTURERS

A. Source Limitations: Obtain primary resinous flooring materials, including primers, resins, hardening agents, grouting coats, and topcoats, from single source from single manufacturer. Obtain secondary materials, including patching and fill material, joint sealant, and repair materials, of type and from manufacturer recommended in writing by manufacturer of primary materials.

2.3 RESINOUS FLOORING

A. Resinous Flooring System: Abrasion-, impact-, and chemical-resistant, aggregate-filled, and resin-based monolithic floor surfacing designed to produce a seamless floor.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. BASF Corporation.
b. Duraflex, Inc.
c. Garland Company, Inc. (The).
d. Laticrete International, Inc.

B. System Characteristics:

1. Color and Pattern: As selected by Architect from manufacturer's full range.
2. Wearing Surface: Orange-peel texture.
3. Overall System Thickness: 1/8 inch (3.2 mm).

C. Primer: Type recommended by resinous flooring manufacturer for substrate and resinous flooring system indicated.

D. Reinforcing Membrane: Flexible resin formulation that is recommended by resinous flooring manufacturer for substrate and resinous flooring system indicated and that inhibits substrate cracks from reflecting through resinous flooring.

E. Patching and Fill Material: Resinous product of or approved by resinous flooring manufacturer and recommended by manufacturer for application indicated.

F. Body Coats:
1. Resin: Epoxy or epoxy novolac.
2. Formulation Description: High solids.
3. Type: Pigmented.
4. Application Method: Self-leveling slurry.
5. Number of Coats: Two.
6. Thickness of Coats: 1/16 inch (1.6 mm).
7. Aggregates: Manufacturer's standard.

G. Topcoats: Sealing or finish coats.
1. Resin: Epoxy or epoxy novolac.
2. Formulation Description: High solids.
3. Type: Clear.
4. Number of Coats: One.
5. Thickness of Coats: 8 mils (0.2 mm).
6. Finish: Gloss.

2.4 PREPARATION

A. Prepare and clean substrates according to resinous flooring manufacturer's written instructions for substrate indicated. Provide clean, dry substrate for resinous flooring application.

B. Concrete Substrates: Provide sound concrete surfaces free of laitance, glaze, efflorescence, curing compounds, form-release agents, dust, dirt, grease, oil, and other contaminants incompatible with resinous flooring.

1. Roughen concrete substrates as follows:

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. Comply with ASTM C 811 requirements unless manufacturer's written instructions are more stringent.

2. Repair damaged and deteriorated concrete according to resinous flooring manufacturer's written instructions.
3. Verify that concrete substrates are dry and moisture-vapor emissions are within acceptable levels according to manufacturer's written instructions.

4. Alkalinity and Adhesion Testing: Verify that concrete substrates have pH within acceptable range. Perform tests recommended by manufacturer. Proceed with application only after substrates pass testing.

C. Patching and Filling: Use patching and fill material to fill holes and depressions in substrates according to manufacturer's written instructions.

1. Control Joint Treatment: Treat control joints and other nonmoving substrate cracks to prevent cracks from reflecting through resinous flooring according to manufacturer's written instructions.

D. Resinous Materials: Mix components and prepare materials according to resinous flooring manufacturer's written instructions.

2.5 APPLICATION

A. Apply components of resinous flooring system according to manufacturer's written instructions to produce a uniform, monolithic wearing surface of thickness indicated.

1. Coordinate application of components to provide optimum adhesion of resinous flooring system to substrate, and optimum intercoat adhesion.
2. Cure resinous flooring components according to manufacturer's written instructions. Prevent contamination during application and curing processes.
3. Expansion and Isolation Joint Treatment: At substrate expansion and isolation joints, comply with resinous flooring manufacturer's written instructions.

B. Primer: Apply primer over prepared substrate at manufacturer's recommended spreading rate.

C. Reinforcing Membrane: Apply reinforcing membrane to substrate cracks.

D. Self-Leveling Body Coats: Apply self-leveling slurry body coats in thickness indicated for flooring system.

1. Aggregates: Broadcast aggregates at rate recommended by manufacturer and, after resin is cured, remove excess aggregates to provide surface texture indicated.

E. Topcoats: Apply topcoats in number indicated for flooring system and at spreading rates recommended in writing by manufacturer and to produce wearing surface indicated.

2.6 PROTECTION

A. Protect resinous flooring from damage and wear during the remainder of construction period. Use protective methods and materials, including temporary covering, recommended in writing by resinous flooring manufacturer.

END OF SECTION 096723

SECTION 099123 – INTERIOR PAINTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes surface preparation and field painting of the following:

1. Exposed interior items and surfaces.

2. Surface preparation, priming, and finish coats specified in this Section are in addition to shop priming and surface treatment specified in other Sections.

B. Related Sections include the following:

1. Division 01 Section “Construction Waste Management”

2. Division 07 Section "Joint Sealants"

C. Paint exposed surfaces, except where the paint schedules indicate that a surface or material is not to be painted or is to remain natural. If the paint schedules do not specifically mention an item or a surface, paint the item or surface the same as similar adjacent materials or surfaces whether or not schedules indicate colors. If the schedules do not indicate color or finish, the Architect will select from standard colors and finishes available.

1. Painting includes field painting of exposed bare and covered pipes and ducts (including color coding), hangers, exposed steel and iron work, and primed metal surfaces of mechanical and electrical equipment.

D. Do not paint prefinished items, concealed surfaces, finished metal surfaces, operating parts, and labels.

1. Prefinished items include the following factory-finished components:
   a. Architectural woodwork and casework.
   b. Acoustical wall panels.
   c. Metal toilet enclosures.
   d. Metal lockers.
   e. Unit kitchens.
   f. Elevator equipment.
   g. Finished mechanical and electrical equipment.
   h. Light fixtures.

i. Distribution cabinets.

2. Concealed surfaces include walls or ceilings in the following generally inaccessible spaces:
   a. Foundation spaces.
   b. Furred areas.
   c. Ceiling plenums.
   d. Utility tunnels.
   e. Pipe spaces.
   f. Duct shafts.
   g. Elevator shafts.

3. Finished metal surfaces include the following:
   a. Anodized aluminum.
   b. Stainless steel.
   c. Chromium plate.
   d. Copper.
   e. Bronze and brass.

4. Operating parts include moving parts of operating equipment and the following:
   a. Valve and damper operators.
   b. Linkages.
   c. Sensing devices.
   d. Motor and fan shafts.

5. Labels: Do not paint over Underwriters Laboratories (UL), Factory Mutual (FM), or other code-required labels or equipment name, identification, performance rating, or nomenclature plates.

1.3 SUBMITTALS

A. Product Data: For each paint system specified. Include block fillers and primers.

1. Manufacturer's Information: Provide manufacturer's technical information, including label analysis and instructions for handling, storing, and applying each coating material proposed for use.

B. Samples for Initial Selection: Manufacturer's color charts (fan decks) showing the full range of colors available for each type of finish-coat material indicated.

1. After color selection, the Architect will furnish color chips for surfaces to be coated.

C. Samples for Verification: Of each color and material to be applied, with texture to simulate actual conditions, on representative Samples of the actual substrate.

1. Provide stepped Samples, defining each separate coat, including block fillers and primers. Use representative colors when preparing Samples for review. Resubmit until required sheen, color, and texture are achieved.

2. Provide a list of materials and applications for each coat of each sample. Label each sample for location and application.

D. Qualification Data: For Applicator.

1.4 QUALITY ASSURANCE

A. Applicator Qualifications: Engage an experienced applicator who has completed painting system applications similar in material and extent to that indicated for this Project with a record of successful in-service performance.

B. Source Limitations: Obtain block fillers, primers, and undercoat materials for each coating system from the same manufacturer as the finish coats.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials to the Project Site in manufacturer's original, unopened packages and containers bearing manufacturer's name and label, and the following information:

1. Product name or title of material.

2. Product description (generic classification or binder type).

3. Manufacturer's stock number and date of manufacture.

4. Contents by volume, for pigment and vehicle constituents.

5. Thinning instructions.

6. Application instructions.

7. Color name and number.

8. VOC content.

B. Store materials not in use in tightly covered containers in a well-ventilated area at a minimum ambient temperature of 45 deg F (7 deg C). Maintain containers used in storage in a clean condition, free of foreign materials and residue.

1. Protect from freezing. Keep storage area neat and orderly. Remove oily rags and waste daily. Take necessary measures to ensure that workers and work areas are protected from fire and health hazards resulting from handling, mixing, and application.

1.6 PROJECT CONDITIONS

A. Apply water-based paints only when the temperature of surfaces to be painted and surrounding air temperatures are between 50 and 90 deg F (10 and 32 deg C).

B. Apply solvent-thinned paints only when the temperature of surfaces to be painted and surrounding air temperatures are between 45 and 95 deg F (7.2 and 35 deg C).

C. Do not apply paint in snow, rain, fog, or mist; or when the relative humidity exceeds 85 percent; or at temperatures less than 5 deg F (3 deg C) above the dew point; or to damp or wet surfaces.

1. Painting may continue during inclement weather if surfaces and areas to be painted are enclosed and heated within temperature limits specified by manufacturer during application and drying periods.

1.7 EXTRA MATERIALS

A. Furnish extra paint materials from the same production run as the materials applied in the quantities described below. Package paint materials in unopened, factory-sealed containers for storage and identify with labels describing contents. Deliver extra materials to the Owner.

1. Quantity: Furnish the Owner with an additional 5 percent, but not less than 1 gal., of each material and color applied.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Available Products: Basis of Design- Sherwin-Williams Co. (S-W). See drawing notes for more detail.

2.2 PAINT MATERIALS, GENERAL

A. Material Compatibility: Provide block fillers, primers, undercoats, and finish-coat materials that are compatible with one another and the substrates indicated under conditions of service and application, as demonstrated by manufacturer based on testing and field experience.

B. Material Quality: Provide manufacturer's best-quality paint material of the various coating types specified. Paint-material containers not displaying manufacturer's product identification will not be acceptable.

1. Proprietary Names: Use of manufacturer's proprietary product names to designate colors or materials is not intended to imply that products named are required to be used to the exclusion of equivalent products of other manufacturers. Furnish manufacturer's material data and certificates of performance for proposed substitutions.

C. Chemical Components of Interior Paints and Coatings: Provide products that comply with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA Method 24) and the following chemical restrictions:

1. Flat Paints and Coatings: VOC content of not more than 50 g/L.

2. Non-Flat Paints and Coatings: VOC content of not more than 150 g/L.

3. Anticorrosive Coatings: VOC content of not more than 250 g/L.

4. Varnishes and Sanding Sealers: VOC content of not more than 350 g/L.

5. Stains: VOC content of not more than 250 g/L.

6. Aromatic Compounds: Paints and coatings shall not contain more than 1.0 percent by weight of total aromatic compounds (hydrocarbon compounds containing one or more benzene rings).

7. Restricted Components: Paints and coatings shall not contain any of the following:

   a. Acrolein.
   b. Acrylonitrile.
   c. Antimony.
   d. Benzene.
   e. Butyl benzyl phthalate.
   f. Cadmium.
   g. Di (2-ethylhexyl) phthalate.
   h. Di-n-butyl phthalate.
   i. Di-n-octyl phthalate.
   j. 1,2-dichlorobenzene.
   k. Diethyl phthalate.
   l. Dimethyl phthalate.
   m. Ethylbenzene.
   n. Formaldehyde.
   o. Hexavalent chromium.
   p. Isophorone.
   q. Lead.
   r. Mercury.
   s. Methyl ethyl ketone.
   t. Methyl isobutyl ketone.
   u. Methylene chloride.
   v. Naphthalene.
   w. Toluene (methylbenzene).
   x. 1,1,1-trichloroethane.
   y. Vinyl chloride.

D. Colors: Provide color selections made by the Architect.

PART 3 - EXECUTION

3.1 CONSTRUCTION WASTE MANAGEMENT

A. The contractor, subcontractors, and their personnel shall follow the procedures and practices for waste separation, collection and transport as defined in the contractor's "Waste Management Plan" as required by Division 01 Section "Construction Waste Management."

3.2 EXAMINATION

A. Examine substrates, areas, and conditions, with the Applicator present, under which painting will be performed for compliance with paint application requirements.

1. Do not begin to apply paint until unsatisfactory conditions have been corrected and surfaces receiving paint are thoroughly dry.

2. Start of painting will be construed as the Applicator's acceptance of surfaces and conditions within a particular area.

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. Gypsum Board: 12 percent.
5. Plaster: 12 percent.

C. Gypsum Board Substrates: Verify that finishing compound is sanded smooth.

D. Verify suitability of substrates, including surface conditions and compatibility with existing finishes and primers.

E. Proceed with coating application only after unsatisfactory conditions have been corrected.

1. Application of coating indicates acceptance of surfaces and conditions.

F. Coordination of Work: Review other Sections in which primers are provided to ensure compatibility of the total system for various substrates. On request, furnish information on characteristics of finish materials to ensure use of compatible primers.

1. Notify the Architect about anticipated problems using the materials specified over substrates primed by others.

3.3 PREPARATION

A. Comply with manufacturer's written instructions and recommendations in "MPI Manual" applicable to substrates indicated.

B. General: Remove hardware and hardware accessories, plates, machined surfaces, lighting fixtures, and similar items already installed that are not to be painted. If removal is impractical or

impossible because of the size or weight of the item, provide surface-applied protection before surface preparation and painting.

1. After completing painting operations in each space or area, reinstall items removed using workers skilled in the trades involved.

C. Clean substrates of substances that could impair bond of paints, including dust, dirt, oil, grease, and incompatible paints and encapsulants.

1. Remove incompatible primers and reprime substrate with compatible primers or apply tie coat as required to produce paint systems indicated.

D. Surface Preparation: Clean and prepare surfaces to be painted according to manufacturer's written instructions for each particular substrate condition and as specified.

1. For existing surfaces, remove all peeling paint, loose and deliterious materials that may impair the performance of the finish coating and that may affect the visually intended results.

2. Sand, clean, dry, etch, neutralize and/or test all surfaces under adequate illumination, ventilation and temperature requirements.

3. Provide barrier coats over incompatible primers or remove and reprime.

4. Concrete Substrates: Remove release agents, curing compounds, efflorescence, and chalk. Do not paint surfaces if moisture content or alkalinity of surfaces to be painted exceeds that permitted in manufacturer's written instructions.

5. Masonry Substrates: Remove efflorescence and chalk. Do not paint surfaces if moisture content or alkalinity of surfaces or mortar joints exceed that permitted in manufacturer's written instructions.

6. Steel Substrates: Remove rust, loose mill scale, and shop primer, if any. Clean using methods recommended in writing by paint manufacturer but not less than the following:
   a. SSPC-SP 2, "Hand Tool Cleaning."
   b. SSPC-SP 3, "Power Tool Cleaning."

7. Shop-Primed Steel Substrates: Clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed areas with the same material as used for shop priming to comply with SSPC-PA 1 for touching up shop-primed surfaces.

8. 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.

9. Aluminum Substrates: Remove loose surface oxidation.

10. Wood Substrates:
    a. Scrape and clean knots, and apply coat of knot sealer before applying primer.
    b. Sand surfaces that will be exposed to view, and dust off.
    c. Prime edges, ends, faces, undersides, and backsides of wood.
    d. After priming, fill holes and imperfections in the finish surfaces with putty or plastic wood filler. Sand smooth when dried.

11. Substrate defects shall be made good and sanded by others ready for painting particularly after the first coat of paint. Start of finish painting of defective surfaces (e.g. gypsum board) shall indicate acceptance of substrate and any costs of making good defects shall be borne by the painter including re-painting of entire defective surface (no touch-up painting).

12. Repair all minor substrate holes and imperfections prior to the application of paint. This includes damaged surfaces, surface punctures, and areas where items have been removed and will not be replaced.
    a. Minor holes and imperfections are considered smaller than a ½“ hole or a surface area smaller than 8“ square per occurrance.
    b. Notify the Architect of unsatisfactory conditions, and do not proceed until unsatisfactory conditions are corrected.
    c. Do not paint over any imperfections.

E. Materials Preparation: Mix and prepare paint materials according to manufacturer's written instructions.

1. Maintain containers used in mixing and applying paint in a clean condition, free of foreign materials and residue.

2. Stir material before application to produce a mixture of uniform density. Stir as required during application. Do not stir surface film into material. If necessary, remove surface film and strain material before using.

3. Use only thinners approved by paint manufacturer and only within recommended limits.

F. Tinting: Tint each undercoat a lighter shade to simplify identification of each coat when multiple coats of the same material are applied. Tint undercoats to match the color of the finish coat, but provide sufficient differences in shade of undercoats to distinguish each separate coat.

3.4 APPLICATION

A. General: Apply paint according to manufacturer's written instructions and to recommendations in "MPI Manual." Use applicators and techniques best suited for substrate and type of material being applied.

1. Paint colors, surface treatments, and finishes are indicated in the schedules.

2. Do not paint over dirt, rust, scale, grease, moisture, scuffed surfaces, or conditions detrimental to formation of a durable paint film.

3. Provide finish coats that are compatible with primers used.

4. The term "exposed surfaces" includes areas visible when permanent or built-in fixtures, convector covers, covers for finned-tube radiation, grilles, and similar components are in place. Extend coatings in these areas, as required, to maintain the system integrity and provide desired protection.

5. Paint surfaces behind movable equipment and furniture the same as similar exposed surfaces. Before the final installation of equipment, paint surfaces behind permanently fixed equipment or furniture with prime coat only.

6. Paint interior surfaces of ducts with a flat, nonspecular black paint where visible through registers or grilles.

7. Paint back sides of access panels and removable or hinged covers to match exposed surfaces.

8. Finish interior of wall and base cabinets and similar field-finished casework to match exterior.

9. Sand lightly between each succeeding enamel or varnish coat.

B. Scheduling Painting: Apply first coat to surfaces that have been cleaned, pretreated, or otherwise prepared for painting as soon as practicable after preparation and before subsequent surface deterioration.

1. The number of coats and the film thickness required are the same regardless of application method. Do not apply succeeding coats until the previous coat has cured as recommended by the manufacturer. If sanding is required to produce a smooth, even surface according to manufacturer's written instructions, sand between applications.

2. Omit primer on metal surfaces that have been shop primed and touchup painted.

3. If undercoats, stains, or other conditions show through final coat of paint, apply additional coats until paint film is of uniform finish, color, and appearance. Give special attention to ensure edges, corners, crevices, welds, and exposed fasteners receive a dry film thickness equivalent to that of flat surfaces.

4. Allow sufficient time between successive coats to permit proper drying. Do not recoat surfaces until paint has dried to where it feels firm, does not deform or feel sticky under moderate thumb pressure, and where application of another coat of paint does not cause the undercoat to lift or lose adhesion.

C. Application Procedures: Apply paints and coatings by brush, roller, spray, or other applicators according to manufacturer's written instructions.

D. Minimum Coating Thickness: Apply paint materials no thinner than manufacturer's recommended spreading rate. Provide the total dry film thickness of the entire system as recommended by the manufacturer.

E. Mechanical and Electrical Work: Painting of mechanical and electrical work is limited to items exposed in occupied spaces.

F. Block Fillers: Apply block fillers to concrete masonry block at a rate to ensure complete coverage with pores filled.

G. Prime Coats: Before applying finish coats, apply a prime coat of material, as recommended by the manufacturer, to material that is required to be painted or finished and that has not been prime coated by others. Recoat primed and sealed surfaces where evidence of suction spots or unsealed areas in first coat appears, to ensure a finish coat with no burn through or other defects due to insufficient sealing.

H. Pigmented (Opaque) Finishes: Completely cover surfaces as necessary to provide a smooth, opaque surface of uniform finish, color, appearance, and coverage. Cloudiness, spotting, holidays, laps, brush marks, runs, sags, ropiness, or other surface imperfections will not be acceptable.

1. Provide scheduled finish for final coats as indicated.

I. Transparent (Clear) Finishes: Use multiple coats to produce a glass-smooth surface film of even luster. Provide a finish free of laps, runs, cloudiness, color irregularity, brush marks, orange peel, nail holes, or other surface imperfections.

1. Provide satin finish for final coats.

J. Completed Work: Match approved samples for color, texture, and coverage. Remove, refinish, or repaint work not complying with requirements.

3.5 COLOR SCHEDULE

A. Apply paint in accordance with the color schedule indicated on the drawings.

B. 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, providing crisp, clean transitions where colors change, either at a change in substrate orientation (such as a corner) or where directed to make a color change on the same surface.

C. Provide painted graphics where indicated.

3.6 FIELD QUALITY CONTROL

A. Dry Film Thickness Testing: Owner may engage the services of a qualified testing and inspecting agency to inspect and test paint for dry film thickness.

1. Contractor shall touch up and restore painted surfaces damaged by testing.
2. If test results show that dry film thickness of applied paint does not comply with paint manufacturer's written recommendations, Contractor shall pay for testing and apply additional coats as needed to provide dry film thickness that complies with paint manufacturer's written recommendations.

3.7 CLEANING

A. Cleanup: At the end of each workday, remove empty cans, rags, rubbish, and other discarded paint materials from the site.

1. After completing painting, clean glass and paint-spattered surfaces. Remove spattered paint by washing and scraping. Be careful not to scratch or damage adjacent finished surfaces.

3.8 PROTECTION

A. Protect work of other trades, whether being painted or not, against damage by painting. Correct damage by cleaning, repairing or replacing, and repainting, as approved by Architect.

B. Provide "Wet Paint" signs to protect newly painted finishes. Remove temporary protective wrappings provided by others to protect their work after completing painting operations.

1. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

3.9 INTERIOR PAINT SCHEDULE

A. Concrete Masonry Units: Provide the following finish systems over interior concrete masonry block units:

1. Epoxy Finish: 2 finish coats over an undercoat and a filled surface.
   a. Block Filler: High-performance, latex-based, block filler applied at spreading rate recommended by the manufacturer to achieve a total dry film thickness of not less than 5.0 mils (0.13 mm).
      1) S-W: Heavy-Duty Block Filler B42W46.
   b. 2nd Coat:
      1) S-W Waterbased Catalyzed Epoxy, B70 Series.
   c. 3rd Coat:
      1) SW Waterbased Catalyzed Epoxy, B70 Series.

B. Gypsum Board: Provide the following finish systems over interior gypsum board surfaces:

1. Low-Luster, Acrylic-Enamel Finish: 2 finish coats over a primer.
   a. Primer: Latex-based, interior primer applied at spreading rate recommended by the manufacturer to achieve a total dry film thickness of not less than 1.2 mils (0.031 mm).
      1) S-W: ProMar 200 Zero VOC Latex Primer,
   b. First and Second Coats: Low-luster (eggshell or satin), acrylic-latex, interior enamel applied at spreading rate recommended by the manufacturer to achieve a total dry film thickness of not less than 2.8 mils (0.071 mm).
      1) S-W: ProMar 200 Zero VOC Latex Eg-shel.

C. Ferrous Metal: Provide the following finish systems over ferrous metal:

1. Semigloss Acrylic Enamel Finish: Two finish coat over an acrylic rust inhbitive primer as recommended by the manufacturer for this substrate, applied at spreading rate recommended by the manufacturer to achieve a total dry film thickness of not less than 1.5 mils (0.038mm)

2. Primer
   1) S-W: Pro Industrial Pro-Cryl Universal Primer B66-310 Series

   b. 2nd & Finish Coats: High Performance Acrylic Semigloss interior exterior finish applied at spreading rate recommended by the manufacturer to achieve a total dry film thickness of not less than 1.4 mils (0.036 mm).

   1) S-W: Pro Industrial Acrylic Semi-Gloss B66-650 Series

END OF SECTION 099123

SECTION 102113.19 - PLASTIC 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 configured as toilet enclosures and urinal screens.

B. Related Requirements:
1. Section 061053 "Miscellaneous Rough Carpentry" for blocking.
2. Section 102800 "Toilet, Bath, and Laundry Accessories" for toilet tissue dispensers, grab bars, purse shelves, and similar accessories mounted on toilet compartments.

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 toilet compartments.

B. Shop Drawings: For toilet compartments.

1. Include plans, elevations, sections, details, and attachment details.
2. Show locations of cutouts for compartment-mounted toilet accessories.
3. Show locations of centerlines of toilet fixtures.
4. Show overhead support or bracing locations.

C. Samples for Initial Selection: For each type of toilet compartment material indicated.

1. Include Samples of hardware and accessories involving material and color selection.

D. Product Schedule: For toilet compartments, prepared by or under the supervision of supplier, detailing location and selected colors for toilet compartment material.

1.4 INFORMATIONAL SUBMITTALS

A. Product Certificates: For each type of toilet compartment.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: For toilet compartments to include in maintenance manuals.

1.6 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents and source.

1. Door Hinges: One hinge(s) with associated fasteners.
2. Latch and Keeper: One latch(es) and keeper(s) with associated fasteners.
3. Door Bumper: One bumper(s) with associated fasteners.
4. Door Pull: One door pull(s) with associated fasteners.
5. Fasteners: Ten fasteners of each size and type.

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 PERFORMANCE REQUIREMENTS

A. Surface-Burning Characteristics: Comply with ASTM E 84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Flame-Spread Index: 75 or less.
2. Smoke-Developed Index: 450 or less.

B. Regulatory Requirements: Comply with applicable provisions in the U.S. Architectural & Transportation Barriers Compliance Board's ADA-ABA Accessibility Guidelines for Buildings and Facilities and ICC A117.1 for toilet compartments designated as accessible.

2.2 SOLID-PLASTIC TOILET COMPARTMENTS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. American Sanitary Partition Corporation.
2. Global Partitions Corp., an ASI Group Company.
3. Hadrian Manufacturing Inc.
4. Scranton Products.

B. Toilet-Enclosure Style: Floor and ceiling anchored, overhead braced.

C. Urinal-Screen Style: Floor anchored with post to ceiling.

D. Door, Panel, and Pilaster Construction: Solid, high-density polyethylene (HDPE) panel material, not less than 1 inch (25 mm) thick, seamless, with eased edges, and with homogenous color and pattern throughout thickness of material.

1. Integral Hinges: Configure doors and pilasters to receive integral hinges.
2. Heat-Sink Strip: Manufacturer's standard continuous, extruded-aluminum or stainless-steel strip fastened to exposed bottom edges of solid-plastic components to hinder malicious combustion.
3. Color and Pattern: One color and pattern in each room as selected by Architect from manufacturer's full range.

E. Pilaster Shoes and Sleeves (Caps): Manufacturer's standard design; stainless steel.

F. Urinal-Screen Post: Manufacturer's standard post design of material matching the thickness and construction of pilasters; with shoe and sleeve (cap) matching that on the pilaster.

G. Brackets (Fittings):
1. Full-Height (Continuous) Type: Manufacturer's heavy-duty design; extruded aluminum or stainless steel.

2.3 HARDWARE AND ACCESSORIES

A. Hardware and Accessories: Manufacturer's heavy-duty operating hardware and accessories.

1. Hinges: Manufacturer's minimum 0.062-inch- (1.59-mm-) thick stainless-steel continuous, cam type that swings to a closed or partially open position, allowing emergency access by lifting door. Mount with through-bolts.
2. Latch and Keeper: Manufacturer's heavy-duty surface-mounted cast-stainless-steel latch unit designed to resist damage due to slamming, with combination rubber-faced door strike and keeper, and with provision for emergency access. Provide units that comply with regulatory requirements for accessibility at compartments designated as accessible. Mount with through-bolts.
3. Coat Hook: Manufacturer's heavy-duty combination cast-stainless-steel hook and rubber-tipped bumper, sized to prevent in-swinging door from hitting compartment-mounted accessories. Mount with through-bolts.
4. Door Bumper: Manufacturer's heavy-duty rubber-tipped cast-stainless-steel bumper at out-swinging doors. Mount with through-bolts.
5. Door Pull: Manufacturer's heavy-duty cast-stainless-steel pull at out-swinging doors that complies with regulatory requirements for accessibility. Provide units on both sides of doors at compartments designated as accessible. Mount with through-bolts.

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, 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 compatible with related materials.

2.4 MATERIALS

A. Aluminum Castings: ASTM B 26/B 26M.

B. Aluminum Extrusions: ASTM B 221 (ASTM B 221M).

C. Stainless-Steel Sheet: ASTM A 666, Type 304, stretcher-leveled standard of flatness.

D. Stainless-Steel Castings: ASTM A 743/A 743M.

2.5 FABRICATION

A. Fabrication, General: Fabricate toilet compartment components to sizes indicated. Coordinate requirements and provide cutouts for through-partition toilet accessories where required for attachment of toilet accessories.

B. 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.

C. 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.

D. Floor-and-Ceiling-Anchored Units: Provide manufacturer's standard corrosion-resistant anchoring assemblies with leveling adjustment nuts at tops and bottoms of pilasters. Provide shoes and sleeves (caps) at pilasters to conceal anchorage.

E. Urinal-Screen Posts: Provide manufacturer's standard corrosion-resistant anchoring assemblies with leveling adjustment nuts at tops and bottoms of posts. Provide shoes and sleeves (caps) at posts to conceal anchorage.

F. Door Size and Swings: Unless otherwise indicated, provide 24-inch- (610-mm-) wide, in-swinging doors for standard toilet compartments and 36-inch- (914-mm-) wide, out-swinging doors with a minimum 32-inch- (813-mm-) wide, clear opening for compartments designated as accessible.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and conditions, with Installer present, for compliance with requirements for fastening, support, alignment, operating clearances, and other conditions affecting performance of the Work.

1. Confirm location and adequacy of blocking and supports required for installation.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 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 (13 mm).
b. Panels and Walls: 1 inch (25 mm).

2. Full-Height (Continuous) Brackets: Secure panels to walls and to pilasters with full-height brackets.

a. Locate bracket fasteners 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. Floor-and-Ceiling-Anchored Units: Secure pilasters to supporting construction and level, plumb, and tighten. Hang doors and adjust so doors are level and aligned with panels when doors are in closed position.

E. Urinal Screens: Attach with anchoring devices to suit supporting structure. Set units level and plumb, rigid, and secured to resist lateral impact.

3.3 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 102113.19

SECTION 102800 - TOILET, BATH, AND LAUNDRY ACCESSORIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Public-use washroom accessories.

B. Related Requirements:

1. Section 061053 "Miscellaneous Rough Carpentry" for blocking installed for support of washroom accessories.

1.3 COORDINATION

A. Coordinate accessory locations with other work to prevent interference with clearances required for access by people with disabilities, and for 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.

1.4 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 anchoring and mounting requirements, including requirements for cutouts in other work and substrate preparation.
3. Include electrical characteristics.

B. Product Schedule: Indicating types, quantities, sizes, and installation locations by room of each accessory required.

1. Identify locations using room designations indicated.
2. Identify accessories using designations indicated.

1.5 INFORMATIONAL SUBMITTALS

A. Sample Warranty: For manufacturer's special warranty.

1.6 CLOSEOUT SUBMITTALS

A. Maintenance Data: For accessories to include in maintenance manuals.

1.7 WARRANTY

A. Manufacturer's Special Warranty for Mirrors: Manufacturer agrees to repair or replace mirrors that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, visible silver spoilage defects.
2. Warranty Period: 15 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 OWNER-FURNISHED MATERIALS

A. Owner-Furnished Materials:

1. Toilet Tissue Dispenser.
2. Paper Towel Dispenser.
3. Liquid Soap Dispenser.

2.2 PERFORMANCE REQUIREMENTS

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.3 PUBLIC-USE WASHROOM ACCESSORIES

A. Source Limitations: Obtain public-use washroom accessories from single source from single manufacturer.

B. Grab Bar A1 / A2 / A3:

1. Basis-of-Design Product: Subject to compliance with requirements, provide Bradley Corporation; 832-2-001 grab bars as designated on Drawings, or a comparable product by one of the following:

a. American Specialties, Inc.
b. Bobrick Washroom Equipment, Inc.

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 texture in grip area.

4. Outside Diameter: 1-1/2 inches (38 mm).
5. Configuration and Length: As indicated on Drawings.

C. Mirror Unit C:

1. Basis-of-Design Product: Subject to compliance with requirements, provide Bradley Corporation; 781-1836 mirror or a comparable product by one of the following:

   a. American Specialties, Inc.
   b. Bobrick Washroom Equipment, Inc.

2. Frame: Stainless-steel channel.

   a. Corners: Manufacturer's standard.

3. Hangers: Produce rigid, tamper- and theft-resistant installation, using method indicated below.

   a. One-piece, galvanized-steel, wall-hanger device with spring-action locking mechanism to hold mirror unit in position with no exposed screws or bolts.
   b. Wall bracket of galvanized steel, equipped with concealed locking devices requiring a special tool to remove.

4. Size: 18 inches (456 mm) x 36 inches (1368 mm).

D. Coat Hook E:

1. Basis-of-Design Product: Subject to compliance with requirements, provide Bradley Corporation; <**product name or designation**> or a comparable product by one of the following:

   a. American Specialties, Inc.
   b. Bobrick Washroom Equipment, Inc.

2. Description: Double-prong unit.
3. Material and Finish: Stainless steel, No. 4 finish (satin).

2.4 UNDERLAVATORY GUARDS

A. Underlavatory Guard:

1. Basis-of-Design Product: Subject to compliance with requirements, provide Truebro by IPS Corporation; Lav Guard 2 insulation kit, or a comparable product by one of the following:

a. Plumberex Specialty Products, Inc.
b. Zurn, Inc.

2. Description: Insulating pipe covering for supply and drain piping assemblies that prevents direct contact with and burns from piping; allow service access without removing coverings.
3. Material and Finish: Antimicrobial, molded plastic, white.
4. Provide at all lavatories.

2.5 MATERIALS

A. Stainless Steel: ASTM A 666, Type 304, 0.031-inch (0.8-mm) minimum nominal thickness unless otherwise indicated.

B. Brass: ASTM B 19, flat products; ASTM B 16/B 16M, rods, shapes, forgings, and flat products with finished edges; or ASTM B 30, castings.

C. Steel Sheet: ASTM A 1008/A 1008M, Designation CS (cold rolled, commercial steel), 0.036-inch (0.9-mm) minimum nominal thickness.

D. Galvanized-Steel Sheet: ASTM A 653/A 653M, with G60 (Z180) hot-dip zinc coating.

E. Galvanized-Steel Mounting Devices: ASTM A 153/A 153M, hot-dip galvanized after fabrication.

F. Fasteners: Screws, bolts, and other devices of same material as accessory unit and tamper-and-theft resistant where exposed, and of galvanized steel where concealed.

G. Chrome Plating: ASTM B 456, Service Condition Number SC 2 (moderate service).

H. Mirrors: ASTM C 1503, Mirror Glazing Quality, clear-glass mirrors, nominal 6.0 mm thick.

2.6 FABRICATION

A. General: Fabricate units with tight seams and joints, and exposed edges rolled. Hang doors and access panels with full-length, continuous hinges. Equip units for concealed anchorage and with corrosion-resistant backing plates.

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. Install concealed solid wood blocking, 2x6 (nominal) minimum, behind all washroom accessories mounted on frame construction. Secure blocking as required to support specified loads.

C. Grab Bars: Install to withstand a downward load of at least 250 lbf (1112 N), when tested according to ASTM F 446.

3.2 ADJUSTING AND CLEANING

A. Adjust accessories for unencumbered, smooth operation. Replace damaged or defective items.

B. Remove temporary labels and protective coatings.

C. Clean and polish exposed surfaces according to manufacturer's written instructions.

END OF SECTION 102800

DIVISION 01 SECTION 019113
GENERAL COMMISSIONING REQUIREMENTS
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SECTION 019113 – GENERAL COMMISSIONING REQUIREMENTS

PART 1. GENERAL

1.1. RELATED DOCUMENTS

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

1.2. SUMMARY

A. This Section includes general requirements that apply to implementation of commissioning without regard to systems, subsystems, and equipment being commissioned.

B. Related Sections include the following:

1. Division 01 Section "HVAC Commissioning Requirements" for specific requirements for commissioning HVAC systems.

2. Division 01 Section "Plumbing System Commissioning Requirements" for specific requirements for commissioning Plumbing systems.

3. Division 01 Section "Contract Closeout" for specific requirements for closeout at substantial and final completion.

4. Division 01 Section "Contract Closeout" for Specific Requirements for training and demonstration of systems to Owner.

5. 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.

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", and "Plumbing System Commissioning Requirements". Test checklists will be jointly developed as the project progresses. Each checklist, regardless of system, subsystem, or equipment being tested, shall include, but not be limited to, the following:

1. Name and identification code of tested item.

2. Test number.

3. Time and date of test.

4. Indication of whether the record is for a first test or retest following correction of a problem or issue.

5. Dated signatures of the person performing test and of the witness, if applicable.

6. Individuals present for test.

7. Deficiencies.

8. Issue number, if any, generated as the result of test.

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

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

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

F. Issues Log: CxA shall prepare and maintain an issues log that describes design, installation, and performance issues that are at variance with the Contract Documents. Identify and track issues as they are encountered, documenting the status of unresolved and

resolved issues.

1. Creating an Issues Log Entry:

    a. Identify the issue with unique numeric or alphanumeric identifier by which the issue may be tracked.
    b. Assign a descriptive title of the issue.
    c. Identify date and time of the issue.
    d. Identify test number of test being performed at the time of the observation, if applicable, for cross-reference.
    e. Identify system, subsystem, and equipment to which the issue applies.
    f. Identify location of system, subsystem, and equipment.
    g. Include information that may be helpful in diagnosing or evaluating the issue.
    h. Note recommended corrective action.
    i. Identify commissioning team member responsible for corrective action.
    j. Identify expected date of correction.
    k. Identify person documenting the issue.

2. Documenting Issue Resolution:

    a. Log date correction is completed or the issue is resolved.
    b. Describe corrective action or resolution taken. Include description of diagnostic steps taken to determine root cause of the issue, if any.
    c. Identify changes to the Contract Documents that may require action.
    d. State that correction was completed and system, subsystem, and equipment is ready for retest, if applicable.
    e. Identify person(s) who corrected or resolved the issue.
    f. Identify person(s) documenting the issue resolution.

3. Issues Log Report: On a periodic basis, but not less than for each commissioning team meeting, CxA shall prepare a written narrative for review of outstanding issues and a status update of the issues log. As a minimum, CxA shall include the following information in the issues log and expand it in the narrative:

    a. Issue number and title.
    b. Date of the identification of the issue.
    c. Name of the commissioning team member assigned responsibility for resolution.
    d. Expected date of correction.

G. Commissioning Report: CxA shall document results of the commissioning process including unresolved issues and performance of systems, subsystems, and equipment. The commissioning report shall indicate whether systems, subsystems, and equipment have been completed and are performing according to the Contract Documents. The commissioning report shall include, but is not limited to, the following:

1. Lists and explanations of substitutions; compromises; variances in the Contract Documents; record of conditions; and, if appropriate, recommendations for resolution. This report shall be used to evaluate systems, subsystems, and

equipment and shall serve as a future reference document during Owner occupancy and operation. It shall describe components and performance that exceed requirements of the Contract Documents and those that do not meet requirements of the Contract Documents. It may also include a recommendation for accepting or rejecting systems, subsystems, and equipment.

2. Commissioning plan.

3. Testing plans and reports.

4. Corrective modification documentation.

5. Issues log.

6. Completed test checklists.

7. Listing of off-season test(s) not performed and a schedule for their completion.

8. 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

DIVISION 01 SECTION 019114
PLUMBING COMMISSIONING REQUIREMENTS
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SECTION 019114– PLUMBING COMMISSIONING REQUIREMENTS

PART 1. GENERAL

1.1. RELATED DOCUMENTS

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

1.2. SUMMARY

A. This Section includes requirements for commissioning the plumbing system and its subsystems and equipment. This Section supplements the general requirements specified in Division 01 Section "General Commissioning Requirements."

B. Related Sections include the following:

1. Division 01 Section "General Commissioning Requirements" for general requirements for commissioning processes that apply to this Section.

C. The following systems and/or equipment shall be commissioned:

1. Domestic hot water re-circulating system.

2. Plumbing Fixtures.

3. Thermostatic mixing valves below hand sinks/lavs.

4. 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.

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

E. TAB Subcontractor:

1. Contract Documents Review: With the CxA, review the Contract Documents before developing TAB procedures.

a. Verify the following:
i. Accessibility of equipment and components required for TAB Work.
ii. Adequate number and placement of 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. 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 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.

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 smoke control 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. Flow rates for domestic re-circulating systems.
    b. Re-circ. pump pressures and flow rates.
    c. Trap priming station water discharge.

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 of all plumbing fixtures.

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. Life-safety and safety systems.

3. Temporary upset of system operation.

4. Partial occupancy conditions.

5. Special cycles.

6. Alarm conditions.

7. 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.

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 domestic re-circulating systems, plumbing fixtures, trap priming stations, thermostatic mixing valves, 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 sector showing the physical location of each item of equipment and pipe test section. Drawings shall be formatted to allow each item of equipment and section of piping to be physically located and identified when referred to in the system testing plan.

2. Tracking checklist for managing and ensuring that all pipe sections have been tested.

3. 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

DIVISION 01 SECTION 019115
HVAC COMMISSIONING REQUIREMENTS
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SECTION 019115 - HVAC COMMISSIONING REQUIREMENTS

PART 1. GENERAL

1.1. RELATED DOCUMENTS

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

1.2. SUMMARY

A. This Section includes requirements for commissioning the HVAC system and its subsystems and equipment. This Section supplements the general requirements specified in Division 01 Section "General Commissioning Requirements."

B. Related Sections include the following:

1. Division 01 Section "General Commissioning Requirements" for general requirements for commissioning processes that apply to this Section.

C. The following systems and/or equipment shall be commissioned:

1. Automatic Temperature Control System.

2. Condensate Overflow Alarms and Condensate Pumps.

3. Re-located Existing Ductless Heat Pump System.

4. Radiant Heat Panels.

5. Exhaust Fans and Ventilation Fans.

6. Auxiliary Electric Heating Coil.

7. HVAC Controls and Sequences of Operation.

8. Split System Heat Pump Units.

1.3. DEFINITIONS

A. Architect: Includes Architect identified in the Contract for Construction between Owner and Contractor, plus consultant/design professionals responsible for design of HVAC, electrical, communications, controls for HVAC systems, and other related systems.

B. CxA: Commissioning Authority.

C. Systems, Subsystems, and Equipment: Where these terms are used together or separately, they shall mean "as-built" systems, subsystems, and equipment.

D. TAB: Testing, Adjusting, and Balancing.

1.4. CONTRACTOR'S RESPONSIBILITIES

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

B. Contractor:

1. Attend procedures meeting for TAB Work.

2. Certify that TAB Work is complete.

3. Assist performing functional performance tests.

C. Mechanical Contractor:

1. Attend TAB verification testing.

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

3. Assist performing functional performance tests.

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

E. TAB Subcontractor:

1. Contract Documents Review: With the CxA, review the Contract Documents before developing TAB procedures.

a. Verify the following:
i. Accessibility of equipment and components required for TAB Work.
ii. Adequate number and placement of duct balancing dampers to allow proper balancing while minimizing sound levels in occupied spaces.
iii. Adequate number and placement of balancing valves to allow proper balancing and recording of water flow.
iv. Adequate number and placement of test ports and test instrumentation to allow reading and compilation of system and equipment performance data needed to conduct both TAB and commissioning testing.
v. Air and water flow rates have been specified and compared to central equipment output capacities.

b. Identify discontinuities and omissions in the Contract Documents.

c. This review of the Contract Documents by the TAB Subcontractor satisfies requirements for a design review report as specified in Division 23 Section "Testing Adjusting & Balancing for HVAC & Plumbing."

d. Assist performing functional performance tests.

2. Additional Responsibilities: Participate in tests specified in Division 23 Sections "Instrumentation & Controls of HVAC & Plumbing Systems."

F. Electrical Contractor:

1. With the Mechanical Contractor, coordinate installations and connections between and among electrical and HVAC systems, subsystems, and equipment.

2. Attend TAB verification testing.

1.5. COMMISSIONING DOCUMENTATION

A. The following are in addition to documentation specified in Division 01 Section "General Commissioning Requirements."

B. Test Checklists: CxA with assistance of Contractor shall develop test checklists for HVAC systems, subsystems, and equipment, including interfaces and interlocks with other systems. CxA shall prepare separate checklists for each mode of operation and provide space to indicate whether the mode under test responded as required. In addition to the requirements specified in Division 01 Section "General Commissioning Requirements," checklists shall include, but not be limited to, the following:

1. Calibration of sensors and sensor function.

2. Testing conditions under which test was conducted, including (as applicable) ambient conditions, set points, override conditions, and status and operating conditions that impact the results of test.

3. Control sequences for HVAC systems.

4. Strength of control signal for each set point at specified conditions.

5. Responses to control signals at specified conditions.

6. Sequence of response(s) to control signals at specified conditions.

7. Electrical demand or power input at specified conditions.

8. Power quality and related measurements.

9. Expected performance of systems, subsystems, and equipment at each step of test.

10. Narrative description of observed performance of systems, subsystems, and equipment. Notation to indicate whether the observed performance at each step meets the expected results.

11. Interaction of auxiliary equipment.

12. Issues log.

1.6. SUBMITTALS

A. The following submittals are in addition to those specified in Division 01 Section "General Commissioning Requirements."

B. Testing Procedures: CxA shall submit detailed testing plan, procedures, and checklists for each series of tests. Submittals shall include samples of data reporting sheets that will be part of the reports.

C. Certificate of Readiness: CxA shall compile certificates of readiness from Contractor certifying that systems, subsystems, equipment, and associated controls are ready for testing.

D. Certificate of Completion of Installation, Prestart, and Startup: CxA shall certify that installation, prestart, and startup activities have been completed. Certification shall include completed checklists provided by TAB Subcontractor as specified in Division 23 Section "Testing Adjusting & Balancing for HVAC & Plumbing."

E. Test and Inspection Reports: CxA shall compile and submit test and inspection reports and certificates, and shall include them in systems manual and commissioning report.

F. Corrective Action Documents: CxA shall submit corrective action documents.

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

1.7. ALTERNATES

A. Refer to Division 01 Section, “Alternates” for description of work under this section affected by alternates.

PART 2. PRODUCTS (NOT USED)

PART 3. EXECUTION

3.1. TESTING PREPARATION

A. Prerequisites for Testing:

1. Certify that HVAC systems, subsystems, and equipment have been completed, calibrated, and started; are operating according to the Contract Documents; and that Certificates of Readiness are signed and submitted.

2. Certify that HVAC instrumentation and control systems have been completed and calibrated; are operating according to the Contract Documents; and that pretest set points have been recorded.

3. Certify that TAB procedures have been completed, and that TAB reports have been submitted, discrepancies corrected, and corrective work approved.

4. Test systems and intersystem performance after approval of test checklists for systems, subsystems, and equipment.

5. Set systems, subsystems, and equipment into operating mode to be tested (e.g., normal shut down, normal auto position, normal manual position, unoccupied cycle, emergency power, and alarm conditions).

6. Verify each operating cycle after it has been running for a specified period and is operating in a steady-state condition.

7. Inspect and verify the position of each device and interlock identified on checklists. Sign off each item as acceptable, or failed. Repeat this test for each operating cycle that applies to system being tested.

8. Check safety cutouts, alarms, and interlocks with [duct detectors] and life-safety systems during each mode of operation.

9. Annotate checklist or data sheet when a deficiency is observed.

10. Verify equipment interface with monitoring and control system and TAB criteria; include the following:

    a. All temperature alarms.
    b. Supply and return flow rates for constant volume systems in each operational mode.
    c. Operation of heat pump units in both heating and cooling cycles.
    d. Minimum outdoor-air intake in each operational mode and at minimum and maximum airflows.
    e. Total exhaust airflow and total outdoor-air intake.
    f. Minimum outdoor-air intake in each operational mode and at minimum and maximum airflows.
    g. Sequences of operation of all HVAC equipment.
    h. Re-located existing ductless heat pump with air flow rates and temperatures.
    i. Electric heating equipment volts, amps, and temperature rise.
    j. Supply and return air flow rates for all HVAC equipment.

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. Life-safety and safety systems.

5. Fire safety.

6. Temporary upset of system operation.

7. Partial occupancy conditions.

8. Special cycles.

9. All alarms.

10. Condensate overflow safety switch and condensate pump shut-down and alarm.

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. Heat-Generation System Testing: HVAC Contractor shall prepare a testing plan to verify performance of air handling units, heat pumps, electric heating coils, auxiliary equipment, and radiant heat panels. 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.

H. Refrigeration System Testing: HVAC Contractor shall prepare a testing plan to verify performance of heat pumps, refrigerant compressors, ductless units, condensate pumps, 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.

I. HVAC Distribution System Testing: HVAC Contractor shall prepare a testing plan to verify performance of air, air handling units, and hydronic distribution systems, 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, and safeties.

J. 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.

K. 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

DIVISION 21 SECTION 210500
COMMON WORK RESULTS FOR FIRE PROTECTION
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SECTION 210500 - 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 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, 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. Remove and re-locate existing fire protection piping and sprinkler heads as required to accommodate new work, corridor renovations, and new ceilings.

1.2. PERMITS AND FEES

A. Obtain all permits and pay taxes, fees and other costs in connection with the work. File necessary plans, prepare documents, give proper notices and obtain necessary approvals. Deliver inspection and approval certificates to Owner prior to final acceptance of the work.

B. Permits and fees shall comply with the Division 01, General Requirements of the specification.

1.3. EXAMINATION OF SITE

A. Examine the site, determine all conditions and circumstances under which the work must be done, and make all necessary allowances for same. No additional cost to the Owner

will be permitted for Contractors failure to do so.

B. Examine and verify specific conditions described in individual specifications sections.

C. Verify that utility services are available, of the correct characteristics, and in the correct locations.

1.4. CONTRACTOR QUALIFICATION

A. Any Contractor or Subcontractor performing work under Division 21 shall be fully qualified and acceptable to the Architect and Owner. Submit the following evidence when requested:

1. A list of not less than five comparable projects which the Contractor completed.

2. Letter of reference from not less than three registered professional engineers, general contractors or building owners.

3. Local and/or State License, where required.

4. Membership in trade or professional organizations where required.

B. A Contractor is any individual, partnership, or corporation, performing work by contract or subcontract on this project.

C. Acceptance of a Contractor or Subcontractor will not relieve the Contractor or subcontractor of any contractual requirements or his responsibility to supervise and coordinate the work, of various trades.

1.5. MATERIALS AND EQUIPMENT

A. Materials and equipment installed as a permanent part of the project shall be new, unless otherwise indicated or specified, and of the specified type and quality. Existing items of equipment are being relocated under another Division of these specifications. The Contractor shall be responsible for connecting all utilities as shown on the drawings, to equipment identified as existing.

B. Where material or equipment is identified by proprietary name, model number and/or manufacturer, furnish named item, or its equal, subject to approval by Engineer. Substituted items shall be equal or better in quality and performance and must be suitable for available space, required arrangement, and application. Submit all data necessary to determine suitability of substituted items, for approval.

C. The suitability of named item only has been verified. Where more than one item is named, only the first named item has been verified as suitable. Substituted items, including items other than first named shall be equal or better in quality and performance to that of specified items, and must be suitable for available space, required arrangement and application. Contractor, by providing other than the first named manufacturer, assumes responsibility for all necessary adjustments and modifications necessary for a satisfactory installation. Adjustments and modifications shall include but not be limited to electrical, structural,

support, and architectural work.

D. Substitution will not be permitted for specified items of material or equipment where noted.

E. All items of equipment furnished shall have a service record of at least five (5) years.

1.6. FIRE SAFE MATERIALS

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

1.7. REFERENCED STANDARDS, CODES AND SPECIFICATIONS

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

B. ASTM - American Society for Testing and Materials

C. FM - Factory Mutual

D. IBC - International Building Code

E. IEEE - Institute of Electrical and Electronics Engineers

F. MSSP - Manufacturers Standards Society of the Valve and Fittings Industry

G. NEC - National Electrical Code

H. NEMA - National Electrical Manufacturers Association

I. NFPA - National Fire Protection Association

J. UL - Underwriters' Laboratories

K. State of Delaware Fire Protection Requirements.

L. All equipment materials, piping and installation shall comply with the codes and standards listed in the enforceable edition of the Applicable National Fire Protection Association Pamphlets.

M. Fire Protection Systems design, equipment and installation shall comply with the Delaware State Fire Prevention Regulations, latest edition including all Annexes and Addendums.

1.8. SUBMITTALS, REVIEW AND ACCEPTANCE

A. Equipment, materials, installation, workmanship and arrangement of work are subject to review and acceptance. No substitution will be permitted after acceptance of equipment or materials except where such substitution is considered by the Architect to be in best interest of Owner.

B. After acceptance of Material and Equipment List, submit three (3) copies or more as required under General Conditions of complete descriptive data for all items. Data shall consist of specifications, data sheets, samples, capacity ratings, performance curves, operating characteristics, catalog cuts, dimensional drawings, wiring diagrams, installation instructions, and any other information necessary to indicate complete compliance with Contract Documents. Edit submittal data specifically for application to this project.

C. Thoroughly review and stamp all submittals to indicate compliance with contract requirements prior to submission. Coordinate installation requirements and any electrical requirements for equipment submitted. Contractor shall be responsible for correctness of all submittals.

D. Submittals will be reviewed for general compliance with design concept in accordance with contract documents, but dimensions, quantities, or other details will not be verified.

E. Identify submittals, indicating intended application, location and service of submitted items. Refer to specification sections or paragraphs and drawings where applicable. Clearly indicate exact type, model number, style, size and special features of proposed item. Submittals of a general nature will not be acceptable. For substituted items, clearly list on the first page of the submittal all differences between the specified item and the proposed item. The contractor shall be responsible for corrective action and maintaining the specification requirements if differences have not been clearly indicated in the submittal.

F. Submit actual operating conditions or characteristics for all equipment where required capacities are indicated. Factory order forms showing only required capacities will not be acceptable. Call attention, in writing, to deviation from contract requirements.

G. Acceptance will not constitute waiver of contract requirements unless deviations are specifically indicated and clearly noted. Use only final or corrected submittals and data prior to fabrication and/or installation.

H. For any submittal requiring more than two (2) reviews by the Engineer (including those caused by a change in subcontractor or supplier) the Owner will withhold contractor's funds by a change order to the contract to cover the cost of additional reviews. One review is counted for each action including rejection or return of any reason.

I. For resubmissions, the Contractor must address in writing all of the Engineer’s comments on the original submission to verify compliance.

1.9. SHOP DRAWINGS

A. Prepare and submit shop drawings for all mechanical equipment, specially fabricated items, modifications to standard items, specially designed systems where detailed design is not shown on the contract drawings, or where the proposed installation differs from that shown on contract drawings.

B. Submit data and shop drawings including but not limited to the list below, in addition to provisions of the paragraph above. Identify all shop drawings by the name of the item and system and the applicable specification paragraph number and drawing number.

C. Every submittal including, but not limited to the list below, shall be forwarded with its own transmittal as a separate, distinct shop drawing. Grouping of items/systems that are not related shall be unacceptable.

D. Items and Systems

1. Access Doors/Panels including layout and location
2. Coordinated Drawings
3. Drip Pans
4. Exterior Equipment/Piping Supports
5. Fire Protection System including Hydraulic Calculations, Equipment and Devices
6. Fire Stopping - Methods and Materials
7. Identification System
8. Material and Equipment List
9. Operations and Maintenance Manuals
10. Pipe Materials Including Itemized Schedule
11. Preliminary Pipe Pressure Tests
12. Sprinkler Heads
13. Test Certificates
14. Valves
15. Wiring Diagrams, Flow Diagrams and Operating Instructions

E. Contractor, additionally, shall submit for review any other shop drawings as required by the Architect. No item shall be delivered to the site, or installed, until the Contractor has received a submittal from the Engineer marked Reviewed or Comments Noted. After the proposed materials have been reviewed, no substitution will be permitted except where approved by the Architect.

F. For any shop drawing requiring more than two (2) reviews by the Engineer (including those caused by a change in subcontractor or supplier) the Owner will withhold contractor's funds by a change order to the contract to cover the cost of additional reviews. One review is counted for each action including rejection or return of any reason.

1.10. SUPERVISION AND COORDINATION

A. Provide complete supervision, direction, scheduling, and coordination of all work under the Contract, including that of subcontractors.

B. Coordinate rough-in of all work and installation of sleeves, anchors, and supports for piping, equipment, and other work performed under Division 21.

C. Arrange for pipe spaces, chases, slots, and openings in building structure during progress of construction to allow for fire protection installations.

D. Coordinate electrical work required under Division 21 with that under Division 26. Coordinate all work under Division 21 with work under all other Divisions.

E. Supply services of an experienced (10 years minimum) and competent Project Manager to be in constant charge of work at site.

F. Where a discrepancy exists within the specifications or drawings or between the specifications and drawings, the more stringent (or costly) requirement shall apply until clarification can be obtained from the Engineer. Failure to clarify such discrepancies with the Engineer will not relieve the Contractor of the responsibility of conforming to the requirements of the Contract.

G. Failure of contractor to obtain a full and complete set of contract documents (either before or after bidding) will not relieve the contractor of the responsibility of complying with the intent of the contract documents.

1.11. CUTTING AND PATCHING

A. Accomplish all cutting and patching necessary for the installation of work under Division 21. Damage resulting from this work to other work already in place, shall be repaired at Contractor's expense. Where cutting is required, perform work in neat and workmanlike manner. Restore disturbed work to match and blend with existing construction and finish, using materials compatible with the original. Use mechanics skilled in the particular trades required.

B. Do not cut structural members without approval from the Architect 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. Where pipes penetrate roofs, flash pipe with Stoneman Stormtite, Pate or approved equal, roof flashing assemblies with skirt and caulked counter flashing sleeve.

C. Furnish and install pitch pockets or weather tight curb assemblies where required.

D. Furnish and install curbs, specifically designed for application to the particular roof construction, and install in accordance with the manufacturer's instructions. The Contractor shall be responsible for sleeve sizes and locations. All roof penetrations shall be installed in accordance with manufacturer’s instructions, the National Roofing Contractors Association, SMACNA, and as required by other divisions of these

specifications.

1.13. CONNECTIONS AND ALTERATIONS TO EXISTING WORK

A. Unless otherwise noted on the drawings, where existing fire protection work is removed, pipes, valves, etc., shall be removed, including hangers, to a point below finished floors or behind finished walls and capped. Such point shall be far enough behind finished surfaces to allow for installation of normal thickness of required finish material.

B. Where work specified in Division 21 connects to existing equipment and piping, etc., Contractor shall perform all necessary alterations, cuttings, fittings, etc., of existing work as may be necessary to make satisfactory connections between new and existing work, and to leave completed work in a finished and workmanlike condition.

C. Where the work specified under Division 21, or under other Divisions, requires relocation of existing equipment, piping, etc., Contractor shall perform all work and make necessary changes to existing work as may be required to leave completed work in a finished and workmanlike condition.

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

E. Fire suppression system will remain active throughout the duration of the project. Contractor will 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. 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 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 in crawl spaces and all other applicable OSHA regulations.

I. Where required to maintain the existing systems in operation, temporarily backfeed existing systems from new equipment. Contractor shall temporarily extend existing piping systems to new piping systems with the appropriate shut-off valves and tamper switches.

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.

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 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. After demolition of ceilings install aluminum inverted pie plates above each sprinkler head. Maintain throughout construction phase. Remove with the installation of new ceilings.

1.15. ALTERNATES

A. Refer to Division 01 Section, "Alternates" for description of work under this section affected by alternates.

1.16. DEFINITIONS

A. Approve - to permit use of material, equipment or methods conditional upon compliance with contract documents requirements.

B. Furnish and install or provide means to supply, erect, install, and connect to complete for readiness for regular operation, the particular work referred to.

C. Contractor means the mechanical contractor and any of his subcontractors, vendors, suppliers, or fabricators.

D. Piping includes pipe, all fittings, valves, hangers, insulation, identification, and other accessories relative to such piping.

E. Concealed means hidden from sight in chases, formed spaces, shafts, hung ceilings, embedded in construction 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. Building Line: Exterior wall of building.

PART 2. ELECTRICAL REQUIREMENTS

2.1. GENERAL MOTOR AND ELECTRICAL REQUIREMENTS

A. Furnish and install control and interlock wiring for the equipment furnished. In general, power wiring and motor starting equipment will be provided under Division 26. Carefully review the contract documents to coordinate the electrical work under Division 21 with the work under Division 26. Where the electrical requirements of the equipment furnished differ from the provisions made under Division 26, make the necessary allowances under Division 21. Where no electrical provisions are made under Division 26, include all necessary electrical work under Division 21.

B. All electrical work performed under Division 21 shall conform to the applicable requirements of Division 26 and conforming to the National Electrical Code. All wiring, conduit, etc., installed in ceiling plenums must be plenum rated per NFPA and the IBC.

C. Provide wiring diagrams with electrical characteristics and connection requirements.

D. Test Reports: Indicate test results verifying nominal efficiency and power factor for three phase motors larger than five (5) horsepower.

E. Protect motors stored on site from weather and moisture by maintaining factory covers and suitable weatherproof covering. For extended outdoor storage, remove motors from equipment and store separately.

F. All motors shall be furnished with visible nameplate indicating motor horsepower, voltage, phase, cycles, RPM, full load amps, locked rotor amps, frame size, manufacturer's name and model number, service factor, power factor and efficiency.

G. Nominal efficiency and power factor shall be as scheduled at full load and rated voltage when tested in accordance with IEEE 112.

H. Brake horsepower load requirement at specified duty shall not exceed 85 percent of nameplate horsepower times NEMA service factor for motors with 1.0 and 1.15 service factors.

I. All single phase motors shall be provided with thermal protection: Internal protection shall automatically open power supply circuit to motor when winding temperature exceeds a safe value calibrated to temperature ratings of motor insulation. Thermal protection device shall automatically reset when motor temperature returns to normal range, unless otherwise indicated.

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.

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 constructed of galvanized steel utilizing galvanized rods, nuts, washers, bolts, etc. At contractor's option stainless steel may be utilized for exterior 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, 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 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.

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 and equipment to prevent the entrance of water, dirt, debris, or other foreign matter. Deliver pipes and tubes with factory applied end caps.

C. Cover or otherwise protect all finishes.

D. Replace damaged materials, devices, finishes and equipment.

E. Protect stored pipes and tubes from moisture and dirt. Elevate above grade. Do not exceed structural capacity of floor, where stored inside.

3.8. OPERATION OF EQUIPMENT

A. Clean all systems and equipment prior to initial operation for testing, 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.

3.9. 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.

C. All items of equipment, including motor starters, fire pump controllers, jockey pump controllers and disconnects shall be furnished with white on black plastic permanent identification cards. Lettering shall be a minimum of ¼ inch high. Identification plates shall be secured, affixed to each piece of equipment, starters, disconnects, panels by screw or adhesive (tuff bond #TB2 or as approved equal). Equipment identification and room name or area served shall be on each label.

D. Provide three (3) copies 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 Protection 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.

3.10. 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.

3.11. 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.

3.12. 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.

3.13. 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 – Christina School District – Stubbs Early Education Center - Adult Services 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. 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 Protection Certificates.

D. 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.

3.14. 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.

3.15. 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 four (4) hours. Testing to be witnessed by Owner's representative and documented in writing.

SYSTEM	TEST PRESSURE
Fire Protection (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.

3.16. PHASING

A. Refer to Architectural Specifications and contract drawings for any required phasing.

B. Maintain building egress and traffic ways at all times. Coordinate egress requirements with the State Fire Marshal, the Owner and Authorities having jurisdiction.

C. Provide dust barriers/partitions, penetration closures, etc., to ensure safety of building occupants and protection of existing surroundings.

D. The Building shall remain watertight at all times.

E. Provide necessary piping, valves, etc. as required. Drain and refill piping systems as often as necessary to accommodate phasing and to minimize time length of outages. Temporarily feed new systems with existing system where required.

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 facility and Architect can be aware of the areas of construction and progress as it relates to the approved schedule.

G. Due to phased construction, some systems must be operated until later phases are completed.

H. 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.

I. After demolition of ceilings install aluminum inverted pie plates above each sprinkler head (as heat trap). Maintain throughout construction phase. Remove with the installation of new ceilings. Submit to Fire Marshall for review and approval.

3.17. 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 210505
FIRE PROTECTION PIPING, FITTINGS & VALVES
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SECTION 210505 - FIRE PROTECTION PIPING, FITTINGS AND 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. RELATED DOCUMENTS

A. This project is to be LEED certified. Refer to Division 01 Sections, including "Sustainable Design Requirements", "Construction Waste Managements", and "Commissioning Requirements" for mandatory work which may apply to all contractors, installers, and suppliers.

1.3. 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.

1.4. 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.

1.5. 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.

1.6. ENVIRONMENTAL REQUIREMENTS

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

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. 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 Protection 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. Wet Pipe Fittings: Steel fittings shall be ASME B16.9, wrought steel, butt welded. Cast iron fittings shall be ASME 16.1, flanges and flanged fittings. Malleable iron fittings shall be ASME B16.3, threaded fittings. Mechanical grooved couplings shall be malleable iron housing clamps to engage and lock C shaped elastomeric sealing gasket, steel bolts, nuts, and washers; galvanized for galvanized pipe. Mechanical formed fittings shall

be carbon steel housing with integral pipe stop and O-ring and O-ring uniformity compressed into permanent mechanical engagement onto pipe.

c. Victaulic, Grinnell, or approved equal, grooved end fittings and mechanical couplings shall be used for wet pipe and dry pipe systems 2" and larger. Couplings and fitting shall be UL listed and FM approved. Fittings shall be ASTM A536 ductile iron, ASTM A234 forged steel or ASTM A53 fabricated steel with factory grooved ends designed to accept Victaulic couplings.

d. Victaulic, Grinnell, or approved equal, mechanical couplings shall consist of two ASTM A536 ductile iron housings, pressure-responsive, synthetic rubber gasket and plated steel bolts and nuts.

i. Rigid Type: Housings shall be cast with offsetting, angle-pattern bolt pads to provide system rigidity and support and hanging in accordance with NFPA-13. Tongue and recess rigid type couplings shall only be used if the contractor uses a torque wrench for installation. Required torque shall be in accordance with the manufacturer's latest recommendation.

1) 1-1/4" through 8": "Installation Ready" stab-on rigid coupling, designed for direct 'stab' installation onto grooved end pipe without prior field disassembly and no loose part. Victaulic FireLock EZ Style 009H (1-1/4" – 4") and Victaulic QuickVic Style 107H (2"-8").

1) 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.

Fire Protection Service	Temperature Range	Gasket Recommendation
Water/Wet Systems	Ambient	Grade EPDM, Type A-C Shaped, FireLock EZ, or QuickVic Design

e. Gate Valves: 2-1/2 inches & larger - listed 175 lb. OS&Y, flanged. 2 inches & smaller - UL/FM listed 175 lb., bronze, screwed. Furnish all sprinkler control valves with slow close manual operator and position indicator. Tamper switches furnish under Division 21.

f. Grooved End Gate Valves: 2-1/2inches and Larger – UL listed/FM approved, 250 psi maximum pressure rating, OS&Y, ductile iron body, bronze mounted, grooved ends. Victaulic FireLock Series 771.

g. Grooved End Butterfly Valves: 2 inches & Larger: UL listed/FM approved, up to 365 psi maximum pressure rating, ductile iron body, nickel-plated ductile iron disc, Nitrile seat, weather-proof actuator with two pre-wired supervisory switches. Victaulic FireLock Series 765 or Series 705.

h. Globe Valves: 2 inches & smaller - 175 lb., bronze, screwed, UL/FM listed.

i. Check Valves: 2-1/2 inches & smaller - UL/FM listed 175 lb., flanged swing check. 2 inches & smaller - listed 175 lb., bronze swing check,

screwed.

j. Grooved End Check Valves: 2 inches and Larger: UL listed/FM approved, up to 365 psi maximum pressure rating, ductile iron body, spring-loaded stainless steel or EPDM coated ductile iron disc, nickel-plated or welded-in nickel seat. Victaulic FireLock Series 717H or Series 717.

k. Finish: All exposed fire protection piping shall be primed and painted with epoxy red paint. White letters shall indicate pipe and indicate direction of flow. Painting shall be provided under Division 09.

l. Special Requirements: All fire protection 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.

2.2. PIPE HANGERS

A. All hangers for metallic piping shall be adjustable, wrought clevis type, or adjustable malleable split ring swivel type, having rods with machine threads. Hangers shall be Grinnell Company's Figure 260 for pipe ¾-inch and larger, and Figure 65 for pipe 2-inches and smaller, or approved equal. Adjustable pipe stanchion with U-bolt shall be Grinnell Company's Figure 191. Pipe roller supports shall be Grinnell's Figure 181 or Figure 271. Exterior pipe hangers shall be galvanized or stainless steel construction. For copper piping in direct contact with the hanger, hanger construction shall be copper coated to prevent contact of dissimilar metals similar to Grinnell's Figure CT-65. Hanger spacing and rod sizes for steel and copper pipe shall not be less than the following:

NOMINAL PIPE SIZE IN	STD. STEEL PIPE	MAXIMUM SPAN FT. COPPER TUBE	MINIMUM ROD DIAMETER INCHES OF ASTM A36 STEEL THREADED RODS
3/4 & 1	6	5	3/8
1 - ½	6	8	3/8
2	8	8	3/8
2 – ½	10	9	½
3	12	10	½

NOMINAL PIPE SIZE IN	STD. STEEL PIPE	MAXIMUM SPAN FT. COPPER TUBE	MINIMUM ROD DIAMETER INCHES OF ASTM A36 STEEL THREADED RODS
4	14	12	5/8
5	14	12	5/8
6	16	14	3/4
8	18	16	7/8
10	20	18	7/8
12	20	18	7/8

B. Anchors, guides, and roller supports shall be installed in accordance with the contract drawings and manufacturer's recommendations to provide pipe support and control pipe movement for all piping systems. Anchors and guides shall be securely attached to the pipe support structure. Submit shop drawing for proposed pipe support structure for guides and anchors for approval of the Structural Engineer. Pipe alignment guides shall be Fig. 255 Grinnell, or as approved equal. Guides shall be sized to accommodate the pipe with insulation. Guides shall be steel factory, fabricated, with bolted two section outer cylinder and base for alignment of piping and two section guiding spider for bolting to pipe.

C. Hangers for pipe sizes ½ to 1 ½ inch (13 to 38 mm): Carbon steel, adjustable swivel, split ring, comply with NFPA-13.

D. Hangers for pipe sizes 2 to 4 inches (50 to 100 mm): Carbon steel, adjustable, clevis. Comply with NFPA-13.

E. Multiple or Trapeze hangers: Steel channels with welded spacers and hanger rods.

F. Wall support for pipe sizes to 3 inches (76 mm): cast iron hook, comply with NFPA-13.

G. Vertical Support: Steel riser clamp, comply with NFPA-13.

H. Floor support for pipe: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support, comply with NFPA-13.

I. Copper pipe support: Carbon steel ring, adjustable, copper plated, comply with NFPA-13.

J. Hanger rods: Mild steel threaded both ends, threaded one end, or continuous threaded, comply with NFPA-13.

K. Inserts: Malleable iron case of galvanized steel shell and expander plug for threaded connection with lateral adjustment, top slot for reinforcing rods, lugs for attaching to forms;

size inserts to suit threaded hanger rods.

L. 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.

2.3. 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.

2.4. 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.

2.5. SLEEVES

A. Sleeves shall be provided around all pipes through walls, floors, ceilings, partitions, roof structure members or other building parts. Sleeves shall be standard weight galvanized iron pipe two sizes larger than the pipe or insulation so that pipe or insulation shall pass through masonry or concrete walls or floors. Provide 20 gauge galvanized steel sheet or galvanized pipe sleeves for all piping passing through frame walls.

B. Sleeves through floors shall be flush with the floor except for sleeves passing through Equipment Rooms which shall extend ¾-inch above the floor. Space between the pipe and sleeve shall be caulked. Escutcheon plates shall be constructed to conceal the ends of sleeves. Each trade shall be responsible for drilling existing floors and walls for necessary sleeve holes. Drilling methods and tools shall be as hereinbefore specified.

C. Sleeves through walls and floors shall be sealed with with a waterproof caulking

compound.

D. Firestop at sleeves that penetrate smoke barriers smoke partitions and/or rated walls/floors.

PART 3. EXECUTION

3.1. GENERAL PIPING INSTALLATION REQUIREMENTS

A. All pipes shall be cut accurately to measurements established at the building, and shall be worked into place without springing or forcing, properly clearing all windows, doors and other openings. Excessive cutting or other weakening of the building structure to facilitate piping installation will not be permitted. All pipes shall be so installed as to permit free expansion and contraction without causing damage. All open ends of pipe lines, equipment, etc., shall be properly capped or plugged during installation to keep dirt or other foreign material out of the system. All pipes shall be run parallel with the lines of the building and as close to walls, columns and ceilings as may be practical, with proper pitch. All piping shall be arranged so as not to interfere with removal of other equipment 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, 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. 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.

3.3. 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.

3.4. 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

END OF SECTION

DIVISION 21 SECTION 211003
WATER BASED FIRE SUPPRESSION SYSTEM – SPRINKLERS
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END OF SECTION 11

SECTION 211003 - 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. Eccentric Reducers
2. Piping
3. Auxiliary Drains
4. Valves

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, City of Wilmington 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 Engineer 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 =	46 psig
Residual Pressure =	43 psig
Flow =	506 gpm
Location =	City of Wilmington Hydrant #: 34196
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.

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 Protection 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.

C. Shut-off valves shall be UL approved O.S. and Y. double disc gate valves or UL/FM approved grooved end butterfly valves.

D. Check valves shall be swing check type or spring-loaded type UL approved for the application.

E. Coordinate the fire protection systems with the fire alarm system specified under Division 26. Provide alarm initiating devices with proper contact arrangement. All electrical wiring shall be furnished and installed under Division 26.

F. Flow control valve, alarm switches and valve supervision shall be furnished and installed under this Division. All wiring shall be accomplished by the electrical contractor, under Division 26. Provide any additional flow control valves, alarm switches, tamper switches and flow switches required by NFPA-13, but not indicated on contract drawings. Coordinate with the alarm system and electrical subcontractor.

G. Pipe and fittings shall meet the requirements of NFPA 13 and NFPA-24.

H. Wet pipe alarm check valve shall be Victaulic FireLock Series 750, Reliable Automatic Sprinkler Co., Tyco Fire Products, or approved equal. Valve shall be UL listed and FM approved for sprinkler systems with 175 psig maximum working pressure. Provide complete valve trim package including all necessary valves, gauges, fittings, nipples and alarm test. Valve internal components shall be replaceable without removing the valve from the installed position. Valve shall be installed in the vertical position only.

2.2. SPRINKLER HEADS

A. 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.

3. Sprinkler heads in all other areas with finished ceilings shall be Victaulic Model V27 or approved equal. These sprinklers shall be standard pendant type with matching screw on escutcheon plate. Sprinkler and escutcheon plate finish shall be chrome plated. Fusible link 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. Quick Response Type:

1. Manufacturers: Victaulic, Viking, Grinnell, Reliable or approved equal.

2. Sprinkler heads shall be listed quick response sprinklers in accordance with NFPA-13 and NFPA-101. Quick response sprinklers shall be Victaulic Model V27 or approved equal. Model and deflector style shall be as required to accommodate upright, pendant, sidewall or recessed mounting. Sprinklers and escutcheon plates shall be chrome plated. Frangible glass bulb shall be temperature rated for specific area hazard.

E. The temperature rating of the sprinklers shall be as required by N.F.P.A.-13 and or the authority having jurisdiction.

F. 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.

G. Provide extended escutcheons in rooms with surface mounted lighting fixtures.

H. 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.

I. 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.

J. Sprinkler escutcheons and guards shall be listed, supplied, and approved for use with the sprinkler, by the sprinkler manufacturer.

K. Provide high temperature sprinkler heads for use adjacent to skylights, heaters, lights, or other high temperature areas.

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. 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.

PART 3. EXECUTION

3.1. GENERAL INSTALLATION REQUIREMENTS

A. Install equipment in accordance with manufacturer's instructions.

B. Place pipe runs to minimize obstruction to other work.

C. Place piping in concealed spaces above finished ceilings.

D. Center sprinklers in two directions in ceiling tile and provided piping offsets as required.

E. Apply masking tape or paper cover to ensure concealed sprinklers, cover plates, and sprinkler escutcheons do not receive field paint finish. Remove after painting. Replace painted sprinklers.

F. Flush entire piping system of foreign matter.

G. Install guards on sprinklers where subject to abuse and where specified.

H. Hydrostatically test entire system.

I. Test must be witnessed by Fire Marshal/authority having jurisdiction/ Owner's insurance underwriter/ Architect/Engineer.

J. The fire protection contractor shall hydraulically prove the most remote area per NFPA-13.

K. Coordinate locations of sprinkler heads with lights, diffusers, ceiling types, etc.

L. Hydrostatically test system at 200 PSI for 4 hours, per NFPA-13.

M. 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.

N. Refer to Architectural Drawings for exact location and extent of all fire rated walls and smoke barriers.

O. 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.

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, Siamese fire department connection, check valves, main piping, branch piping, inspector's test, drains, sprinkler heads, hose valves and cabinet, ball drip valves, signs, standpipes, 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. Provide permanent identification signs indicating portion of system controlled by each valve.

B. Install check valve in each water-supply connection.

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 piping to specialty valves, specialties, and accessories.

B. Connect alarm devices to fire 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. Fill wet-pipe sprinkler piping with water.

F. Energize circuits to electrical equipment and devices.

G. Adjust operating controls and pressure settings.

H. 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, NFPA Standard No. 14, 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 220500
COMMON WORK RESULTS FOR PLUMBING
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SECTION 220500 - COMMON WORK RESULTS FOR PLUMBING

PART 1. GENERAL

1.1. SUMMARY

A. All work under Division 22 is subject to the Division 01, General Requirements, the General Conditions and Supplementary Conditions.

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

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

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

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

F. Coordinate the work under Division 22 with the work of all other construction trades.

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

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 three (3) copies or more as required under General Conditions of complete descriptive data for all items. Data shall consist of specifications, data sheets, samples, capacity ratings, performance curves, operating characteristics, catalog cuts, dimensional drawings, wiring diagrams, installation instructions, and any other information necessary to indicate complete compliance with Contract Documents. Edit submittal data specifically for application to this project.

C. Thoroughly review and stamp all submittals to indicate compliance with contract requirements prior to submission. Coordinate installation requirements and any electrical requirements for equipment submitted. Contractor shall be responsible for correctness of all submittals.

D. Submittals will be reviewed for general compliance with design concept in accordance with contract documents, but dimensions, quantities, or other details will not be verified.

E. Identify submittals, indicating intended application, location and service of submitted items. Refer to specification sections or paragraphs and drawings where applicable. Clearly indicate exact type, model number, style, size and special features of proposed item. Submittals of a general nature will not be acceptable. For substituted items, clearly list on the first page of the submittal all differences between the specified item and the proposed item. The contractor shall be responsible for corrective action and maintaining the specification requirements if differences have not been clearly indicated in the submittal.

F. Submit actual operating conditions or characteristics for all equipment where required capacities are indicated. Factory order forms showing only required capacities will not be acceptable. Call attention, in writing, to deviation from contract requirements.

G. Acceptance will not constitute waiver of contract requirements unless deviations are specifically indicated and clearly noted. Use only final or corrected submittals and data prior to fabrication and/or installation.

H. For any submittal requiring more than two (2) reviews by the Engineer (including those caused by a change in subcontractor or supplier) the Owner will withhold contractor's funds by a change order to the contract to cover the cost of additional reviews. One review is counted for each action including rejection or return of any reason.

I. For resubmissions, the Contractor must address in writing all of the Engineer’s comments on the original submission to verify compliance.

1.9. SHOP DRAWINGS

A. Prepare and submit shop drawings for all plumbing equipment, specially fabricated items, modifications to standard items, specially designed systems where detailed design is not shown on the contract drawings, or where the proposed installation differs from that shown

on contract drawings.

B. Submit data and shop drawings including but not limited to the list below, in addition to provisions of the paragraph above. Identify all shop drawings by the name of the item and system and the applicable specification paragraph number and drawing number.

C. Every submittal including, but not limited to the list below, shall be forwarded with its own transmittal as a separate, distinct shop drawing. Grouping of items/systems that are not related shall be unacceptable.

D. Items and Systems

1. Access Doors/Panels including layout and location
2. Coordinated Drawings
3. Direct Buried Piping
4. Drain Valves
5. Drip Pans
6. Fire Stopping - Methods and Materials
7. Floor Drains
8. Interior Recessed Wall Hydrants
9. Identification System
10. Material and Equipment List
11. Operations and Maintenance Manuals
12. Pipe Guides and Anchors.
13. Pipe Materials Including Itemized Schedule
14. Plumbing Fixtures & Trim
15. Preliminary Testing and Balancing Report
16. Roof Curbs
17. Strainers
18. Test Certificates
19. Thermal Insulation Materials Include Table Summary
20. Thermometers and Gauges

21. Thermostatic Mixing Valves

22. Trap Priming Stations

23. Vacuum Breakers

24. Valves

25. 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.

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. 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.

1.14. 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, 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.

1.15. EXCAVATION AND BACKFILLING

A. GENERAL

1. Perform all necessary excavation, or installation of work under Division 22, in whatever materials or conditions encountered, using suitable methods and equipment.

2. Accurately establish required lines and grades and properly locate the work.

3. Determine the locations of all existing utilities before commencing the work.

B. Excavation: (Refer also to other portions of the specifications)

1. Excavate only the required elevations. If excavation is carried below the

foundation lines or other required limits, backfill the excess with concrete.

2. Keep banks of trenches as nearly vertical as possible, and provide sheeting and/or shoring as required for protection of work and safety of personnel. Follow local, State, and OSHA Guidelines.

3. Keep excavations dry. Protect excavations from freezing.

C. Backfilling: (Refer also to other portions of the specifications)

1. Backfill excavations to the required elevations and restore surfaces to their original or required conditions.

2. Backfill shall be similar material, free from objectionable matter such as rubbish, roots, stumps, brush, rocks and other sharp objects. Unless otherwise indicated, suitable material from the excavation may be used for backfill.

3. Carefully place and mechanically tamp backfill in layers not exceeding 12 inches loose thickness. Compact to 95 percent minimum.

4. Do not backfill against frozen material. Do not use frozen material for backfill.

1.16. 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, embedded in construction or in crawl space or attic.

F. Exposed means not installed underground or concealed as defined above.

G. Invert Elevation means the elevation of the inside bottom of pipe.

H. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct shafts, unheated spaces immediately below roof, spaces above ceiling, unexcavated spaces, crawl spaces, and tunnels.

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

J. Building Line: Exterior wall of building.

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

1.19. 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.

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.

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. 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.

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

2.3. MOTOR INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install securely on firm foundation. Mount ball bearing motors to support shaft regardless of shaft position.

C. Check line voltage and phase and ensure agreement with nameplate. Check that proper thermal overloads have been installed prior to operating motors.

2.4. WIRING DIAGRAMS

A. The Contractor is responsible for obtaining and submitting wiring diagrams for all major items of equipment.

B. Wiring diagrams shall be provided with shop drawings for all equipment requiring electric

power.

C. Provide wiring diagrams for all major plumbing items of equipment to electrical contractor and ATC subcontractor for coordination.

2.5. ENCLOSURES

A. Electrical enclosures including factory provided enclosures, field provided and installed enclosures, and automatic temperature control system enclosures shall be as follows:

1. Dry Interior Locations: NEMA 1.

2. Damp/Wet Locations, Including Exterior Locations: NEMA 3R.

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. 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.

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 manu-factured 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. 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, Fire Pump Rooms, Mezzanines, and Storage where PVC jacketed shall not require painting. Label and identify and color code as specified.

3.6. CLEANING OF SYSTEMS

A. Thoroughly clean systems after satisfactory completion of pressure tests and before permanently connecting fixtures, equipment, traps, strainers, and other accessory items. Blow out and flush piping until interior surfaces are free of foreign matter.

B. Flush piping in re-circulating water systems to remove cutting oil, excess pipe joint compound, solder slag and other foreign materials. Do not use system pumps until after cleaning and flushing has been accomplished to the satisfaction of the Engineer. Employ

chemical cleaners, including a non-foaming detergent, not harmful to system components. After cleaning operation, final flushing and refilling, the residual alkalinity shall not exceed 300 parts per million. Submit a certificate of completion to Engineer stating name of service company used.

C. Maintain strainers and dirt pockets in clean condition.

D. Pay for labor and materials required to locate and remove obstructions from systems that are clogged with construction refuse after acceptance. Replace and repair work disturbed during removal of obstructions.

E. Leave systems clean, and in complete running order.

3.7. COLOR SELECTION

A. Color of finishes shall be as selected by the Architect.

B. Submit color of factory-finished equipment for acceptance prior to ordering.

3.8. PROTECTION OF WORK

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

B. Cover temporary openings in piping and equipment to prevent the entrance of water, dirt, debris, or other foreign matter. Deliver pipes and tubes with factory applied end caps.

C. Cover or otherwise protect all finishes.

D. Replace damaged materials, devices, finishes and equipment.

E. Protect stored pipes and tubes from moisture and dirt. Elevate above grade. Do not exceed structural capacity of floor, where stored inside.

3.9. OPERATION OF EQUIPMENT

A. Clean all systems and equipment prior to initial operation for testing, balancing, or other purposes. Lubricate, adjust, and test all equipment in accordance with manufacturer's instructions. Do not operate equipment unless all proper safety devices or controls are operational. Provide all maintenance and service for equipment that is authorized for operation during construction.

B. Where specified, or otherwise required, provide the services of the manufacturer's factory-trained servicemen or technicians to start up the equipment. Where factory start-up of equipment is not specified, provide field start-up by qualified technician.

C. Submit factory start-up sheets or field start-ups sheets for all equipment prior to the commencement of testing and balancing work. Testing and balancing work shall not commence until start-up reports have been completed, reviewed by Engineer and forwarded to Testing and Balancing Agency.

D. Do not use plumbing systems for temporary services or temporary conditioning during construction. Refer to Division 01 section "Temporary Facilities and Controls" for temporary plumbing during construction.

E. Upon completion of work, clean and restore all equipment to new conditions; replace expendable items such as filters.

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

A. Contractor shall submit for approval schematic piping diagrams of each piping system installed in the building. Diagrams shall indicate the location and the identification number of each valve in the particular system. Following approval by all authorities, the diagrams shall be framed, mounted under safety glass and hung in each Mechanical Room where directed. Contractor shall deliver the tracing or sepia from which the diagrams were reproduced to the Owner.

B. All valves shall be plainly tagged. For any bypass valves, install sign indicating valve position as “Normally Open” or “Normally Closed” as required.

C. All items of equipment, including motor starters and disconnects shall be furnished with white on black plastic permanent identification cards. Lettering shall be a minimum of ¼ inch high. Identification plates shall be secured, affixed to each piece of equipment, starters, disconnects, panels by screw or adhesive (tuff bond #TB2 or as approved equal). Equipment identification and room name or area served shall be on each panel.

D. Provide three (3) copies of operating and maintenance instructions for all principal items of equipment furnished. This material shall be bound as a volume of the Operations and Maintenance Manuals as hereinafter specified.

E. All 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 4 hours of straight time instruction to the operating personnel. Time of instruction shall be designated by the Owner.

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 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. Extend all floor sleeves through floor at least 2-inches above finished floor, caulk sleeve the entire depth and furnish and install floor plate.

3.12. RECORD DRAWINGS

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

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

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 year period from the time of final acceptance by the Owner.

1. That the work contains no faulty or imperfect material or equipment or any imperfect, careless, or unskilled workmanship.

2. That all work, equipment, machines, devices, etc. shall be adequate for the use to which they are intended, and shall operate with ordinary care and attention in a satisfactory and efficient manner.

3. That the contractor will re-execute, correct, repair, or remove and replace with proper work, without cost to the Owner, any work found to be deficient. The contractor shall also make good all damages caused to their work or materials in the process of complying with this section.

4. That the entire work shall be water-tight and leak-proof.

3.14. OPERATIONS AND MAINTENANCE MANUALS

A. The Contractor shall have prepared three (3) hardcopies and one (1) electronic copy of the Operations and Maintenance Manuals and deliver these copies of the manuals to the Owner. The manuals shall be as specified herein. The manuals must be approved and will not be accepted as final until so stamped.

B. The manuals shall be bound in a three ring loose-leaf binder similar to National No. 3881 with the following title lettered on the front: Operations and Maintenance Manual Christina School District – Stubbs Early Education Center – Adult Services 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. 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 and operation 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 and Plumbing and Electrical Certificates.

14. Start-up reports for equipment.

D. 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 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 manu¬facturer's literature showing internal wiring.

3.16. PIPING SYSTEMS TESTING

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

SYSTEM	TEST PRESSURE
Domestic Water & Coil Drain Piping	100 psi
Sanitary Water Piping	As specified below

B. All waste, vent and water piping shall be tested by the Contractor and approved by the Engineer before acceptance. All storm, soil, and waste piping, located underground, shall

be tested before backfilling. The costs of all equipment required for tests are to be included in the contract price.

C. The entire new drainage system and venting system (including acid waste/vent systems) 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.

D. 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.

E. 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. 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.

3.18. PHASING

A. Refer to Architectural Specifications and contract drawings for any required phasing.

B. Maintain building egress and traffic ways at all times. Coordinate egress requirements with the State Fire Marshal, the Owner and Authorities having jurisdiction.

C. Provide dust barriers/partitions, penetration closures, etc., to ensure safety of building occupants and protection of existing surroundings.

D. The Building shall remain watertight at all times.

E. Provide necessary piping, valves, etc. as required. Drain and refill piping systems as often as necessary to accommodate phasing and to minimize time length of outages. Provide valves, to maintain existing systems in operation until all equipment is connected. Temporarily feed new systems with existing system where required or shown on contract

drawings.

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 facility 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.

3.19. 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 220505
PLUMBING PIPING, FITTINGS & VALVES
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SECTION 220505 - PLUMBING PIPING, FITTINGS AND VALVES

PART 1. GENERAL

1.1. SUMMARY

A. The conditions of the contract and other general requirements apply to the work specified in this section. All work under this section shall also be subject to the requirements of Division 22 Section, Common Work Results for Plumbing and Division 01, General Requirements.

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

1.2. SYSTEM DESCRIPTION CONDITIONS

A. Provide all labor and materials necessary to furnish and install all piping systems on this project as herein specified and/or shown on the drawings. Final connections to equipment furnished in other sections of the specifications shall be included under this section.

B. All piping and insulation installed in ceiling plenums must be plenum rated and comply with NFPA and International Building Code (IBC).

C. Where more than one piping system material is specified, ensure system components are compatible and joined to ensure the integrity of the system is not jeopardized. Provide necessary joining fittings. Ensure flanges, union, and couplings for servicing are consistently provided.

D. Use unions, flanges, and couplings downstream of valves and at equipment or apparatus connections. Do not use direct welded or threaded connections to valves, equipment or other apparatus.

E. Use non-conducting dielectric connections whenever jointing dissimilar metals in open systems.

F. Provide pipe hangers and supports in accordance with ASTM B31.9 and MSS SP69 unless indicated otherwise.

G. Use 3/4 inch (20 mm) ball valves with cap and chain for drains at main shut-off valves, low points of piping, bases of vertical risers, and at equipment. Pipe to nearest floor drain.

H. 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. 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.

C. All castings used for coupling housings, fittings, and valve bodies shall be date stamped for quality assurance and traceability.

D. Maintain one copy of each document on site.

1.4. DELIVERY, STORAGE AND HANDLING

A. Deliver, store, protect and handle products to site under as hereinbefore specified.

B. Accept valves on site in shipping containers with labeling in place. Inspect for damage.

C. Provide temporary protective coating on cast iron and steel valves.

D. Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.

E. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed systems.

1.5. ENVIRONMENTAL REQUIREMENTS

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

1.6. ALTERNATES

A. Refer to Division 01 Section, "Alternates" for description of work under this section affected by alternates.

1.7. LEAD FREE REQUIREMENTS

A. All plumbing fixtures, equipment, and devices that contact potable water must be lead free per the State requirements.

1.8. PLASTIC PIPE PENETRATIONS

A. Install UL listed collars, sealing methods, and firestopping at all plastic pipe penetrations of smoke walls and fire rated walls per NFPA.

PART 2. PRODUCTS

2.1. PIPE MATERIALS

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

1. Sanitary Underground - Within Building to 5 Feet Outside of Foundation Wall:

a. PVC Pipe: Schedule 40 DWV or cellular core. Fittings: Schedule 40 PVC,

ASTM D 2665 or ASTM F891 socket fittings. Joints: ASTM D2855, solvent weld with ASTM D2564 solvent cement.

2. Sanitary and Vents Above Floor Inside Building:

   a. PVC Pipe: Schedule 40 DWV or cellular core. Fittings: Schedule 40 PVC, ASTM D 2665 or ASTM F891 socket fittings. Joints: ASTM D2855, solvent weld with ASTM D2564 solvent cement.

3. Indirect Waste Piping:

   a. Pipe & Fittings: Hard drawn Type L copper tubing with cast brass drainage fittings. ASTM B88-78 and ANSI B16.1877. All exposed indirect waste piping shall be chrome plated or primed and painted with silver paint.

4. Storm Water Below Grade or Under Building to Point 5 Feet from Building Line:

   a. PVC Pipe: Schedule 40 DWV or cellular core. Fittings: Schedule 40 PVC, ASTM D 2665 or ASTM F891 socket fittings. Joints: ASTM D2855, solvent weld with ASTM D2564 solvent cement.

5. Domestic Hot, Cold, and Recirc., Water Piping Inside Buildings, Above Grade:

   a. Refer to Specification Section 22 11 16, "Domestic Water Piping."
   b. Extended Valve Stems: Provide and install round collar type extended valve stems on all valves installed in insulated piping. Valve stem and collar shall be selected to suit insulation thickness and maintain valve handles outside of insulation.

2.2. 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. Spacing of hangers for polypropylene pipe (where specified) shall be as follows:

1. 2-inches & smaller - every 2 feet

2. Larger than 2-inches - every 3 feet

3. Plastic piping shall not be installed in ceiling plenums per NFPA.

C. 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.

D. Hangers for pipe sizes ½ to 1 ½ inch (13 to 38 mm): Carbon steel, adjustable swivel, split ring.

E. Hangers for cold pipe sizes 2 inches (50 mm) and over: Carbon steel, adjustable, clevis.

F. Hangers for cold pipe sizes 2 to 4 inches (50 to 100 mm): Carbon steel, adjustable, clevis.

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. Copper pipe support: Carbon steel ring, adjustable, copper plated.

N. Hanger rods: Mild steel threaded both ends, threaded one end, or continuous threaded.

O. Inserts: Malleable iron case of galvanized steel shell and expander plug for threaded connection with lateral adjustment, top slot for reinforcing rods, lugs for attaching to forms; size inserts to suit threaded hanger rods.

2.3. VALVES

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

2.4. STRAINERS

A. Strainers shall be of the basket or "Y" type and shall be heavy and durable, constructed of best grade gray iron with the bottoms drilled and plugged. Bodies shall have arrows clearly cast on the sides to show flow direction. Strainers shall be equipped with easily removable covers and brass sediment baskets made of brass not less than #22 gauge in thickness. Total area of basket perforations shall be not less than four times the cross section of the entering pipe. Flow shall be into basket, and then out through the perforations. Strainers shall be suitable for water or the intended fluid. Strainers 2 inches and smaller shall have threaded or solder ends, 2 inches and larger shall have flanged ends.

B. Strainer screens shall be stainless steel with perforations and shall be 1/16-inch for pipe sizes 5 inches and less, 1/8-inch (40 percent open area) perforations for pipe sizes 6-inch and greater.

C. Provide valved and capped (with chain) blowdowns in each strainer. Blowdown valves shall be Appolo 78-100/200 series or as approved equal.

D. Strainers shall be manufactured by Watts, Mueller, Armstrong, Yarway, Spirax/Sarco or as approved equal.

2.5. UNIONS, FLANGES, AND COUPLINGS

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

B. Unions in copper pipe 2-inches and smaller shall be sweat fittings with bronze seats designed for a working pressure of 125 psig.

C. Flanges for steel pipe over 2 inches shall be 150 psig, forged steel, slip on. Gaskets shall be 1/16 inch thick pre-formed neoprene.

D. Flanges for copper pipe over 2 inches shall be bronze. Gaskets shall be 1/16 inch thick preformed neoprene.

2.6. MANUAL AIR VENTS

A. Manual air vents shall be similar to the hereinafter specified gauge valves. Provide 1/4-inch size on ¾-inch pipe and smaller, ½ -inch size on 1-inch pipe and larger. Install at all high points of piping. Valves shall be Crane No. 88, Honeywell or as approved equal, with threaded ends, bronze body, bronze or brass bonnet and bronze stem.

2.7. 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.

2.8. 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, 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.

2.9. 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.

2.10. TRANSITION FITTINGS

A. General Requirements:

1. Same size as pipes to be joined.

2. Pressure rating at least equal to pipes to be joined.

3. End connections compatible with pipes to be joined.

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

C. Plastic-to-Metal Transition Fittings:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Charlotte Pipe and Foundry Company.
b. Harvel Plastics, Inc.
c. Spears Manufacturing Company.

2. Description: PVC or CPVC one-piece fitting with manufacturer's Schedule 80 equivalent dimensions; one end with threaded brass insert and one solvent-cement-socket end.

D. Plastic-to-Metal Transition Unions:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Colonial Engineering, Inc.
b. NIBCO INC.
c. Spears Manufacturing Company.

2. Description: PVC or CPVC four-part union. Include brass threaded end, solvent-cement-joint plastic end, rubber O-ring, and union nut.

PART 3. EXECUTION

3.1. GENERAL PIPING INSTALLATION REQUIREMENTS

A. All pipes shall be cut accurately to measurements established at the building, and shall be worked into place without springing or forcing, properly clearing all windows, doors and other openings. Excessive cutting or other weakening of the building structure to facilitate piping installation will not be permitted. All pipes shall be so installed as to permit free expansion and contraction without causing damage. All 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. 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 plumbing lines.

I. Shut-off valves shall be installed at the inlet and outlet of each piece of equipment to permit isolation for maintenance and repair.

J. Balancing valves shall be installed in all domestic re-circulating systems and where indicated on the drawings.

K. 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.

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. Install all valves with stem upright or horizontal, not inverted.

O. Where pipe support members are welded to structural building framing, scrape, brush clean, weld and apply one coat of zinc rich primer.

P. Provide clearance for installation of insulation and access to valves and fittings.

Q. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed system.

R. All water containing pipes shall be routed clear of louvers to prevent freezing condition when dampers are open.

S. Provide manual air vents at top of piping systems.

T. Where access doors are required, install piping so that valves can be grouped together to minimize the quantity of access doors.

U. Install manufactured U.L. listed firestop collars at all floor/wall penetrations for all PVC, PEX, and CPVC pipe penetrations.

3.2. VALVE INSTALLATION REQUIREMENTS

A. Examine piping system for compliance with requirements for installation tolerances and other conditions affecting performance of valves. Do not proceed with installation until unsatisfactory conditions have been corrected.

B. Examine valve interior for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks, used to prevent disc movement during shipping and handling.

C. Operate valves from fully open to fully closed positions. Examine guides and seats made accessible by such operation.

D. Examine threads on valve and mating pipe for form and cleanliness.

E. Examine mating flange faces for conditions that might cause leakage. Check bolting for proper size, length, and material. Check gasket material for proper size, material composition suitable for service, and freedom from defects and damage.

F. 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.

3.3. 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.

3.4. 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. 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.

C. Where copper piping joins steel piping, approved bronze adapters shall be used.

D. 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. 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. Shield 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.

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.

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.

3.6. 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.

3.7. 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.

I. Install expansion loops, guides, and anchors on all PEX domestic water piping as required per manufacturer’s instructions.

3.8. 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

3.9. VALVE IDENTIFICATION REQUIREMENTS

A. All valves shall be tagged with a numbered tag.

B. The tags shall be made of 1-inch diameter brass tags fastened to the valve by means of brass chains. Numbers shall agree with valve numbers on diagrammatic herein before specified.

C. Provide a minimum of three (3) valve charts with valve numbers indicating valve type, size, manufacturer and service.

D. Additional valve charts shall be mounted behind glazed wooden frames and be hung in each mechanical equipment room including each air handling unit mechanical equipment room. Additional copies shall be provided in each copy of the O&M manuals.

3.10. 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.

END OF SECTION

DIVISION 22 SECTION 220701
PLUMBING INSULATION
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SECTION 220701 - PLUMBING INSULATION

PART 1. GENERAL

1.1. REFERENCE

A. The Conditions of the Contract and other General Requirements apply to the work specified in this Section. All work under this Section shall be subject to the requirements of Division 22 Section, Common Work Results for Plumbing.

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

1.2. DESCRIPTION

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

1.3. SCOPE

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

1.4. STANDARDS

A. Thermal insulation materials shall meet the property requirements of one or more of the following specifications as applicable to the specific product or use:

1. American Society for Testing of Materials Specifications:

   a. ASTM C 547, “Standard Specification for Mineral Fiber Preformed Pipe Insulation”.
   b. ASTM C 533, “Standard Specification for Calcium Silicate Pipe & Block Insulation”.
   c. ASTM C 55, “Standard Specification for Mineral Fiber Blanket and Felt Insulation”.
   d. ASTM E 96, “Standard Test Methods for Water Vapor Transmission of Materials”.
   e. ASTM C 585, “Recommended Practice for Inner and Outer Diameters of Rigid Pipe Insulation for Nominal Sizes of Pipe and Tubing (NPS System)”.
   f. ASTM C 612, “Standard Specification for Mineral Fiber Block and Board Thermal Insulation”.
   g. ASTM C 1136, “Standard Specification for Barrier Material, Vapor, “Type 1 or 2 (Jacket only).
   h. ASHRAE 90.1 “Energy efficient design of new buildings except low-rise residential buildings”, latest edition.

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. 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.

G. On cold systems such as domestic cold water, vapor barrier performance is extremely important. All penetrations and seams of the ASJ and exposed ends of insulation must be sealed with vapor barrier coating. The ASJ must be protected with either a vapor barrier coating or a suitable vapor retarding outer jacket. Vapor seals at butt joints shall be applied at every fourth pipe section joint and at each fitting to provide isolation of water incursion. Vapor Barrier Coating: Foster 30-65; Childers CP-34 or Vimasco 749. Permeance shall be 0.03 perms or less at 45 mils dry at test by ASTM E96.

H. Fittings and valves shall be insulated with pre-formed fiberglass fittings, fabricated sections of Fiberglass pipe insulation, Fiberglass pipe and tank insulation, Fiberglass blanket insulation, or insulating cement. Thickness shall be equal to adjacent pipe insulation. Finish shall be with pre-formed PVC fitting covers or as otherwise specified on contract drawings. Where applicable, grooved joint PVC fitting valve and coupling covers shall be utilized. Grooved joint PVC covers shall be installed with matching pipe insulation jacketing material, vinyl tape, solvent weld adhesive and appropriate fasteners.

1. Flanges, couplings and valve bonnets shall be covered with an oversized pipe insulation section sized to provide the same insulation thickness as on the main pipe section. An oversized insulation section shall be used to form a collar between the two insulation sections with low density blanket insulation being used to fill gaps. Jacketing shall match that used on straight pipe sections. Rough cut ends shall be coated with a suitable weather or vapor-resistant mastic as dictated by the system location and service. Finish valve installation with a Tyvac jacket with ends that secure to adjacent piping.

2. On hot systems where fittings are to be left exposed, insulation ends should be

beveled away from bolts for easy access.

3. On cold systems, particular care must be given to vapor sealing the fitting cover or finish to the pipe insulation vapor barrier. All valve stems must be sealed with caulking which allows free movement of the stem but provides a seal against moisture incursion. All gauge and thermometer penetrations and extensions shall be correctly sealed and insulated to prevent surface condensation.

I. All piping shall be supported in such a manner that neither the insulation or the vapor/weather barrier is compromised by the hanger or the effects of the hanger. In all cases, hanger spacing must be such that the circumferential joint may be made outside the hanger. On cold systems, vapor barrier must be continuous, including material covered by the hanger saddle.

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

PIPING INSULATION THICKNESS SCHEDULE SERVICES	THICKNESS
All Drain Piping from Cooling Coils/Evaporators	½-inch thickness
All Domestic Hot and Cold Water Piping, including Re-circulating Piping	1-inch thickness
Above Grade Trap Priming Lines	½ -inch thickness
Electric Water Cooler Drains	1-inch thickness

2.4. 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."

2.5. 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.

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 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.

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, 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 221116
DOMESTIC WATER PIPING
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SECTION 221116 - DOMESTIC WATER PIPING

PART 1. GENERAL

1.1. RELATED DOCUMENTS

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

1.2. SUMMARY

A. Section Includes:

1. PEX tube and fittings.
2. PEX-AL-PEX tube and fittings.
3. Piping joining materials.
4. Encasement for piping.
5. Transition fittings.
6. Dielectric fittings.

1.3. ACTION SUBMITTALS

A. Product Data: For transition fittings and dielectric fittings.

1.4. INFORMATIONAL SUBMITTALS

A. System purging and disinfecting activities report.

B. Field quality-control reports.

1.5. FIELD CONDITIONS

A. Interruption of Existing Water Service: Do not interrupt water service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary water service according to requirements indicated:

1. Notify Owner no fewer than two days in advance of proposed interruption of water service.
2. Do not interrupt water service without Owner's written permission.

PART 2. PRODUCTS

2.1. PIPING MATERIALS

A. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, fitting materials, and joining methods for specific services, service locations, and pipe sizes.

B. Potable-water piping and components shall comply with NSF 14, NSF 61, and NSF 372. Include marking "NSF-pw" on piping.

2.2. PEX TUBE AND FITTINGS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Heat Innovations Inc.
2. IPEX USA LLC.
3. MrPex Systems Inc.
4. REHAU.
5. Uponor.
6. Viega LLC.
7. Watts Radiant; A WATTS Brand.

B. Tube Material: PEX plastic according to ASTM F 876 and ASTM F 877.

C. Fittings: ASTM F 1960, cold expansion fittings and reinforcing rings.

D. Manifold: Multiple-outlet, plastic or corrosion-resistant-metal assembly complying with ASTM F 876; with plastic or corrosion-resistant-metal valve for each outlet.

2.3. PEX-AL-PEX TUBE AND FITTINGS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Heat Innovations Inc.
2. IPEX USA LLC.
3. Uponor.
4. Viega LLC.
5. Watts Radiant; A WATTS Brand.

B. Tube Material: PEX plastic bonded to the inside and outside of a welded aluminum tube according to ASTM F 1281.

C. Oxygen Barrier: Limit oxygen diffusion through the pipe to maximum 0.10 mg per cu.

m/day at 104° F (40° C) according to DIN 4726.

D. Fittings: ASTM F 1974, metal insert fittings with split ring and compression nut (compression joint) or metal insert fittings with copper crimp rings (crimp joint).

2.4. PIPING JOINING MATERIALS

A. Pipe-Flange Gasket Materials:

1. AWWA C110/A21.10, rubber, flat face, 1/8 inch (3.2 mm) thick or ASME B16.21, nonmetallic and asbestos free unless otherwise indicated.

2. Full-face or ring type unless otherwise indicated.

B. Metal, Pipe-Flange Bolts and Nuts: ASME B18.2.1, carbon steel unless otherwise indicated.

C. Solder Filler Metals: ASTM B 32, lead-free alloys.

D. Flux: ASTM B 813, water flushable.

E. Plastic, Pipe-Flange Gaskets, Bolts, and Nuts: Type and material recommended by piping system manufacturer unless otherwise indicated.

2.5. ENCASEMENT FOR PIPING

A. Standard: ASTM A 674 or AWWA C105/A21.5.

2.6. 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. Sleeve-Type Transition Coupling: AWWA C219.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Cascade Waterworks Mfg. Co.
b. Dresser, Inc.
c. Ford Meter Box Company, Inc. (The).
d. Jay R. Smith Mfg Co; a division of Morris Group International.
e. JCM Industries, Inc.

f. Romac Industries, Inc.
g. Smith-Blair, Inc.
h. Viking Johnson.

D. Plastic-to-Metal Transition Fittings:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Aquatherm.
b. Charlotte Pipe and Foundry Company.
c. Harvel Plastics, Inc.
d. Sioux Chief Manufacturing Company, Inc.
e. Spears Manufacturing Company.
f. Uponor.

2. Description

a. CPVC one-piece fitting with manufacturer's Schedule 80 equivalent dimensions.
b. One end with threaded brass insert and one solvent-cement-socket or threaded end.

E. Plastic-to-Metal Transition Unions:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Aquatherm.
b. Colonial Engineering, Inc.
c. NIBCO INC.
d. Spears Manufacturing Company.

2. Description:

a. CPVC four-part union.
b. Brass or stainless-steel threaded end.
c. Solvent-cement-joint or threaded plastic end.
d. Rubber O-ring.
e. Union nut.

PART 3. EXECUTION

3.1. PIPING INSTALLATION

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of domestic water piping. Indicated locations and arrangements are used to size pipe and calculate friction loss, expansion, and other design considerations. Install piping as

indicated unless deviations to layout are approved on coordination drawings.

B. Install shutoff valve immediately upstream of each dielectric fitting.

C. Install domestic water piping level without pitch and plumb.

D. Install piping concealed from view and protected from physical contact by building occupants unless otherwise indicated and except in equipment rooms and service areas.

E. 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 other-wise.

F. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal, and co-ordinate with other services occupying that space.

G. Install piping to permit valve servicing.

H. Install nipples, unions, special fittings, and valves with pressure ratings the same as or higher than the system pressure rating used in applications below unless otherwise indicated.

I. Install piping free of sags and bends.

J. Install fittings for changes in direction and branch connections.

K. Install PEX tubing with loop at each change of direction of more than 90 degrees.

L. Install escutcheons for piping penetrations of walls, ceilings, and floors.

3.2. JOINT CONSTRUCTION

A. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

B. Remove scale, slag, dirt, and debris from inside and outside of pipes, tubes, and fittings before assembly.

C. Joints for PEX Tubing: Join according to ASTM F 1807 for metal insert and copper crimp ring fit-tings and ASTM F 1960 for cold expansion fittings and reinforcing rings.

D. Joints for PEX Tubing: Join according to ASSE 1061 for push-fit fittings.

E. Joints for Dissimilar-Material Piping: Make joints using adapters compatible with materials of both piping systems.

3.3. TRANSITION FITTING INSTALLATION

A. Install transition couplings at joints of dissimilar piping.

B. Transition Fittings in Aboveground Domestic Water Piping NPS 2 (DN 50) and Smaller:

Plastic-to-metal transition fittings or unions.

3.4. INSTALLATION OF HANGERS AND SUPPORTS

A. Comply with requirements for hangers, supports, and anchor devices in Plumbing Pipes, Valves, and Fittings."

1. Vertical Piping: MSS Type 8 or 42, clamps.

2. Individual, Straight, Horizontal Piping Runs:

a. 100 Feet (30 m) and Less: MSS Type 1, adjustable, steel clevis hangers.
b. Longer Than 100 Feet (30 m): MSS Type 43, adjustable roller hangers.
c. Longer Than 100 Feet (30 m) if Indicated: MSS Type 49, spring cushion rolls.

3. Multiple, Straight, Horizontal Piping Runs 100 Feet (30 m) or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.

4. Base of Vertical Piping: MSS Type 52, spring hangers.

B. Install vinyl-coated hangers for PEX tubing, with maximum horizontal spacing and minimum rod diameters, to comply with manufacturer's written instructions, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.

C. Support horizontal piping within 12 inches (300 mm) of each fitting.

D. Support vertical runs of PEX tubing to comply with manufacturer's written instructions, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.

3.5. CONNECTIONS

A. Drawings indicate general arrangement of piping, fittings, and specialties.

B. When installing piping adjacent to equipment, allow space for service and maintenance.

3.6. IDENTIFICATION

A. Identify system components. Comply with requirements for identification materials and installation in Division 22 Specification Section "Common Work Results for Plumbing." Label pressure piping with system operating pressure.

3.7. FIELD QUALITY CONTROL

A. Perform the following tests and inspections:

1. Piping Inspections:

a. Do not enclose, cover, or put piping into operation until it has been

inspected and approved by authorities having jurisdiction.

b. During installation, notify authorities having jurisdiction at least one day before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction:

i. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing in after roughing in and before setting fixtures.

ii. Final Inspection: Arrange for authorities having jurisdiction to observe tests specified in "Piping Tests" Subparagraph below and to ensure compliance with requirements.

c. Re-inspection: If authorities having jurisdiction find that piping will not pass tests or inspections, make required corrections and arrange for re-inspection.

d. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.

2. Piping Tests:

a. Fill domestic water piping. Check components to determine that they are not air bound and that pip-ing is full of water.

b. Test for leaks and defects in new piping and parts of existing piping that have been altered, extend-ed, or repaired. If testing is performed in segments, submit a separate report for each test, complete with diagram of portion of piping tested.

c. Leave new, altered, extended, or replaced domestic water piping uncovered and unconcealed until it has been tested and approved. Expose work that was covered or concealed before it was tested.

d. Cap and subject piping to static water pressure of 50 psig (345 kPa) above operating pressure, with-out exceeding pressure rating of piping system materials. Isolate test source and allow it to stand for four hours. Leaks and loss in test pressure constitute defects that must be repaired.

e. Repair leaks and defects with new materials, and retest piping or portion thereof until satisfactory results are obtained.

f. Prepare reports for tests and for corrective action required.

B. Domestic water piping will be considered defective if it does not pass tests and inspections.

C. Prepare test and inspection reports.

3.8. ADJUSTING

A. Perform the following adjustments before operation:

1. Close drain valves, hydrants, and hose bibbs.

2. Open shutoff valves to fully open position.

3. Remove plugs used during testing of piping and for temporary sealing of piping

during installation.

4. Remove and clean strainer screens. Close drain valves and replace drain plugs.

5. Remove filter cartridges from housings and verify that cartridges are as specified for application where used and are clean and ready for use.

6. Check plumbing specialties and verify proper settings, adjustments, and operation.

3.9. CLEANING

A. Clean and disinfect potable domestic water piping as follows:

1. Purge new piping and parts of existing piping that have been altered, extended, or repaired before using.

2. Use purging and disinfecting procedures prescribed by authorities having jurisdiction; if methods are not prescribed, use procedures described in either AWWA C651 or AWWA C652 or follow procedures described below:

a. Flush piping system with clean, potable water until dirty water does not appear at outlets.
b. Fill and isolate system according to either of the following:
i. Fill system or part thereof with water/chlorine solution with at least 50 ppm (50 mg/L) of chlorine. Isolate with valves and allow to stand for 24 hours.
ii. Fill system or part thereof with water/chlorine solution with at least 200 ppm (200 mg/L) of chlorine. Isolate and allow to stand for three hours.
c. Flush system with clean, potable water until no chlorine is in water coming from system after the standing time.
d. Repeat procedures if biological examination shows contamination.
e. Submit water samples in sterile bottles to authorities having jurisdiction.

B. Clean non-potable domestic water piping as follows:

1. Purge new piping and parts of existing piping that have been altered, extended, or repaired before using.

2. Use purging procedures prescribed by authorities having jurisdiction or; if methods are not pre-scribed, follow procedures described below:

a. Flush piping system with clean, potable water until dirty water does not appear at outlets.
b. Submit water samples in sterile bottles to authorities having jurisdiction. Repeat procedures if bio-logical examination shows contamination.

C. Prepare and submit reports of purging and disinfecting activities. Include copies of water-

sample approvals from authorities having jurisdiction.

D. Clean interior of domestic water piping system. Remove dirt and debris as work progresses.

3.10. PIPING SCHEDULE

A. Transition and special fittings with pressure ratings at least equal to piping rating may be used in applications below unless otherwise indicated.

B. Flanges and unions may be used for aboveground piping joints unless otherwise indicated.

C. Fitting Option: Extruded-tee connections and brazed joints may be used on aboveground copper tubing.

D. Aboveground domestic water piping, NPS 2 (DN 50) and smaller, shall be the following:

1. Fittings for PEX tube:

a. ASTM F1807, metal insert and copper crimp rings.
b. ASTM F 1960, cold expansion fittings and reinforcing rings.
c. ASSE 1061, push-fit fittings.

3.11. VALVE SCHEDULE

A. Drawings indicate valve types to be used. Where specific valve types are not indicated, the following requirements apply:

1. Shutoff Duty: Use ball valves for piping NPS 2 (DN 50) and smaller. Use butterfly, ball, or gate valves with flanged ends for piping NPS 2-1/2 (DN 65) and larger.

2. Drain Duty: Hose-end drain valves.

3. Install valve handle extensions on all valves to allow valve handle to clear pipe insulation when valve handle is rotated.

END OF SECTION

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PLUMBING FIXTURES
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END OF SECTION 15

SECTION 224000 – PLUMBING FIXTURES

PART 1. GENERAL

1.1. GENERAL

A. For General Mechanical Requirements, see Division 22 Section, Common Work Results for Plumbing & Division 01, General Requirements.

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

C. All exposed bolts, screws, etc., shall be vandal proof.

D. All plumbing materials, equipment and fixtures shall be new and of best grade, free of defects and complete with all required appurtenances and accessories.

E. Piping and insulation are specified under other sections.

F. Use "Sani-Sett" setting compound for fixtures.

G. Provide all materials, equipment and perform all labor required to install plumbing system complete as specified, as drawings indicated and as required by the State of Delaware, National Standard Plumbing Code and International Plumbing Code, City of Wilmington local code, and all other authorities have jurisdiction. Comply with the current lead free laws per the requirements of the state in which the project is being constructed.

H. Provide stops for all plumbing fixtures and equipment. Stops are to be accessible.

I. Provide P traps on fixtures for which traps have not been included as part of furnished equipment. Trap size to equal size of fixture tailpiece.

J. All exposed metal parts of fixtures shall be chromium plated brass. Piping, fittings, valves, traps and accessories including escutcheons for piping shall be chromium plated where exposed in finished areas.

K. All faucets for lavatories 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.

L. Ensure products and installation of specified products are in conformance with recommendations and requirements of the following organizations:

1. National Sanitation Foundation (NSF).
2. American Society of Mechanical Engineers (ASME).
3. National Electrical Manufacturers' Association (NEMA).
4. Underwriters Laboratories (UL).

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/ASMI A112.19.2 - Vitreous China Plumbing Fixtures.

D. ANSI/ASME A112.19.4 - Porcelain Enameled Formed Steel Plumbing Fixtures.

E. ANSI/ASME A112.19.5 -Trim for Water-Closet Bowl, Tanks, and Urinals (Dimensional Standards).

F. ANSI/NFPA 70 - National Electrical Code.

G. 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.

1.6. GRAB BAR COORDINATION

A. For handicapped plumbing fixtures coordinate location of flush valves with grab bars prior to installation.

1.7. ALTERNATES

A. Refer to Division 01 Section, Alternates for description of work under this section affected

by alternates.

PART 2. PRODUCTS

2.1. WALL-MOUNTED WATER CLOSETS

A. WC-1 Wall Hung, Exposed Manual Flush Valve

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Kohler Model K-4325 Kingston
   b. American Standard
   c. Crane
   d. Sloan
   e. Zurn

2. Bowl:

   a. Material: Vitreous china
   b. Type: Siphon Jet
   c. Style: Flushometer Valve
   d. Height: Standard
   e. Rim Contour: Elongated
   f. Spud Size; Location: NPS 1-1/2; Top

3. Flushometer Valve:

   a. Diaphragm Type: Sloan Model Royal #111, Delany, Zurn or approved equal.
   b. Chrome plated brass.
   c. ADA compliant non-hold open handle.
   d. 1-inch I.P.S. screwdriver back check angle stop.
   e. Spud coupling and flange.
   f. Free spinning vandal resistant stop cap.
   g. Adjustable tail piece.
   h. High back pressure vacuum breaker flush connection.
   i. Sweat solder adapter with cover tube and cast set screw wall flange.
   j. Split Ring Wall Support: Sloan Model J-312-A.
   k. Provide 3-year limited Manufacturer's warranty.

4. Toilet Seat: Kohler Model K-4670-C, American Standard 5901.100, solid plastic white seat with open front and check hinge.

5. Carrier: Zurn, Josam, or Watts cast iron watercloset Carrier with fittings as required. ANSI/ASME A112.6.1 adjustable cast iron frame integral drain hub and vent, adjustable speed, lugs for floor and wall attachment, threaded fixture studs

with nuts and washers.

B. WC-1A Wall Hung, Exposed Manual Flush Valve, Handicapped

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Kohler Model K-4325 Kingston
   b. American Standard
   c. Crane
   d. Sloan
   e. Zurn

2. Bowl:

   a. Material: Vitreous china
   b. Type: Siphon Jet
   c. Style: Flushometer Valve
   d. Height: A.D.A. Compliant
   e. Rim Contour: Elongated
   f. Spud Size; Location: NPS 1-1/2; Top

3. Flushometer Valve:

   a. Diaphragm Type: Sloan Model Royal #111, Delany, Zurn or approved equal.
   b. Chrome plated brass.
   c. ADA compliant non-hold open handle.
   d. 1-inch I.P.S. screwdriver back check angle stop.
   e. Spud coupling and flange.
   f. Free spinning vandal resistant stop cap.
   g. Adjustable tail piece.
   h. High back pressure vacuum breaker flush connection.
   i. Sweat solder adapter with cover tube and cast set screw wall flange.
   j. Split Ring Wall Support: Sloan Model J-312-A.
   k. Provide 3-year limited Manufacturer's warranty.

4. Seat: Kohler Model K-4670-C, American Standard 5901.100, solid plastic white seat with open front and check hinge.

5. Carrier: Zurn, Josam, or Watts cast iron watercloset Carrier with fittings as required. ANSI/ASME A112.6.1 adjustable cast iron frame integral drain hub and vent, adjustable speed, lugs for floor and wall attachment, threaded fixture studs with nuts and washers.

2.2. WALL-HUNG URINALS

A. U-1 Wall-Hung, Exposed Manual Flush Valve

1. Manufacturers: Subject to compliance with requirements, provide products by one

of the following:

a. Kohler Model K-4991-ET Bardon
b. American Standard
c. Sloan
d. Zurn

2. Fixture:

a.	Material:	Vitreous china
b.	Type:	Washout
c.	Rim Height:	Standard
d.	Spud Size; Location:	NPS 3/4; Top
e.	Outlet Size; Location:	NPS 2; Back

3. Flushometer Valve:

a. Diaphragm Type: Sloan Model Royal #186, Delany, Zurn or approved equal.
b. Chrome plated.
c. ADA compliant non-hold open handle.
d. 3/4-inch I.P.S. screwdriver back check angle stop.
e. Spud coupling and flange.
f. Free spinning vandal resistant stop cap.
g. Adjustable tail piece.
h. High back pressure vacuum breaker flush connection.
i. Sweat solder adapter with cover tube and cast set screw wall flange.
j. Split Ring Wall Support: Sloan Model J-312-A.
k. Provide 3-year limited Manufacturer's warranty.

4. Carrier: Zurn, Josam or Watts cast iron urinal carrier with fittings as required. ANSI/ASME A112.6.1A; cast iron and steel frame with tubular legs, legs for floor and wall attachment, threaded fixtures studs for fixture hanger, bearing studs.

B. U-1A Wall-Hung, Exposed Manual Flush Valve, Handicapped

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Kohler Model K-1991-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 Royal #186, Delany, Zurn or approved equal.
b. Chrome plated.
c. ADA compliant non-hold open handle.
d. 3/4-inch I.P.S. screwdriver back check angle stop.
e. Spud coupling and flange.
f. Free spinning vandal resistant stop cap.
g. Adjustable tail piece.
h. High back pressure vacuum breaker flush connection.
i. Sweat solder adapter with cover tube and cast set screw wall flange.
j. Split Ring Wall Support: Sloan Model J-312-A.
k. Provide 3-year limited Manufacturer's warranty.

4. Carrier: Zurn, Josam or Watts cast iron urinal carrier with fittings as required. ANSI/ASME A112.6.1A; cast iron and steel frame with tubular legs, legs for floor and wall attachment, threaded fixtures studs for fixture hanger, bearing studs.

2.3. WALL-MOUNTED LAVATORIES

A. LAV-1 Wall-Hung, Deck Mounted Metering Faucet

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Kohler Model K-2032 Greenwich
b. American Standard Lucerne
c. Crane
d. Zurn

2. Fixture:

a. Material: Vitreous china
b. Type: Wall-Hung
c. Rim Mounting Height: Standard
d. Nominal Size: 20-3/4”L x 18-1/4”W
e. Faucet-Hole Punching: Three Holes, 4-inch centers
f. Faucet-Hole Location: Top
g. Color: White
h. Mounting Material: Concealed Arm Carrier

3. Faucet:

a. Chicago Faucet 802-VE2805-665ABCP, Sloan, American Standard
b. Deck Mounted
c. Metering Push Handles
d. Low-Flow Outlet

e. Polished Chrome Finish
f. 4-inch Spout
g. Unit shall operate at less than 5 lbs. push at 80 psi water pressure.
h. Certification to comply with ADA shall be furnished

4. Strainer:

a. Chicago Faucet Model 327A, American Standard
b. 1-1/4-inch tailpiece
c. Non-removable brass strainer
d. Grid strainer waste
e. Chrome plated finished.

5. P-Trap:

a. Cast Brass 1-1/4-inch "P" trap

6. Stops:

a. Chicago Faucet Model l005-ABCP valve stops.
b. 3/8-inch loose key cap
c. Removable tee handle
d. Wall flange
e. Chrome plated finished.

7. Thermostatic Mixing Valves:

a. Provide and install below fixture.
b. See Part 2 “Thermostatic Mixing Valves”.

8. Carrier:

a. Zurn, Josam, or Watts cast iron and steel carrier.
b. ANSI/ASME A112.6.1
c. Cast iron and steel frame with tubular legs.
d. Lugs for floor and wall attachment.
e. Concealed arm supports.
f. Bearing plate and studs.

B. LAV-1A Wall-Hung, Deck Mounted Metering Faucet, Handicapped

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Kohler Model K-2032 Greenwich
b. American Standard Lucerne
c. Crane
d. Zurn

2. Fixture:

a.	Material:	Vitreous china
b.	Type:	Wall-Hung
c.	Rim Mounting Height:	A.D.A. Compliant
d.	Nominal Size:	20-3/4”L x 18-1/4”W
e.	Faucet-Hole Punching:	Three Holes, 4-inch centers
f.	Faucet-Hole Location:	Top
g.	Color:	White
h.	Mounting Material:	Concealed Arm Carrier

3. Faucet:

   a. Chicago Faucet 802-VE2805-665ABCP, Sloan, American Standard
   b. Deck Mounted
   c. Metering Push Handles
   d. Low-Flow Outlet
   e. Polished Chrome Finish
   f. 4-inch Spout
   g. Unit shall operate at less than 5 lbs. push at 80 psi water pressure.
   h. Certification to comply with ADA shall be furnished

4. Strainer:

   a. Chicago Faucet Model 327A, American Standard
   b. 1-1/4-inch tailpiece
   c. Non-removable brass strainer
   d. Grid strainer waste
   e. Chrome plated finished.

5. P-Trap:

   a. Cast Brass 1-1/4-inch "P" trap

6. Stops:

   a. Chicago Faucet Model l005-ABCP valve stops.
   b. 3/8-inch loose key cap
   c. Removable tee handle
   d. Wall flange
   e. Chrome plated finished.

7. Thermostatic Mixing Valves:

   a. Provide and install below fixture.
   b. See Part 2 “Thermostatic Mixing Valves”.

8. Carrier:

   a. Zurn, Josam, or Watts cast iron and steel carrier.

b. ANSI/ASME A112.6.1
c. Cast iron and steel frame with tubular legs.
d. Lugs for floor and wall attachment.
e. Concealed arm supports.
f. Bearing plate and studs.

9. Lavatory Protective Enclosure:

a. Provide and install Truebro Model # 2018 lav shield lavatory enclosure on all lavatories with sensor operated faucets. Protective enclosure shall be ADA conforming, 20-inch x 18-inch wheel chair accessible. Unit shall have white finish, be constructed of high impact, stain resistant vinyl, and include seven (7) wall anchors.

2.4. MOP SINKS

A. J-1 Janitor 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, 24x24
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.

2.5. THERMOSTATIC MIXING VALVES (INDIVIDUAL FIXTURE TYPE)

A. Furnish and install thermostatic mixing valves at all lavatories, and below all lavatories

and hand sinks that are provided with hot water temperatures above 109 degrees F.

B. Thermostatic mixing valves shall be Bradley S59-4000A, Watts, Moen, Leonard Ecobix, Acorn, or approved equal for installation under lavatories. Provide in-line check valves, lead free body, escutcheon plates, inlet filters, and insulation as required. Thermostatic mixing valves shall be adjusted to deliver 105 degrees Fahrenheit hot water when supplied with 140 degrees Fahrenheit delivering hot water. Furnish with adjusting cap with locking feature. The thermostatic mixing valves shall be listed for use at the scheduled flow rate of the equipment served.

C. The thermostatic mixing valves shall be ASSE standard 1070 listed.

2.6. 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.

2.7. 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. Insulation thickness to be minimum 2 inch.

E. Where lav. Guards are provided insulation may be omitted.

2.8. 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. Install and secure fixtures in place with wall supports, wall carriers and bolts.

I. Solidly attach water closets to floor with lug screws. Lead flashing is not intended to hold fixture in place.

J. Install flush valve handles on the open side of all ADA waterclosets in accordance with ANSI requirements.

K. Fixtures shall be vitreous china unless otherwise noted. Cast iron fixtures shall have acid resisting enamel finish unless noted otherwise, color shall be white.

L. 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.

M. 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.

N. All plumbing vents within a 10'-0" radius of exhaust vents shall be extended to a height of 3'-0" above exhaust vent crown.

O. All plumbing vents within a 10'-0" radius of any rooftop unit or intake louver shall be extended to a height of 3'-0" above fresh air intake.

P. Slopes and invert elevations of all interior piping shall be established before any piping is installed in order that proper slopes will be maintained. All piping shall be located and determined where to be run to avoid conflict with other trades.

Q. Unless otherwise noted, all plumbing piping shall be routed as high as possible between bottom of roof joists and above ceiling to allow proper installation of ductwork, fire protection piping, conduits, etc.

R. Coordinate with Architectural Drawings before roughing in plumbing.

S. All openings in ceilings and plenum walls for plumbing shall be sealed air tight and protected with fire stop.

T. See domestic water riser diagrams for location of valves, shock absorbers, etc.

U. Make proper HW, CW, re-circ, waste, and vent connections to all fixtures and equipment even though all branch main, elbows and connections are not shown.

V. Unless otherwise noted, sanitary waste piping shown is below floor and all other piping is overhead, above ceiling. Domestic hot, cold and re-circ. water piping shall be installed between ceiling and attic insulation.

W. Unless otherwise noted, horizontal sanitary piping shall be pitched 1 percent.

X. Unless otherwise noted, all domestic water piping and fire protection piping shall be installed on heated side of ceiling insulation.

Y. All piping and installation shall comply with all local and national plumbing codes. Test piping as required by plumbing code and authority having jurisdiction.

Z. For sizes of all domestic water piping see plumbing fixture schedule and domestic water riser diagrams.

AA. 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. Fasten recessed, wall-mounting plumbing specialties to reinforcement built into walls.

B. Secure supplies to supports or substrate.

C. 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.

D. Install water-supply stop valves in accessible locations.

E. 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.

F. Include wood-blocking reinforcement for recessed and wall-mounting plumbing specialties.

3.3. FITTINGS FOR FIXTURES SUPPLIED BY OTHERS

A. Fittings, accessories and connection of these fixtures to the plumbing system are provided under this section.

B. Rough-in and final connection includes but is not limited to all domestic water, waste, vent, 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. 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, and valves 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.

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. Standard 22 inches to top of bowl rim.
b. 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. 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 224005
PLUMBING EQUIPMENT
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END OF SECTION 10

SECTION 224005 - PLUMBING EQUIPMENT

PART 1. GENERAL

1.1. GENERAL

A. For General Mechanical Requirements, see Division 22 Section, Common Work Results for Plumbing & Division 01, General Requirements.

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

C. All exposed bolts, screws, etc., shall be vandal proof.

D. All plumbing materials and equipment shall be new and of best grade, free of defects and complete with all required appurtenances and accessories.

E. Piping and insulation are specified under other sections.

F. Provide all materials, equipment and perform all labor required to install plumbing system complete as specified, as drawings indicated and as required by the State of Delaware, National Standard Plumbing Code , International Plumbing Code, City of Wilmington Code, the local code, and all other authorities have jurisdiction.

G. Provide stops for all plumbing equipment. Stops are to be accessible.

H. Ensure products and installation of specified products are in conformance with recommendations and requirements of the following organizations:

1. National Sanitation Foundation (NSF).

2. American Society of Mechanical Engineers (ASME).

3. National Electrical Manufacturers' Association (NEMA).

4. Underwriters Laboratories (UL).

I. 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 A112.21.1 - Floor Drains.

C. ANSI A112.26.1 - Water Hammer Arrestors.

D. PDI WH-201 Water Hammer Arresters.

E. ANSI/ASHRAE 90A - Energy Conservation in New Building Design.

F. ANSI/NFPA 70 - National Electrical Code.

G. 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.

PART 2. PRODUCTS

2.1. FLOOR DRAINS

A. Provide Nikaloy strainers on all floor drains unless specified otherwise.

B. Provide flashing clamps on all drains penetrating waterproofing membrane.

C. Provide suitable flashing material and clamping collar for drains which are not set in place when slab is poured.

D. Provide traps for all floor drains connected to the sanitary system.

E. 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.

F. 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.

G. Where applicable, for floor drains utilized for washing machines, provide a stainless steel lint screen/strainer.

H. Schedule of Drains and Accessories:

1. FDR.-1: General Service Floor Drain: Zurn ZN-415, Watts, or MIFAB floor and shower drain, dura coated cast iron body with bottom outlet, combination invertible membrane clamp and adjustable collar with Type "B" polished nickel bronze strainer. Provide with ½ -inch trap primer connection.

I. Approved Manufacturers: Josam, J.R. Smith, Zurn, Wade, Ancon, Mifab, Watts.

2.2. CLEANOUTS

A. Provide cleanouts in sanitary and storm drainage systems at ends of runs, at changes in direction, near the base of stacks, every 50 feet in horizontal runs, of 4-inch diameter or less, every 100 feet in horizontal runs over 4-inches, and where indicated.

B. Cleanouts shall be full size of pipe up to 4-inches and shall be 4-inches for larger sizes. Where installed in finished floors inserts shall match adjacent floor construction.

C. Materials and Approved Manufacturers: Josam, J.R. Smith, Zurn, Wade or Ancon, Mifab, Watts, equal to Josam numbers given below:

1.	Concealed Piping	C.I. Pipe
2.	Unfinished Areas	
3.	Floors	57000-Z-CI
4.	Walls	58600-PLG
5.	Finished Areas Floors	
6.	Terrazzo	56040-13
7.	Composition Tile	57000-X-12
8.	Ceramic Tile	57000-X
9.	Finished Areas Walls	
10.	Plaster/Dry Wall	58640-COT
11.	Tile/CMU	58600-COT

2.3. 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.

2.4. 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. 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.

D. 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.

E. Approved manufacturers: Watts, Beeco, B&K Industries, Zurn, Sparco, Conbraco or approved equal.

2.5. 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.

2.6. 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.

2.7. 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

2.8. INTERIOR RECESSED WALL HYDRANTS (HYD)

A. 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.

B. Units shall be encased Ecotrol “anti-siphon" wall hydrant for interior wall installation. Unit shall be suitable for hot or cold water as indicated on Contract Drawings.

C. 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.

D. Furnish each unit mounted in a stainless steel box and hinged cover with operating key lock and "water" stamped on cover.

E. Furnish each unit with the following accessories:

1. 3/4 inch – 90 degrees inlet elbow with union nut

2. cylinder lock

3. key operator

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. 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.

E. Install floor drains in low points so the top of grates are at or below the finished floor level.

F. Drains not functioning properly shall be removed and re-installed properly at the expense of the contractor.

G. Coordinate cutting and forming of roof and floor construction to receive drains to required invert elevations.

H. 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.

I. All plumbing, vents in exterior walls shall be offset a minimum of 3'-0" in ceiling at roof before penetration.

J. All plumbing vents within a 10'-0" radius of exhaust vents shall be extended to a height of 3'-0" above exhaust vent crown.

K. All plumbing vents within a 10'-0" radius of any rooftop unit or intake louver shall be extended to a height of 3'-0" above fresh air intake.

L. Slopes and invert elevations of all interior piping shall be established before any piping is installed in order that proper slopes will be maintained. All piping shall be located and determined where to be run to avoid conflict with other trades.

M. Unless otherwise noted, all plumbing piping shall be routed as high as possible between bottom of roof joists and above ceiling to allow proper installation of ductwork, fire protection piping, conduits, etc.

N. Coordinate with Architectural Drawings before roughing in plumbing.

O. All openings in ceilings and plenum walls for plumbing shall be sealed air tight and protected with fire stop.

P. See domestic water riser diagrams for location of valves, shock absorbers, etc.

Q. Make proper HW, CW, re-circ., waste, and vent connections to all equipment even though all branch main, elbows and connections are not shown.

R. Cleanouts shall be provided near base of each vertical waste or solid stack. Provide 18" minimum clearance for access.

S. Unless otherwise noted, sanitary waste piping shown is below floor and all other piping is overhead, above ceiling. Domestic hot, cold and re-circ. water piping shall be installed between ceiling and roof insulation.

T. Unless otherwise noted, horizontal sanitary piping pitches shall be 1 percent.

U. Unless otherwise noted, all domestic water piping and fire protection piping shall be installed on heated side of ceiling insulation.

V. All piping and installation shall comply with all local and national plumbing codes. Test

piping as required by plumbing code and authority having jurisdiction.

W. For sizes of all domestic water piping see plumbing fixture schedule and domestic water riser diagrams.

X. 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. Install interior recessed wall hydrants with integral or field installed vacuum breaker.

C. All interior recessed wall hydrants shall be mounted 24" above finished grade unless otherwise specified.

D. 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.

E. 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.

F. Fasten recessed, wall mounting plumbing specialties to reinforcement built into walls.

G. Secure supplies to supports or substrate.

H. 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.

I. Install water supply stop valves in accessible locations.

J. 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.

K. Include wood blocking reinforcement for recessed and wall mounting plumbing specialties.

L. Install ball valves at all shock absorbers to allow removal for service/replacement.

3.3. FITTINGS FOR FIXTURES SUPPLIED BY OTHERS

A. 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:

1. Through a 3/4-inch hose connection in each branch main and building main, pump in sufficient sodium hypochlorite to produce a free available chlorine residual of not less than 200 ppm. Plumbing Contractor shall provide plumbing connections and power for pumping chlorine into system.

2. Proceed upstream from the point of chlorine application opening all faucets and taps until chlorine is detected. Close faucets and taps when chlorine is evident.

3. When chlorinated water has been brought to every faucet and tap with a minimum concentration of 200 ppm chlorine, retain this water in the system for at least three (3) hours.

4. CAUTION: Over-concentration of chlorine and more than three (3) hours of retention may result in damage to piping system. It is not necessary to retain chlorine in any system for twenty-four hours to achieve sterilization. AWWA states that 200 ppm chlorine for three hours is sufficient.

5. At the end of the retention period, no less than 100 ppm of chlorine shall be present at the extreme end of the system.

6. Proceed to open all faucets and taps and thoroughly flush all new lines until the chlorine residual in the water is less than 1.0 ppm.

7. Obtain representative water sample from the system for analysis by an independent and recognized bacteriological laboratory.

8. If the sample tested for coliform organisms is negative, a letter and laboratory report shall be submitted by the service organization to the Contractor, certifying successful completion of the sterilization. Additionally, this report shall be forwarded to the Owner as well as be included in the O&M Manual.

9. If any samples tested indicate the presence of coliform organisms, the entire

sterilization procedure shall be repeated.

10. Take precautions to avoid use of plumbing fixtures and domestic water systems during sterilization period. Place signs on all plumbing fixtures and outlets during sterilization period.

3.6. EXAMINATION

A. Verify that walls and floor finishes are prepared and ready for installation of fixtures.

B. Verify that electric power is available and of the correct characteristics.

3.7. PREPARATION

A. Rough-in fixture piping connections in accordance with minimum sizes indicated in fixture rough-in schedule for particular fixtures.

3.8. INTERFACE WITH OTHER PRODUCTS

A. Review millwork shop drawings. Confirm location and size of fixtures and openings before rough-in and installation.

3.9. CLEANING

A. At completion, clean plumbing equipment.

END OF SECTION

DIVISION 23 SECTION 230500
COMMON WORK RESULTS FOR HVAC
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SECTION 230500 - COMMON WORK RESULTS FOR HVAC

PART 1. GENERAL

1.1. SUMMARY

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

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

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

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

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

F. Coordinate the work under Division 23 with the work of all other construction trades.

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

1.2. PERMITS AND FEES

A. Obtain all permits and pay taxes, fees and other costs in connection with the work. File necessary plans, prepare documents, give proper notices and obtain necessary approvals. Deliver inspection and approval certificates to Owner prior to final acceptance of the work.

B. Permits and fees shall comply with the Division 01, General Requirements of the specification.

1.3. EXAMINATION OF SITE

A. Examine the site, determine all conditions and circumstances under which the work must be done, and make all necessary allowances for same. No additional cost to the Owner will be permitted for contractors' failure to do so.

B. Examine and verify specific conditions described in individual specifications sections.

C. Verify that utility services are available, of the correct characteristics, and in the correct locations.

1.4. CONTRACTOR QUALIFICATION

A. Any Contractor or Subcontractor performing work under Division 23 shall be fully qualified and acceptable to the Architect/Engineer and Owner. Submit the following evidence when requested:

1. A list of not less than five comparable projects which the Contractor completed.

2. Letter of reference from not less than three registered professional engineers, general contractors or building owners.

3. Local and/or State License, where required.

4. Membership in trade or professional organizations where required.

B. A Contractor is any individual, partnership, or corporation, performing work by contract or subcontract on this project.

C. Acceptance of a Contractor or Subcontractor will not relieve the Contractor or subcontractor of any contractual requirements or his responsibility to supervise and coordinate the work, of various trades.

1.5. MATERIALS AND EQUIPMENT

A. Materials and equipment installed as a permanent part of the project shall be new, unless otherwise indicated or specified, and of the specified type and quality. Existing items of equipment are being relocated under another Division of these specifications. The Contractor shall be responsible for connecting all utilities as shown on the drawings, to equipment identified as existing.

B. Where material or equipment is identified by proprietary name, model number and/or manufacturer, furnish named item, or its equal, subject to approval by Engineer. Substituted items shall be equal or better in quality and performance and must be suitable for available space, required arrangement, and application. Submit all data necessary to determine suitability of substituted items, for approval.

C. The suitability of named item only has been verified. Where more than one item is named, only the first named item has been verified as suitable. Substituted items, including items other than first named shall be equal or better in quality and performance to that of specified items, and must be suitable for available space, required arrangement and application. Contractor, by providing other than the first named manufacturer, assumes responsibility for all necessary adjustments and modifications necessary for a satisfactory installation. Adjustments and modifications shall include but not be limited to electrical, structural, support, and architectural work.

D. Substitution will not be permitted for specified items of material or equipment where noted.

E. All items of equipment furnished shall have a service record of at least five (5) years.

1.6. FIRE SAFE MATERIALS

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

1.7. REFERENCED STANDARDS, CODES AND SPECIFICATIONS

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

B.	AABC		Associated Air Balance Council
C.	ACCA	-	Air Conditioning Contractors of America
D.	ACGIH	-	American Conference of Governmental Industrial Hygienist
E.	ADC		Air Diffusion Council
F.	AMCA		Air Movement and Control Association
G.	ANSI	-	American National Standards Institute
H.	ARI	-	Air Conditioning and Refrigeration Institute
I.	ASHRAE	-	American Society of Heating, Refrigerating and Air Conditioning Engineers
J.	ASME	-	American Society of Mechanical Engineers
K.	ASPE	-	American Society of Plumbing Engineers
L.	ASTM	-	American Society for Testing and Materials
M.	FM	-	Factory Mutual
N.	IBC	-	International Building Code
O.	IEEE	-	Institute of Electrical and Electronics Engineers
P.	MSSP	-	Manufacturers Standards Society of the Valve and Fittings Industry
Q.	NEC	-	National Electrical Code
R.	NEMA	-	National Electrical Manufacturers Association
S.	NFPA	-	National Fire Protection Association

T. SMACNA - Sheet Metal and Air Conditioning Contractors National Association

U. UL - Underwriters' Laboratories

V. State of Delaware Fire Protection Regulations

W. All mechanical equipment and materials shall comply with the codes and standards listed in the latest edition of ASHRAE HVAC Applications Handbook, Chapter entitled Codes and Standards.

1.8. SUBMITTALS, REVIEW AND ACCEPTANCE

A. Equipment, materials, installation, workmanship and arrangement of work are subject to review and acceptance. No substitution will be permitted after acceptance of equipment or materials except where such substitution is considered by the Architect] to be in best interest of Owner.

B. After acceptance of Material and Equipment List, submit three (3) copies or more as required under General Conditions of complete descriptive data for all items. Data shall consist of specifications, data sheets, samples, capacity ratings, performance curves, operating characteristics, catalog cuts, dimensional drawings, wiring diagrams, installation instructions, and any other information necessary to indicate complete compliance with Contract Documents. Edit submittal data specifically for application to this project.

C. Thoroughly review and stamp all submittals to indicate compliance with contract requirements prior to submission. Coordinate installation requirements and any electrical requirements for equipment submitted. Contractor shall be responsible for correctness of all submittals.

D. Submittals will be reviewed for general compliance with design concept in accordance with contract documents, but dimensions, quantities, or other details will not be verified.

E. Identify submittals, indicating intended application, location and service of submitted items. Refer to specification sections or paragraphs and drawings where applicable. Clearly indicate exact type, model number, style, size and special features of proposed item. Submittals of a general nature will not be acceptable. For substituted items, clearly list on the first page of the submittal all differences between the specified item and the proposed item. The contractor shall be responsible for corrective action and maintaining the specification requirements if differences have not been clearly indicated in the submittal.

F. Submit actual operating conditions or characteristics for all equipment where required capacities are indicated. Factory order forms showing only required capacities will not be acceptable. Call attention, in writing, to deviation from contract requirements.

G. Acceptance will not constitute waiver of contract requirements unless deviations are specifically indicated and clearly noted. Use only final or corrected submittals and data prior to fabrication and/or installation.

H. For any submittal requiring more than two (2) reviews by the Engineer (including those caused by a change in subcontractor or supplier) the Owner will withhold contractor's funds by a change order to the contract to cover the cost of additional reviews. One review is counted for each action including rejection or return of any reason.

I. For resubmissions, the Contractor must address in writing all of the Engineer's comments on the original submission to verify compliance.

1.9. SHOP DRAWINGS

A. Prepare and submit shop drawings for all mechanical equipment, specially fabricated items, modifications to standard items, specially designed systems where detailed design is not shown on the contract drawings, or where the proposed installation differs from that shown on contract drawings.

B. Submit data and shop drawings including but not limited to the list below, in addition to provisions of the paragraph above. Identify all shop drawings by the name of the item and system and the applicable specification paragraph number and drawing number.

C. Every submittal including, but not limited to the list below, shall be forwarded with its own transmittal as a separate, distinct shop drawing. Grouping of items/systems that are not related shall be unacceptable.

D. Items and Systems

1. Access Doors/Panels including layouts and locations
2. Air Distribution Systems
3. Automatic Temperature Control Systems and Equipment
4. Condensate Pumps
5. Coordinated Drawings
6. Drip Pans
7. Duct Materials
8. Electric Radiant Heat Panels
9. Equipment Supports
10. Fans
11. Filters
12. Filter Housings
13. Fire Stopping - Methods and Materials

14. Fire Dampers

15. Grilles, Registers, Diffusers

16. Identification Systems

17. Louvers

18. Material and Equipment Lists

19. Operations and Maintenance Manuals

20. Pipe Materials Including Itemized Schedules

21. Preliminary Testing and Balancing Reports

22. Screen shots of ATC System Graphics

23. Test Certificates

24. Thermal Insulation Materials Include Table Summaries

25. Thermometers and Gauges

26. Vibration Isolation Materials

27. 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 curbs, vent assemblies, and duct sleeves specifically designed for application to the particular roof construction, and install in accordance with the manufacturer's instructions. The Contractor shall be responsible for sleeve sizes and locations. All roof penetrations shall be installed in accordance with manufacturer’s instructions, the National Roofing Contractors Association, SMACNA, and as required by other divisions of these specifications.

E. All work associated with the existing roof shall be performed so as to maintain the existing roof warranty.

1.13. 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.

1.14. 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, etc., as required. Drain and refill piping systems as often as necessary to accommodate phasing and to minimize time lengths of outages.

D. The Contractor shall be responsible for visiting the site and determining the existing conditions in which the work is to be performed.

E. Refer to phasing plans for additional requirements.

F. Where any abandoned pipes in existing floors, walls, pipe tunnels, ceilings, etc., conflict with new work, remove abandoned pipes as necessary to accommodate new work.

G. The location of all existing equipment, piping, ductwork, etc., indicated is approximate only and shall be checked and verified. Install all new mechanical/plumbing/fire protection work to connect to or clear existing work as applicable.

H. Maintain egress at all times. Coordinate egress requirements with the State Fire Marshal, the Owner and the authorities having jurisdiction.

I. Make provisions and include in bid all costs associated with confined entry/space requirements in crawl spaces and all other applicable OSHA regulations.

J. Where required to maintain the existing systems in operation, temporarily backfeed existing systems from new equipment. Contractor shall temporarily extend existing piping systems to new piping systems with the appropriate shut-off valves.

K. At completion of project all temporary piping, valves, controls, etc., shall be removed in their entirely.

L. Existing piping, equipment, ductwork, materials, etc., not required for re-use or re-installation in this project, shall be removed from the project site.

M. Deliver to the Owner, on the premises where directed, existing equipment and materials which are removed and which are desired by the Owner or are indicated to remain the property of the Owner.

N. All other materials and equipment which are removed shall become property of the Contractor and shall be promptly removed, from the premises, and disposed of by the Contractor, in an approved manner. Contractor shall be responsible for proper disposal of all removed equipment containing refrigerants. Contractor shall include in his bid all cost associated with the evacuation, removal and disposal of all existing equipment containing refrigerants in accordance with EPA and Health Department requirements. Where existing split systems or ductless units are indicated to be relocated, extend refrigeration piping, power, and control wiring to the same.

O. Where piping and/or ductwork is removed, remove all pipe or ductwork hangers which were supporting the removed piping or ductwork. Patch the remaining penetration voids with like materials and paint to match existing construction.

P. Where required, provide and coordinate removal and re-installation of existing equipment. Take care to protect materials and equipment indicated for reuse. Contractor shall repair or replace items which are damaged. Contractor shall have Owner's representative present to confirm condition of equipment prior to demolition.

Q. Before demolition begins, and in the presence of the Owners representative, test and note all deficiencies in all existing systems affected by demolition but not completely removed by demolition. Provide a copy of the list of system deficiencies to the Owner and the Engineer. Videotape existing conditions in each space prior to beginning demolition work.

R. The Owner shall have the first right of refusal for all fixtures, devices and equipment removed by the Contractor.

S. All devices and equipment designated by the Owner to remain the property of the Owner shall be moved and stored by the Contractor at a location on site as designated by the Owner. It shall be the Contractor's responsibility to store all devices and equipment in a safe manner to prevent damage while stored.

T. All existing equipment refused by the Owner shall become the property of the Contractor and shall be removed from the site by the Contractor in a timely manner and disposed of

in a legal manner.

U. Work Abandoned in Place: Cut and remove underground pipe a minimum of 2 inches beyond face of adjacent construction. Cap and patch surface to match existing finish.

V. Temporary Disconnection: Remove, store, clean, reinstall, reconnect, and make operational equipment indicated for relocation.

W. Terminate services and utilities in accordance with local laws, ordinances, rules and regulations.

1.15. 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.

1.16. 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”.

1.17. ALTERNATES

A. Refer to Division 01 Section, “Alternates” for description of work under this section affected by alternates.

1.18. FASTENERS/CAPS

A. For all exterior 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.

1.19. DEFINITIONS

A. Approve - to permit use of material, equipment or methods conditional upon compliance with contract documents requirements.

B. Furnish and install or provide means to supply, erect, install, and connect to complete for readiness for regular operation, the particular work referred to.

C. Contractor means the mechanical contractor and any of his subcontractors, vendors,

suppliers, or fabricators.

D. Piping includes pipe, all fittings, valves, hangers, insulation, identification, and other accessories relative to such piping.

E. Ductwork includes duct material, fittings, hangers, insulation, sealant, identification and other accessories

F. Concealed means hidden from sight in chases, formed spaces, shafts, hung ceilings, embedded in construction or in crawl space.

G. Exposed means not installed underground or concealed as defined above.

H. Invert Elevation means the elevation of the inside bottom of pipe.

I. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct shafts, unheated spaces immediately below roof, spaces above ceiling, unexcavated spaces, crawl spaces, and tunnels.

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

K. Building Line: Exterior wall of building.

1.20. MINIMUM EFFICIENCY REQUIREMENTS

A. All heating, ventilating, and air conditioning equipment shall be manufactured to provide the minimum efficiency requirements as specified in ASHRAE Standard 90.1, latest edition.

B. All piping, ductwork, and equipment insulation shall comply with ASHRAE Standard 90.1, latest edition.

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

1.21. SYSTEM INTEGRATION

A. For all HVAC equipment specified to be provided with packaged controls and interfaced with the automatic temperature control system, provide system integration between the equipment manufacturer and the automatic temperature control subcontractor.

B. HVAC equipment submittals requiring system integration as defined above must identify all required system integration points.

C. HVAC equipment manufacturers must coordinate with ATC subcontractor regarding system integration prior to submitting on the equipment.

D. A system integration meeting must be arranged by the Mechanical Contractor and include, but not be limited to the systems integrator for the HVAC equipment manufacturer and the ATC Subcontractor. This portion of systems integration must occur prior to HVAC equipment being delivered to the project.

E. Once the HVAC equipment is on site, a second systems integration meeting must be arranged by the Mechanical Contractor to coordinate the packaged controls with the ATC system. The HVAC equipment manufacturer's representative familiar with system integration and the ATC subcontractor familiar with programming must be present.

F. A final system integrations meeting shall occur once all equipment is in place and ready for operation. The Mechanical Contractor, the HVAC equipment systems' integrator, and the ATC Subcontractor shall meet on site to jointly program, schedule, verify points, interlock devices, and fully set up all systems integration components.

G. All systems integration coordination, programming, and graphics must be completed prior to requesting commissioning and/or inspections by the Engineer of Record.

PART 2. ELECTRICAL REQUIREMENTS

2.1. GENERAL MOTOR AND ELECTRICAL REQUIREMENTS

A. Furnish and install control and interlock wiring for the equipment furnished. In general, power wiring and motor starting equipment will be provided under Division 26. Carefully review the contract documents to coordinate the electrical work under Division 23 with the work under Division 26. Where the electrical requirements of the equipment furnished differ from the provisions made under Division 26, make the necessary allowances under Division 23. Where no electrical provisions are made under Division 26, include all necessary electrical work under Division 23.

B. All electrical work performed under Division 23 shall conform to the applicable requirements of Division 26 and conforming to the National Electrical Code. All wiring, conduit, etc., installed in ceiling plenums must be plenum rated per NFPA and the International Building Code.

C. Provide wiring diagrams with electrical characteristics and connection requirements.

D. Test Reports: Indicate test results verifying nominal efficiency and power factor for three phase motors larger than five (5) horsepower.

E. Protect motors stored on site from weather and moisture by maintaining factory covers and suitable weatherproof covering. For extended outdoor storage, remove motors from equipment and store separately.

F. All motors shall be furnished with visible nameplate indicating motor horsepower, voltage, phase, cycles, RPM, full load amps, locked rotor amps, frame size, manufacturer's name and model number, service factor, power factor and efficiency.

G. Motors located in exterior locations, wet air streams, air cooled condensers, and outdoors shall be totally enclosed weatherproof epoxy-treated type.

H. Nominal efficiency and power factor shall be as scheduled at full load and rated voltage when tested in accordance with IEEE 112.

I. Brake horsepower load requirement at specified duty shall not exceed 85 percent of nameplate horsepower times NEMA service factor for motors with 1.0 and 1.15 service factors.

J. All single phase motors shall be provided with thermal protection: Internal protection shall automatically open power supply circuit to motor when winding temperature exceeds a safe value calibrated to temperature ratings of motor insulation. Thermal protection device shall automatically reset when motor temperature returns to normal range, unless otherwise indicated.

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 such mechanical equipment as fans, unit heaters, humidifiers and damper controllers. When approved by the Engineer, deviations from the specifications will be permitted as follows:

1. Open motors may be installed as part of an assembly where enclosure within a cabinet provides protection against moisture.

2. Motors used in conjunction with low voltage control systems may have a voltage rating less than 115 volts.

E. Single phase motors, greater than 1/20 horsepower and less than ½ horsepower shall be ball bearing; drip-proof, totally enclosed or explosion proof, as specified, with Class A or B insulation, as standard with the motor manufacturer; 115 or 120/208/240 volts as required; capacitor start-induction run, permanent split capacitor, or repulsion start-induction run type with minimum efficiency of 70 percent and a minimum full load power of 77 percent.

F. Except as otherwise specified in the various specification sections, 3 phase motors 60 horsepower and smaller shall be NEMA design B squirrel cage induction type meeting the requirements of this paragraph. Motors shall be drip-proof, totally enclosed or explosion proof, as specified or indicated. Insulation shall be Class B or F, at 40 degrees C ambient temperature. Drip-proof motors shall have a 1.15 service factor and totally enclosed and explosion proof motors shall have a service factor of 1.00 or higher. Motors specified for operation at 480, 240, and 208 volts shall be nameplated 460, 230, 200 volts, respectively. Efficiencies and percent power factor at full load for three phase motors shall be not less than the values listed below for premium efficiency motors:

MOTOR NAMEPLATE	MINIMUM PERCENT EFFICIENCY AT NOMINAL SPEED AND RATED LOAD	MINIMUM PERCENT POWER FACTOR
1HP and above to	85.5 percent	84 percent
1-½ HP	86.5 percent	85 percent
2HP	86.5 percent	85 percent
3HP	89.5 percent	86 percent
5HP	89.5 percent	87 percent
7½ HP	91 percent	86 percent

MOTOR NAMEPLATE	MINIMUM PERCENT EFFICIENCY AT NOMINAL SPEED AND RATED LOAD	MINIMUM PERCENT POWER FACTOR
10HP	91.7 percent	85 percent
15HP	93.0 percent	85 percent
20HP	93.0 percent	86 percent
25HP	93.6 percent	85 percent
50HP and above	94.5 percent	88 percent
60 HP	95.0 percent	90 percent
75HP	95.0 percent	90 percent
100 HP	95.4 percent	90 percent
125 HP	95.8 percent	95 percent
150 HP and above	96.0 percent	95 percent

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.

J. Provide manufacturer's warranty for all motors for minimum of 5 years including all labor and materials.

2.3. MOTOR INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install securely on firm foundation. Mount ball bearing motors to support shaft regardless of shaft position.

C. Check line voltage and phase and ensure agreement with nameplate. Check that proper thermal overloads have been installed prior to operating motors.

D. Use adjustable motor mounting bases for belt-driven motors.

E. Align pulleys and install belts.

F. Tension belts according to manufacturer's written instructions.

2.4. WIRING DIAGRAMS

A. The Contractor is responsible for obtaining and submitting wiring diagrams for all major items of equipment.

B. Wiring diagrams shall be provided with shop drawings for all equipment requiring electric power.

C. Provide wiring diagrams for all major mechanical items of equipment to electrical contractor and ATC subcontractor for coordination.

2.5. ENCLOSURES

A. Electrical enclosures including factory provided enclosures, field provided and installed enclosures, and automatic temperature control system enclosures shall be as follows:

1. Dry Interior Locations: NEMA 1.

2. Damp/Wet Locations, Including Exterior Locations: NEMA 3R.

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 manu¬factured items or fabricated structural steel shapes. All interior hangers shall be galvanized or steel with rust inhibiting paint. For un-insulated copper piping provide copper hanger to prevent contact of dissimilar metals. All exterior hangers shall be constructed of stainless steel utilizing stainless steel rods, nuts, washers, bolts, etc.

3.3. PROVISIONS FOR ACCESS

A. The contractor shall provide access panels and doors for all concealed equipment, valves, strainers, dampers, filters, controls, control devices, cleanouts, 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

i. 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, Mezzanines, and Storage where PVC jacketed shall not require painting. Label and identify and color code as specified.

3.5. CLEANING OF SYSTEMS

A. Thoroughly clean systems after satisfactory completion of pressure tests and before permanently connecting fixtures, equipment, traps, strainers, and other accessory items. Blow out and flush piping until interior surfaces are free of foreign matter.

B. Flush piping in re-circulating water systems to remove cutting oil, excess pipe joint compound, solder slag and other foreign materials. Do not use system pumps until after cleaning and flushing has been accomplished to the satisfaction of the Engineer. Employ

chemical cleaners, including a non-foaming detergent, not harmful to system components. After cleaning operation, final flushing and refilling, the residual alkalinity shall not exceed 300 parts per million. Submit a certificate of completion to Engineer stating name of service company used.

C. Maintain strainers and dirt pockets in clean condition.

D. Clean fans, ductwork, enclosures, flues, registers, grilles, and diffusers at completion of work.

E. Install filters of equal efficiency to those specified in permanent air systems operated for temporary heating during construction. Replace with clean filters as specified prior to acceptance and after cleaning of system.

F. Pay for labor and materials required to locate and remove obstructions from systems that are clogged with construction refuse after acceptance. Replace and repair work disturbed during removal of obstructions.

G. Leave systems clean, and in complete running order.

3.6. COLOR SELECTION

A. Color of finishes shall be as selected by the Architect.

B. Submit color of factory-finished equipment for acceptance prior to ordering.

3.7. PROTECTION OF WORK

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

B. Cover temporary openings in piping, ductwork, and equipment to prevent the entrance of water, dirt, debris, or other foreign matter. Deliver pipes and tubes with factory applied end caps.

C. Cover or otherwise protect all finishes.

D. Replace damaged materials, devices, finishes and equipment.

E. Protect stored pipes and tubes from moisture and dirt. Elevate above grade. Do not exceed structural capacity of floor, where stored inside.

F. Provide moisture protection for ductwork in areas which are not under roof.

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 con-struction, unless approved by Owner in writing. Refer to Division 01 Section "Temporary Facilities and Controls" for temporary heating/cooling during construction.

E. Upon completion of work, clean and restore all equipment to new conditions; replace expendable items such as filters.

3.9. DEMONSTRATION AND TRAINING VIDEO RECORDINGS

A. General: Record demonstration and training video recordings. Record each training module separately.

1. At beginning of each training module, record each chart containing learning objective and lesson outline.

B. Video Recording Format: Provide high-quality color video recordings with menu navigation in format acceptable to Engineer

C. Recording: Mount camera on tripod before starting recording, unless otherwise necessary to show area of demonstration and training. Display continuous running time.

D. Narration: Describe scenes on video recording by audio narration by microphone while video recording is recorded. Include description of items being viewed.

E. Transcript: Provide a transcript of the narration. Display images and running time captured from videotape opposite the corresponding narration segment.

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

A. Contractor shall submit for approval schematic piping diagrams of each piping system installed in the building. Diagrams shall indicate the location and the identification number of each valve in the particular system. Following approval by all authorities, the diagrams shall be framed, mounted under safety glass and hung in each Mechanical Room where directed. Contractor shall deliver the tracing or sepia from which the diagrams were reproduced to the Owner.

B. All valves shall be plainly tagged. For any bypass valves, install sign indicating valve position as “Normally Open” or “Normally Closed” as required.

C. All items of equipment, including motor starters, disconnects and ATC panels shall be furnished with white on black plastic permanent identification cards. Lettering shall be a minimum of ¼ inch high. Identification plates shall be secured, affixed to each piece of equipment, starters, disconnects, panels by screw or adhesive (tuff bond #TB2 or as approved equal).

D. Provide three (3) copies of operating and maintenance instructions for all principal items of equipment furnished. This material shall be bound as a volume of the Record and Information Booklet as hereinafter specified.

E. All lines piping and ductwork installed under this contract shall be stenciled with direction of flow arrows and with stenciled letters naming each pipe and ductwork and service. Refer to Division 23 Section, "HVAC Piping, Fittings, Valves, Etc." and Division 23 Section, "HVAC Air Distribution". Color-code all direction of flow arrows and labels. In finished spaces omit labeling and direction of flow arrows. Paint in color as selected by Architect.

F. Submit list of wording, symbols, letter size, and color coding for mechanical identification. Submit samples of equipment identification cards, piping labels, ductwork labels, and valve tags to Engineer for review prior to installation.

G. Provide at least 4 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.

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 year period from the time of final acceptance by the Owner.

1. That the work contains no faulty or imperfect material or equipment or any imperfect, careless, or unskilled workmanship.

2. That all work, equipment, machines, devices, etc. shall be adequate for the use to which they are intended, and shall operate with ordinary care and attention in a satisfactory and efficient manner.

3. That the contractor will re-execute, correct, repair, or remove and replace with proper work, without cost to the Owner, any work found to be deficient. The contractor shall also make good all damages caused to their work or materials in the process of complying with this section. Contractor shall repair and/or replace any/all damage to finishes and furniture resulting from their corrective work.

4. That the entire work shall be water-tight and leak-proof.

3.14. LUBRICATION

A. All bearings, motors, and all equipment requiring lubrication shall be provided with

accessible fittings for same. Before turning over the equipment to the Owner, the Contractor shall fully lubricate each item of equipment, shall provide one year's supply of lubricant for each, and shall provide Owner with complete written lubricating instructions, together with diagram locating the points requiring lubrication. Include this information in the Record and Information Booklet.

B. In general, all motors and equipment shall be provided with grease lubricated roller or ball bearings with Alemite or equal accessible or extended grease fittings and drain plugs.

3.15. OPERATIONS AND MAINTENANCE MANUALS

A. The Contractor shall have prepared three (3) hardcopies and one (1) electronic copy of the Operations and Maintenance Manuals and deliver these copies of the booklet to the Owner. The booklet shall be as specified herein. The booklet must be approved and will not be accepted as final until so stamped.

B. The booklet shall be bound in a three ring loose-leaf binder similar to National No. 3881 with the following title lettered on the front: Operations and Maintenance Manuals - Christina School District - Stubbs Early Education Center – Adult Services 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. 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 heat pumps.

5. Chart form indicating frequency and type of routine maintenance for all mechanical equipment. The chart shall also indicate model number of equipment, location and service.

6. Provide sales and authorized service representatives names, address, and phone numbers of all equipment and subcontractors.

7. Provide supplier and subcontractor's names, address, and phone number.

8. Catalog data of all equipment, valves, etc. shall include wiring diagrams, parts list and assembly drawing.

9. Provide and install in locations as directed by the Owner, valve charts including

valve tag number, valve type, valve model number, valve manufacturer, style, service and location. Each valve chart shall be enclosed in a durable polymer based frame with a cover safety glass.

10. Copy of the approved balancing report including duct leakage data.

11. ATC systems including as-built ATC drawings of systems including internal of all panels.

12. Access panel charts with index illustrating the location and purpose of access panels.

13. Approved Health Department and Electrical Certificates.

14. Start-up reports for equipment.

15. Provide and install in locations as directed by Owner, filter charts, including filter type, size, model number, manufacturer, quantity and size for each filter utilized on the project. Filter charts shall be enclosed in a durable polymer based frame with a cover safety glass.

16. Insert color graphic with embedded parameters for ATC system into record and information booklet.

17. Filter charts indicating equipment served, size, and type of filter required.

D. Submit Record and Information Booklets prior to anticipated date of substantial completion for Engineer review and approval. Substantial completion requires that Record and Information booklets be reviewed and approved.

3.16. 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 manu¬facturer'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 four (4) hours. Testing to be witnessed by Owner's representative and documented in writing.

SYSTEM	TEST PRESSURE
Refrigerant Piping	550 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/General Contractor.

3.18. EQUIPMENT BY OTHERS

A. This Contractor shall make all system connections required to equipment furnished and installed under other divisions or furnished by the Owner. Connections shall be complete in all respects to render this equipment functional to its fullest intent.

B. It shall be the responsibility of the supplier of this equipment to furnish complete instructions for connections. Failure to do so will not relieve this contractor of any responsibility for improper equipment operation.

3.19. ADDITIONAL FILTERS AND BELTS

A. One complete set of additional filters and belts shall be turned over to the owner upon final acceptance of the building by the owner. Provide correspondence to the Engineer (copy) documenting that additional filters and belts have been turned over to Owner.

B. All filters and belts shall be tagged and identified for equipment served. Furnish filters in protection wrap.

3.20. PHASING

A. Refer to Architectural Specifications and contract drawings for any required phasing.

B. Maintain building egress and traffic ways at all times. Coordinate egress requirements with the State Fire Marshal, the Owner and Authorities having jurisdiction.

C. Provide dust barriers/partitions, penetration closures, etc, to ensure safety of building occupants and protection of existing surroundings.

D. The Building shall remain watertight at all times.

E. Provide necessary piping, valves, piping, conduit, controllers, ATC wiring, etc. as required. Drain and refill piping systems as often as necessary to accommodate phasing and to minimize time length of outages. Provide steam traps, drips, valves, etc., to maintain existing steam system in operation until all equipment is connected to the hot water system. Temporarily feed new systems with existing system where required or shown on contract drawings.

F. At completion of the first phase the ATC System shall be sufficiently complete to turn over HVAC equipment. All wiring, testing, balancing, commissioning, programming, graphics, and ATC computer shall be completed and operational for all equipment in each phase prior to Owner taking ownership of the same.

G. Within thirty days of Award of Contract, the Contractor shall submit a minimum of six (6) copies of the proposed Phasing Plan (Drawings and detailed written description) to the Architect for review and approval based on the general and specific requirements indicated on the Drawings and Specifications. The phasing plan shall reflect the work of all trades. The phasing plan shall be updated as often as needed (i.e. major deviations and/or modified sequence of events) and reviewed during each progress meeting so the facility and Architect can be aware of the areas of construction and progress as it relates to the approved schedule.

H. While work is in progress, except for designated short intervals during which connections are made, continuity of service shall be maintained to all existing systems. Interruptions shall be coordinated with the Owner as to time and duration. The contractor shall be responsible for any interruptions to service and shall repair any damages to existing systems caused by his operations.

3.21. OUTAGES

A. Provide a minimum of fourteen (14) days notice to schedule outages. The Contractor shall include in their bid outages and/or work in occupied areas to occur on weekends, holidays, or at night. Coordinate and get approval of all outages with the Owner.

B. Submit Outage Request form, attached at end of this Section, to Owner for approval.

END OF 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 230505
HVAC PIPING, FITTINGS & VALVES
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SECTION 230505 - HVAC PIPING, FITTINGS AND VALVES

PART 1. GENERAL

1.1. SUMMARY

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

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

1.2. SYSTEM DESCRIPTION CONDITIONS

A. Provide all labor and materials necessary to furnish and install all piping systems on this project as herein specified and/or shown on the drawings. Final connections to equipment furnished in other sections of the specifications shall be included under this section.

B. All piping and insulation installed in ceiling plenums must be plenum rated and comply with NFPA and International Building Code (IBC).

C. Where more than one piping system material is specified, ensure system components are compatible and joined to ensure the integrity of the system is not jeopardized. Provide necessary joining fittings. Ensure flanges, union, and couplings for servicing are consistently provided.

D. Use unions, flanges, and couplings downstream of valves and at equipment or apparatus connections. Do not use direct welded or threaded connections to valves, equipment or other apparatus.

E. Use non-conducting dielectric connections whenever jointing dissimilar metals in open systems.

F. Provide pipe hangers and supports in accordance with ASTM B31.9 and MSS SP69 unless

indicated otherwise.

1.3. QUALITY ASSURANCE

A. Valves: Manufacturer's name and pressure rating marked on valve body.

B. Maintain one copy of each document on site.

1.4. DELIVERY, STORAGE AND HANDLING

A. Deliver, store, protect and handle products to site under as hereinbefore specified.

B. Accept valves on site in shipping containers with labeling in place. Inspect for damage.

C. Provide temporary protective coating on cast iron and steel valves.

D. Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.

E. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed systems.

1.5. 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. Refrigeration Piping:

a. Concealed: Tube Size ¾ -inch & Smaller:
b. 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.
c. Concealed: Tube Size 7/8 inch through 4-1/8inches:
d. Copper tube, Type ACR, soft annealed temper; wrought-copper, brazed-joint fittings; brazed joints.
e. Exposed: Tube Size ¾ Inch and Smaller:

f. 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.

g. Exposed: Tube Sizes 7/8 Inch and Larger:

h. 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.

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

j. 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.

k. Diaphragm Packless Valves:

l. 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.

m. 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.

n. Service Valves: 500-psig (3450-kPa) pressure rating; forged-brass body with copper stubs, brass caps, removable valve core, integral ball check valve, and with brazed-end connections.

2. Cooling Coil A/C Condensate Drain Piping:

a. Pipe & Fittings: All A/C condensate drain piping shall be constructed of Type L copper tubing, with sweat fittings made with 95-5 solder. Washout plugs (cleanouts) shall be strategically located to allow periodic flush out of system. At a minimum, provide washout plugs at equipment connections and at direction changes of 90 degrees F or greater.

B. Copper pipe shall be Revere, Anaconda or Chase with approved solder fittings.

2.2. PIPE HANGERS

A. All hangers for metallic piping shall be adjustable, wrought clevis type, or adjustable malleable split ring swivel type, having rods with machine threads. Hangers shall be Grinnell Company's Figure 260 for pipe ¾-inch and larger, and Figure 65 for pipe 2-inches and smaller, or approved equal Victaulic, Sure-Joint, 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. 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. 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. 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

H. Wall support for pipe sizes 4 inches (100 mm) and over: Welded steel bracket and wrought steel clamp.

I. Vertical Support: Steel riser clamp.

J. Floor support for cold pipe: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.

K. Copper pipe support: Carbon steel ring, adjustable, copper plated.

L. Hanger rods: Mild steel threaded both ends, threaded one end, or continuous threaded.

M. 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.

N. For exterior pipe supports provide stainless steel brackets and anchors.

2.3. VALVES

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

2.4. UNIONS, FLANGES, AND COUPLINGS

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

B. Unions in copper pipe 2-inches and smaller shall be sweat fittings with bronze seats designed for a working pressure of 125 psig.

C. Unions in stainless steel pipe 2-inches and smaller shall be hexagonal threaded type stainless steel unions, with VicPress ends. Basis of Design: Victaulic Style P584.

D. Flanges for steel pipe over 2 inches shall be 150 psig, forged steel, slip on. Gaskets shall be 1/16 inch thick pre-formed neoprene.

E. Flanges for copper pipe over 2 inches shall be bronze. Gaskets shall be 1/16 inch thick preformed neoprene.

2.5. ESCUTCHEONS

A. Provide chromium plated escutcheons properly fitted and secured with set screws on all exposed piping which passes through walls, floors or ceilings of finished spaces.

B. All escutcheon plates shall be chrome plated spun brass of plain pattern, and shall be set tight on the pipe and to the building surface. Plastic escutcheon plates will not be accepted.

2.6. DIELECTRIC CONNECTIONS:

A. Furnish and install electrically insulated dielectric waterway fittings, unions or flanges, as manufactured by Victaulic Company Style 47, EPCO Sales, Inc., or approved equal at the following locations:

1. Where steel piping systems join copper piping.

2. Where copper tube connects to 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.

2.7. SLEEVES

A. Sleeves shall be provided around all pipes through walls, floors, ceilings, partitions, roof structure members or other building parts. Sleeves shall be standard weight galvanized iron pipe two sizes larger than the pipe or insulation so that pipe or insulation shall pass through masonry or concrete walls or floors. Provide 20 gauge galvanized steel sheet or galvanized pipe sleeves for all piping passing through frame walls.

B. Sleeves through floors shall be flush with the floor except for sleeves passing through Equipment Rooms which shall extend ¾-inch above the floor. Refer to Division 23 Section, Vibration Controls for HVAC, Plumbing and Fire Protection Equipment for mechanical equipment room penetrations additional requirements. Space between the pipe and sleeve shall be caulked. Escutcheon plates shall be constructed to conceal the ends of sleeves. Each trade shall be responsible for drilling existing floors and walls for necessary sleeve holes. Drilling methods and tools shall be as hereinbefore specified.

C. Sleeves through walls and floors shall be sealed with a waterproof caulking compound.

D. Firestop at sleeves that penetrate smoke barriers smoke partitions and/or rated walls/floors.

2.8. WATER PROOF PIPE PENETRATION SEALS

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

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

2.9. 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. 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.

F. 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.

G. 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.

H. 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.

I. Install all valves with stem upright or horizontal, not inverted.

J. Where pipe support members are welded to structural building framing, scrape, brush clean, weld and apply one coat of zinc rich primer.

K. Provide clearance for installation of insulation and access to valves and fittings.

L. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed system.

3.2. VALVE INSTALLATION REQUIREMENTS

A. Examine piping system for compliance with requirements for installation tolerances and other conditions affecting performance of valves. Do not proceed with installation until unsatisfactory conditions have been corrected.

B. Examine valve interior for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks, used to prevent disc movement during shipping and handling.

C. Operate valves from fully open to fully closed positions. Examine guides and seats made

accessible by such operation.

D. Examine threads on valve and mating pipe for form and cleanliness.

E. Examine mating flange faces for conditions that might cause leakage. Check bolting for proper size, length, and material. Check gasket material for proper size, material composition suitable for service, and freedom from defects and damage.

F. Do not attempt to repair defective valves; replace with new valves.

G. Install valves as indicated, according to manufacturer's written instructions.

H. Piping installation requirements are specified in other Division 23 Sections. Drawings indicate the general arrangement of piping, fittings, and specialties.

I. Install valves with unions or flanges at each piece of equipment arranged to allow servicing, maintenance, and equipment removal without system shutdown.

J. Locate valves for easy access and provide separate support where necessary.

K. Install valves in horizontal piping with stem at or above the center of the pipe.

L. Install valves in a position to allow full stem movement.

M. Adjust or replace packing after piping systems have been tested and put into service, but before final adjusting and balancing. Replace valves if leak persists.

3.3. REFRIGERANT PIPING AND ACCESSORIES INSTALLATION REQUIREMENTS

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

B. Install refrigerant piping according to ASHRAE 15.

C. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.

D. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise. 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 new and re-located 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 strainers in suction line of steel pipe.

PP. Install moisture-liquid indicators in liquid lines between filter-dryers and thermostatic expansion valves and in liquid line to receiver.

QQ. Test and inspect refrigerant piping according to ASME B31.5, Chapter VI.

1. Test refrigerant piping and specialties. Isolate compressor, condenser, evaporator, and safety devices from test pressure.

2. Test high- and low-pressure side piping of each system at not less than the lower of the design pressure or the setting of pressure relief device protecting high and low side of system.

   a. System shall maintain test pressure at the manifold gage throughout duration of test.
   b. Test joints and fittings by brushing a small amount of soap and glycerin solution over joint.
   c. Fill system with nitrogen to raise a test pressure of 150 psig (1035 kPa) or higher as required by authorities having jurisdiction.
   d. Remake leaking joints using new materials, and retest until satisfactory results are achieved.

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 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.

3.4. HANGERS INSTALLATION REQUIREMENTS

A. General: All hangers shall be of an approved type arranged to maintain the required grading and pitching of lines to prevent vibration and to provide for expansion and contraction. Provide protection saddles between hangers and insulation on heating water insulated pipe. Saddles shall be Grinnells Figure 173/273 or approved equal. Provide approved spacers between saddles and pipe where flexible insulation is specified. Provide insulation protection shields for insulated piping without saddles. Shield shall be Grinnell Figure 167 or as approved equal.

B. Spacing: Regardless of spacing, hangers shall be provided at or near all changes in direction, both vertical and horizontal, for all piping. For cast iron soil pipe, one hanger shall be placed at each hub or bell.

C. Vertical Lines: Shall be supported at their bases, using either a suitable hanger placed in a horizontal line near the riser, or a base type fitting set on a pedestal, foundation or support. All vertical lines extending through more than one floor level shall be supported at each floor with a riser clamp. Riser clamp shall be Grinnell Co.'s Figure 261, or approved equal.

All vertical drops to pump suction elbows shall be supported by floor posts.

D. Racks and Brackets: All horizontal piping on vertical walls shall be properly supported by suitable racks securely anchored into the wall construction. Where not practical to obtain ceiling anchorage, all piping near walls shall be supported by approved brackets securely anchored into the wall construction. Washer plates (Fib. 60, 60L) and other miscellaneous attachments, fasteners, etc., shall be Grinnell or as approved equal. All exterior hanger and bracket systems in their entirety shall be galvanized.

E. Pipe Hangers and supports shall be attached to the panel point at the top chord of bar joist or at a location approved by the structural engineer.

F. Select hangers and components for loads imposed. Secure rods with double nuts.

G. Support of horizontal piping shall allow for vertical adjustment after installation of piping.

H. Support overhead piping with clevis hangers.

I. Do not support all parallel piping from the same joist. Stagger all supports in accordance with the structural engineer's recommendations.

J. Install guides on piping adjoining expansion fittings and loops.

K. Attach guides to pipe and secure to building structure.

L. Install anchors at locations to prevent stresses from exceeding those permitted by ASME B31.9 and to prevent transfer of loading and stresses to connected equipment.

M. Fabricate and install steel anchors by welding steel shapes, plates, and bars to piping and to structure. Comply with ASME B31.9 and AWS D1.1.

N. Construct concrete anchors of poured in place concrete of dimensions indicated and include embedded fasteners.

O. Install pipe anchors according to expansion fitting manufacturer's written instructions if expansion fittings are indicated.

P. Use grout to form flat bearing surfaces for expansion fittings, guides, and anchors installed on or in concrete.

Q. Refer to structural documents for appropriate connection/attachment materials to building.

3.5. PIPING IDENTIFICATION INSTALLATION REQUIREMENTS

A. All piping shall be identified with painted background marked with the name of the service with arrows to indicate flow direction. Color code and system identification shall comply with ANSI Standards and piping identification system shall comply with ASME A13.1-81., scheme for the identification of piping systems and ASHRAE Fundamentals

Handbook, latest edition.

B. Markings shall be plain block letters, stenciled on pipes, and shall be located near each branch connection, near each valve, and at least every 10 feet on straight runs of pipe. Where pipes are adjacent to each other, markings shall be neatly lined up. All markings shall be located in such manner as to be easily legible from the floor. Pipe identification schedule shall be as follows:

OUTSIDE DIAMETER OF PIPE OR COVERING (INCHES)	LENGTH OF COLOR FIELD (INCHES)	SIZE OF LETTERS (INCHES)
½ to 1 ¼	8	½
1-½ to 2	8	¾
2 ½ to 6	12	1 ¼
8 to 10	24	2 ½
Over 10	32	3 ½

3.6. VALVE IDENTIFICATION REQUIREMENTS

A. All valves shall be tagged with a numbered tag.

B. The tags shall be made of 1-inch diameter brass tags fastened to the valve by means of brass chains. Numbers shall agree with valve numbers on diagrammatic herein before specified.

C. Provide a minimum of three (3) valve charts with valve numbers indicating valve type, size, manufacturer and service.

D. Additional valve charts shall be mounted behind glazed wooden frames and be hung in each mechanical equipment room including each air handling unit mechanical equipment

room. Additional copies shall be provided in each copy of the O&M manuals.

END OF SECTION

DIVISION 23 SECTION 230548
VIBRATION CONTROLS FOR HVAC, PLUMBING & FIRE PROTECTION EQUIPMENT
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SECTION 230548 - VIBRATION CONTROLS FOR HVAC, PLUMBING AND FIRE PROTECTION EQUIPMENT

PART 1. RELATED DOCUMENTS

1.1. GENERAL

A. Drawings and General Provisions of Contract, including General and Supplementary Conditions and Division 0I 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., 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. 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.

2.7. 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.

2.8. RUBBER MOUNTS

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

PART 3. EXECUTION

3.1. GENERAL PROVISIONS

A. Install vibration-and-noise isolation materials and equipment as indicated and in accordance with machinery manufacturer's instructions.

B. Where neoprene elements of vibration isolator may be subjected to high pipe temperatures above 160°F, provide metal heat shields or thermal isolators.

C. A minimum of 4" thick reinforced concrete housekeeping pads shall be provided under all floor mounted equipment. Rest subbases on structural floor and reinforce with steel rods

interconnected with floor reinforcing bars by tie bars hooked at both ends. Provide at least one (1) inch clearance between subbases and inertia bases, steel bases, and steel saddles with machinery in operation.

D. All vibration isolators exposed to weather or humid environment shall be hot dipped galvanized with springs coated with neoprene in accordance with paragraph hereinbefore described.

E. Anchor Bolts and Grout: Secure machinery to foundations and inertia bases with anchor bolts. Grout equipment with baseplates, the full area under baseplates with premixed non-shrinking grout. After grout has set, remove wedges, shims, and jack bolts and fill spaces with grout.

F. 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.

G. 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.

H. 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.

I. 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.

J. 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.

K. 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.

L. 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 360o without touching any object.

M. 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.

N. 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.

O. Install in accordance with manufacturer's instructions.

P. Install isolation for motor driven equipment.

Q. Install spring hangers without binding.

R. On closed spring isolators, adjust so side stabilizers are clear under normal operating conditions.

S. 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.

T. Connect wiring to isolated equipment with flexible hanging loop.

3.2. 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. Heat Pump Air Handling Units:

1. All heat pump units shall be supported on stable steel springs in series with ribbed neoprene pads selected for not less than 1.0" deflection under full operating load. Mason Industries type SLF springs or as approved equal. Following the manufacturer's specific installation instructions for specific equipment is acceptable.

2. Heat Pump outdoor unit shall be supported on ribbed neoprene pads resting on exterior wall support frame.

C. Re-located Ductless Units: Re-located indoor ductless units shall be supported with rubber grommet type suspension isolators. Re-located outdoor ductless units shall be supported on ribbed neoprene pads resting on exterior wall support frame.

3.3. MANUFACTURER'S FIELD SERVICES

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

END OF SECTION

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

PART 1. GENERAL

1.1. GENERAL

A. This section covers performance testing, adjusting and balancing of heating, ventilating, air conditioning and domestic re-circulating systems as specified in Division 23 Section, Heating, Ventilating, and Air Conditioning Equipment and in Division 22 Section, Plumbing Fixtures and Plumbing Equipment.

B. For Common Work Results of HVAC, See Division 23. See Division 01 for General Requirements.

C. The mechanical contractor shall select and employ an impartial, independent balancing agency to provide testing and balancing services for the heating, ventilating and air conditioning (HVAC) systems and other specified systems of this project.

D. The work included in this section consists of furnishing labor, instruments, and tools required in testing, adjusting and balancing the HVAC and plumbing systems, as described in these specifications or shown on accompanying drawings. Services shall include checking equipment performance, taking the specified measurements, and recording and reporting the results.

E. The items requiring testing, adjusting, and balancing include, but are not limited to, the following:

<u>Air Systems</u>:

1. Coils (Air Temperatures & Static Pressure Drops)
2. Diffusers, Registers and Grilles
3. Re-located Existing Ductless Split System Units
4. Exhaust Fans
5. Radiant Heat Panels
6. Supply Fan AHU/Heat Pumps
7. Ventilation Fans
8. Zone Branch and Main Ducts

<u>Hydronic Systems:</u>

1. Condensate Overflow Safety Switches/Condensate Pumps
2. Domestic Re-circulating Systems

3. Thermostatic Mixing Valves

4. In addition, any existing fans, equipment or air devices specified to be re-used under this project shall be tested and balanced, similar to new fans.

1.2. EXAMINATION

A. Verify that systems are complete and operable before commencing work. Ensure the following conditions:

1. Systems are started and operating in a safe and normal condition.

2. Temperature control systems are installed complete and operable.

3. Proper thermal overload protection is in place for electrical equipment.

4. Final filters are clean and in place. If required, install temporary media in addition to final filters.

5. Duct systems are clean of debris.

6. Fans are rotating correctly.

7. 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.

1.3. 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.

1.4. PRE-BALANCING CONFERENCE

A. Convene a conference one week prior to commencing work of this Section with all appropriate individuals.

1.5. STANDARDS

A. The balancing agency shall perform the services specified herein in accordance with the Associated Air Balance Council's National Standards, including revisions, to the date of the contract.

B. All terms in this specification shall have their meaning defined as stated in the National Standards.

C. ADC: Test Code for 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

1.6. COORDINATION

A. It will be necessary for the balancing agency to perform its services in close coordination with the mechanical contractor.

B. The plans and specifications have indicated meters, valves, dampers, and other devices for the purpose of adjusting the system to obtain optimum operating conditions. It will be the responsibility of the mechanical contractor to install these devices in a manner that will leave them accessible and readily adjustable. The balancing agency shall provide guidance if there is a questionable arrangement of a control or balancing device.

C. The general contractor/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 air flow rates and refrigerant pressures.

1.7. INSTALLATION TOLERANCE

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

1.8. RESPONSIBILITIES OF THE MECHANICAL CONTRACTOR

A. The mechanical contractor shall sufficiently complete the installation and start all HVAC systems to insure they are working properly and shall perform all other items as described hereinafter to assist the balancing agency in performing the testing and balancing of the HVAC system.

B. Record equipment manufacturer's standard start-up information and submit to Engineer for review. Testing and balancing work shall not commence on any equipment until start-up reports have been completed, reviewed by Engineer, and forwarded to Testing and Balancing Agency.

C. Air Distribution Systems

1. Verify installation for conformity to design.

2. 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, 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 and operational.

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. For heat pumps provide refrigerant suction and discharge pressure to Test and Balance Engineer for inclusion in the final TAB Report.

1.9. 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 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.

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.

1.10. NOTIFICATION FOR TESTING AND BALANCING WORK TO BEGIN

A. The mechanical contractor shall notify the balancing agency in writing when all heating, ventilating, and air conditioning systems are complete and ready for testing and balancing. The mechanical contractor shall attest that he has completed all items as herein described.

B. The following must be completed prior to start of system balancing:

1. All duct work and associated grilles/registers/diffusers installed and completed.

2. Piping systems completed, flushed and filled.

3. Equipment properly started by qualified personnel or start-up technicians.

4. Ceiling tiles installed.

5. Automation system (temperature controls) installed and completed for both air and water systems.

6. All equipment controlled in automatic ("Auto") mode.

7. Access granted to the balancing contractor to the automation/controls system provided.

1.11. DEFICIENCIES

A. Any deficiencies in the installation or performance of a system or component observed by the TAB agency shall be brought to the attention of the appropriate responsible person.

B. The work necessary to correct items on the deficiency listing shall be performed and verified by the affected Contractor before the TAB Agency returns to retest. Unresolved deficiencies shall be noted in the final report.

1.12. 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.

1.13. ALTERNATES

A. Refer to Division 01 Section, Alternates for description of work under this section affected by alternates.

1.14. GENERAL COMMISSIONING REQUIREMENTS

A. Refer to Division 01 Section, "General Commissioning Requirements" for description of work under this Division affected by General Commissioning.

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 system and equipment controls.

E. Examine ceiling plenums used for supply, return, or relief air to verify that they meet the leakage class of connected ducts and are properly separated from adjacent areas. Verify that penetrations in plenum walls are sealed and fire-stopped if required.

F. Examine equipment performance data including fan and pump curves.

1. Relate performance data to Project conditions and requirements, including system effects that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system.

2. Calculate system-effect factors to reduce performance ratings of HVAC equipment when installed under conditions different from the conditions used to rate equipment performance. To calculate system effects for air systems, use tables and charts found in AMCA 201, "Fans and Systems," or in SMACNA's "HVAC Systems – Duct Design". Compare results with the design data and installed conditions.

G. Examine system and equipment installations and verify that field quality-control testing, cleaning and adjusting specified in individual Sections have been performed.

H. Examine test reports specified in individual system and equipment Sections.

I. Examine HVAC equipment and filters and verify that bearings are greased, belts are aligned and tight, and equipment with functioning controls is ready for operation.

J. Examine strainers. Verify that startup screens are replaced by permanent screens and indicated perforations.

K. Examine heat-transfer coils for correct piping connections and for clean and straight fins.

L. Examine operating safety interlocks and controls on HVAC equipment.

M. Report deficiencies discovered before and during performance of TAB procedures. Observe and record system reactions to changes in conditions. Record default set points if different from indicated values.

3.3. AIR SYSTEM PROCEDURES

A. The balancing agency shall perform the following testing and balancing functions in accordance with the Associated Air Balance Council's National Standards:

1. Fan Speeds - Test and adjust fan RPM to achieve design CFM requirements.

2. Current and Voltage - Measure and record motor current and voltage. Check and record thermal overload ratings for all motors.

3. Pitot-Tube Traverse - Perform a Pitot-tube traverse of main supply, return and exhaust ducts to obtain total CFM. If a Pitot-tube traverse is not practical, the summation of the outlets or inlets may be used. An explanation why a traverse was not made must appear on the appropriate data sheet.

4. 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, register, and terminal box. 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.

16. Measure temperature conditions across outside air, return air, and exhaust dampers to check leakage.

17. For new and re-located 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.

3.4. WATER SYSTEM PROCEDURES

A. The various water circulating systems shall be filled, purged of air, and put into operation before hydronic balancing by the mechanical contractor.

B. The balancing agency shall perform the following testing and balancing functions in accordance with the AABC National Standards.

C. All Hydronic equipment and domestic re-circulating pumps shall be Tested and Balanced as described below:

1. Strainers - Request that the mechanical contractor clean all strainers.

2. Air Vents - Check all air vents at the high points of the water system and determine if they are installed and operating.

3. Valves - Set all balancing valves to the full-open position for balancing.

4. Pumps - Adjust all 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.

5. Tolerances - Proceed to balance all coils, pumps, balance valves to within 5 percent of design requirements.

6. Marking - Mark all settings and record all data after completing the flow readings and coil adjustments.

7. 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.

8. Test all A/C condensate pumps for proper operation.

9. Test condensate overflow safety switches.

D. 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.

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.

3.7. VERIFICATION OF TEMPERATURE CONTROL

A. The balancing agency shall be assisted by the temperature control contractor in verifying the operation and calibration of all temperature control systems. The following tests shall be conducted:

1. Verify that all control components are installed in accordance with project requirements and are functional, including all electrical interlocks, damper sequences, air and water reset.

2. Verify that all controlling instruments are calibrated and set for design operating conditions.

3. Verify the accuracy of the final settings by taking temperature readings. The readings shall be in a typical conditioned space for each separately controlled zone.

3.8. TEST AND BALANCE REPORTS

A. The test and balance report shall be complete with logs, data, and records as required herein. All logs, data, and records shall be typed on white bond paper and bound. The report shall be certified accurate and complete by the balancing agency's certified test and balance engineer.

B. Three (3) copies of the test and balance report are required and shall be submitted to the Engineer. If, in the opinion of the Engineer, test results or portions thereof are incomplete or inconclusive, repeat necessary portions of the work to the satisfaction of the Engineer.

C. The report shall contain the following general data in a format selected by the balancing

agency:

1. Project Number
2. Contract Number
3. Project Title
4. Project Location
5. Project Architect
6. Project Mechanical Engineer
7. Test & Balance Agency
8. Test & Balance Engineer
9. General Contractor/Construction Manager
10. Mechanical Subcontractor
11. Dates tests were performed
12. Certification
13. Duct Leakage Tests
14. Phone Numbers of all Individuals Listed Above

D. The test and balance report shall be recorded on report forms conforming to the recommended forms in the AABC National Standards.

3.9. 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, filters, mixing boxes, and similar devices.
5. Outside-air, return-air, and exhaust air total CFM.

6. Actual operating current, voltage and brake horsepower of each fan motor. For packaged equipment, this includes supply fans, relief air fans, and condenser fans.

7. Final RPM of each fan.

8. Fan and motor sheave manufacturer, model, size, number of grooves, bore, and center distance.

9. Belt size, quantity and make.

10. Static-pressure controls final operating set points (if applicable).

11. Total and external static pressure.

B. Pump Test Forms - Submit pump curve showing design, operating, and no-flow points of operation. Also, record the following items on each pump test form:

1. Manufacturer, size, model, service and serial number.

2. All design and manufacturer's rated data.

3. Pump operating suction and discharge pressure and final total dynamic head.

4. No flow (pump discharge valve closed) suction and discharge pressure and corresponding total dynamic head. This procedure is to determine actual impeller size. Record impeller size.

5. Rated and actual operating current, voltage, and brake horsepower of each pump motor.

6. Total operating head pressure.

7. Shutoff, discharge and suction pressures.

8. Shutoff, total head pressure.

C. Heating and Cooling-Coil Test Forms - Record the following items on each test form:

1. Manufacturer, location, service.

2. All design and manufacturer's rated data.

3. Rated and actual static pressure drop across each coil.

4. Wet-bulb and dry-bulb temperatures entering and leaving each cooling coil; dry-bulb temperatures entering and leaving each heating coil.

5. Air flow (Design and Actual).

6. For DX-coil, provide design and actual saturated suction temperature.

7. For DX-Coil, provide design and actual discharge pressures.

D. 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

E. 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.

F. 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.

G. 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.

H. Air Distribution Test Sheet:

1. Air terminal number.

2. Room number/location.

3. Terminal type.

4. Terminal size.

5. Area factor.

6. Design velocity.

7. Design air flow.

8. Test (final) velocity.

9. Test (final) air flow.

10. Percent of design air flow.

I. Existing Re-located Ductless Unit Test Forms:

1. Manufacturer.

2. Type, air conditioning, heat pump.

3. Identification number.

4. Location.

5. All design and manufacturer's rated data.

6. Rated and actual entering and leaving dry bulb temperatures.

7. Rated and actual entering and leaving wet bulb temperatures.

8. Air flow (design and actual).

9. Provide actual saturated suction temperature.

10. Actual operating current, voltage and brake horsepower of each fan motor.

11. Final fan RPM.

J. Heat Pump Air Handling 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. Test voltage.

13. Supply, return, and outside air flow rates.

K. Air Cooled Heat Pump Test Forms:

1. Manufacturer.

2. Model Number.

3. Location.

4. Size/Capacity.

5. Fan RPM (Min and Max).

6. Compressor and Heat Pump Fan Electrical Characteristics.

7. Heat Pump Fan RPM.

8. Amp Draw of all Components.

9. Refrigerant Suction/Discharge Pressures.

10. Thermal Overload Sizes.

L. 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.

M. Condensate Over Flow Switches/Floats

1. Manufacturer.

2. Type.

3. Location.

4. Equipment shut down verification.

5. ATC interlock verification.

N. 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.

11. Actual entering/leaving air temperature.

END OF SECTION

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

PART 1. GENERAL

1.1. GENERAL

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

1.2. DESCRIPTION

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

1.3. SUBMITTALS

A. Shop Drawings: Indicate assembly, equipment dimensions, weight loading, required clearances, construction details, field connection details, and electrical characteristics and connection requirements.

B. Product Data:

1. Provide literature which indicates dimensions, weights, capacities, ratings, performance, gages and finishes of materials, and electrical characteristics and connection requirements.

2. Provide data of filter media, filter performance data, filter assembly, and filters frames.

3. Provide fan curves with specified operating point clearly plotted.

4. Submit sound power level data for both fan outlet and casing radiation at rated capacity. Submit sound power levels by octave band or sound pressure levels by octave band for all equipment.

5. Submit electrical requirements for power supply wiring including wiring diagrams for interlock and control wiring, clearly indicating factory-installed and field-installed wiring.

1.4. OPERATION AND MAINTENANCE DATA

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

1.5. DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, protect, and handle products to site under provisions of General Requirements.

B. Accept products on site in factory-fabricated protective containers, with factory-installed shipping skids and lifting lugs. Inspect for damage.

C. Store all equipment in clean dry place and protect from weather and construction traffic. Handle carefully to avoid damage to components, enclosures, and finish.

D. Comply with manufacturer's installation instructions for rigging, unloading and transporting equipment.

E. Protect all motors, shafts, and bearings from weather and construction dust.

1.6. ENVIRONMENTAL REQUIREMENTS

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

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. SPLIT SYSTEM HEAT PUMP UNITS

A. General

1. Furnish and install split system heat pump units of the size, capacity, performance, and electrical characteristics as indicated on the contract documents. Indoor units shall be Carrier indoor air handlers with matching coils, Bryant, Trane, York, Daikin or approved equal. Outdoor units shall be Carrier Model 38YCB, Bryant, Trane, York, Daikin or approved equal.

2. Indoor units shall be horizontal or vertical arrangement as indicated on contract drawings. Indoor and outdoor coils shall be matched by the factory to provide performance indicated.

3. Install each unit on the plans in accordance with the manufacturers recommendations and all applicable national and local codes.

4. Adequate space around all sides of the indoor units shall be provided for proper service and maintenance. Outdoor units shall be located for proper service and maintenance and should be installed to prevent short cycling of condenser air.

5. Provide exterior wall mounted support for all outdoor heat pump units. Horizontal units shall be hung with all threaded rods with vibration isolators.

6. All systems performance shall comply with ARI Standard 240.

7. Refrigerant piping between indoor and outdoor units shall be sized and installed, per manufacturers recommendations.

8. Provide flexible duct connections at supply and return connections to all indoor units.

B. Warranty

1. Each outdoor unit shall be covered by a five year limited parts warranty on the complete unit, ten year limited warranty on the compressor and a two year limited warranty on the controls. Each indoor unit shall be covered by a two year, limited parts warranty and a two year limited warranty on the electric heaters.

2. Indoor and outdoor units shall be U.L. listed for intended application.

C. Indoor Units (Air Handlers)

1. Provide and install indoor units as indicated on contract drawings. All units shall be suitable for use with auxiliary slide-in electric heaters.

2. Each air handler shall include a decorative casing constructed of 20 gauge pre-painted steel including high density, super thick R4.2 insulation.

3. Indoor unit fans shall be centrifugal blower type with a direct-drive, permanent split capacitor type, three speed motor. Fan motors shall be high efficiency type as specified in Division 23 Section, Common Work Results for HVAC. Motor mounts shall be flexible type for reduced transmission of noise and vibration.

4. Coils shall be slant or "V" arrangement. Each coil shall include a York-mate control device (or equal) which regulates refrigerant flow during cooling and acts as a check-valve when used in heat pump models. Coils shall have staggered 3/8-inch rifled copper tubes mechanically expanded into aluminum fins. Coils shall be furnished with quick connect or sweat connect refrigerant fittings. Coil casing shall be constructed of 22-gauge, pre-painted steel, including 1-inch insulation. Each coil shall be leak tested, dehydrated and shipped with a refrigerant (R-410A) charge. Condensate drain pans shall be constructed of galvanized steel and be fully insulated. Contractor shall provide auxiliary drain pans on all horizontal units as indicated on contract drawings.

5. Provide and install auxiliary electric resistance slide-in type heaters at all indoor units. A low voltage plug shall be provided in each unit for quick auxiliary heat connection. The electric heaters shall operate in sequence stages as controlled by space thermostats. The heater shall feed line voltage power to the unit fan and transformer to provide emergency heat capability in the event of an open unit circuit breaker.

6. Provide and install filter racks on all units to accept standard size 1-inch washable filters. Filters shall be nominal 1-inch standard size filters, 20 percent efficient.

Provide one additional set of filter media for each indoor unit to be delivered to the owner representative upon completion of the project.

7. The following accessories shall be provided with each air handler as required:

   a. Electric slide in heaters with single point connection kits.
   b. Fan relay kit.
   c. Suspension kit (horizontal units only).
   d. Filter racks.
   e. Thermal expansion/check valve kit.
   f. Vibration isolators.

D. Outdoor Units

1. Provide and install outdoor heat pump units as indicated on contract drawings. All units shall be suitable and specifically designed for outdoor installation. Housing shall be constructed of 18 gauge pre-painted galvanized steel that complies with ASTM B117 salt spray test at a minimum of 500 hours.

2. Base pan shall be equipped with drainage holes in perimeter and rubber isolator grommets to allow for proper moisture removal. Install each unit on 6-inch high pump ups with rubber isolator pad and concrete pad.

3. Each unit shall be provided with raised top panel for strength and a PVC coated coil guard with 1-inch x 4-inch grill pattern.

4. Each outdoor unit shall include the following defrost control features:

   a. demand defrost
   b. 5 minute anti-recycle timer
   c. loss of charge protection
   d. compressor lockout

5. Compressors shall be hermetic type with internal pressure and temperature protection for compressor motor. Outdoor coils shall be constructed of 3/8-inch copper tubes mechanically expanded into aluminum fins.

6. Refrigerant tubing shall be brazed copper with liquid line filter-drier, suction accumulator, and re-usable service valves. Refrigerant circuit shall be factory leak tested and dehydrated. Unit shall be shipped with a full factory change of refrigerant (R-410A).

7. Fans shall be direct drive, vertical discharge, propeller type. Fan motors shall be high efficiency, permanent, split capacitor type equipped with permanently lubricated bearings and internal overload protection.

8. Accessories: the following additional accessories and features shall be provided with each unit:

   a. Compressor Start Assist-PTC Type. Solid-state electrical device which

gives a "soft" boost to the compressor at each start-up.

b. Crankcase Heater. An electric resistance heater which mounts to the base of the compressor to keep the lubricant warm during off cycles. Improves compressor lubrication on restart and minimizes chance of refrigerant slugging.

c. Cycle Protector. Solid-state timing device which prevents compressor rapid recycling. Control provides an approximate 5-minute delay after power to the compressor has been interrupted for any reason, including normal room thermostat cycling.

d. Evaporator Freeze Thermostat. A SPST temperature actuated switch which stops unit operation when evaporator reaches freeze-up conditions.

e. Heat Pump Risers. Six inch tall plastic rails that are used to elevate outdoor units above mounting pad.

f. Low-Ambient Controller. Head pressure controller is a cycle control device activated by a temperature sensor mounted on a header tube or the outdoor coil. It is designed to cycle the outdoor fan motors in order to maintain condensing temperature within normal operating limits (approximately 130 degrees F to 110 degrees F high, 70 degrees to 50 degrees F low). The control shall maintain working head pressure at low-ambient temperatures down to –20 degrees F.

g. Low-Pressure Switch. Auto reset SPST switch activated by refrigerant pressure on low side of refrigerant circuit. Cycles compressor off if refrigerant pressure drops to about 27 psig. Prevents indoor coil freeze-up due to loss of indoor airflow. Provides additional protection against compressor damage due to loss of refrigerant charge .

h. Thermostatic Expansion Valve (TXV). A modulating flow-control valve which meters refrigerant liquid flow rate into the evaporator in response to the superheat of the refrigerant gas leaving the evaporator. Kit includes valve, adapter tubes, and external equalizer tube.

i. Time-Delay Relay. A SPST delay relay which briefly continues operation of the indoor blower motor to provide additional cooling after the compressor cycles off.

j. Winter Start Control. A SPST delay relay which bypasses the low-pressure switch for approximately 3 minutes to permit start up for cooling operation under low-load conditions.

k. Outdoor heat pump fan guard.

2.2. 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, 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. Thermostats shall be Q-Mark Model WRIE 30S Mercury Bulb, single pole single throw, 24 volt with 40 degrees F and 80 degrees F range. Provide and install stainless steel thermostat guards over all thermostats. Provide and install Q-Mark Model LTR2-277 dual level temp relays. Relays shall be enclosure mounted. Provide and install low voltage transformers as required.

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. Power Roof Ventilators

1. Belt Drive

a. Furnish and install belt driven power roof ventilators of the size, capacity, and electrical characteristics a shown on contract drawings.
b. Roof fans shall be centrifugal belt driven type.
c. The fan wheel shall be centrifugal backward inclined, constructed of aluminum and shall include a wheel cone carefully matched to the inlet cone for precise running tolerances. Wheels shall be statically and dynamically balanced.
d. The fan housing shall be constructed of heavy gauge aluminum with a rigid internal support structure. The fan shroud shall have a rolled bead for added strength.
e. Motors shall be heavy duty ball bearing type, carefully matched to the fan load, and furnished at the specified voltage, phase and enclosure. Motor and drives shall be mounted on vibration isolators, out of the airstream. Fresh air for motor cooling shall be drawn into the motor compartment from an area free of discharge contaminants. Motors shall be readily accessible for maintenance. Motors shall be two (2) speed type where indicted on drawings.
f. Drive frame assemblies shall be constructed of heavy gauge steel and mounted on vibration isolators.
g. Precision ground and polished fan shaft shall be mounted in permanently sealed, lubricated pillow block ball bearings. Bearings shall be selected for a minimum (L50) life in excess of 200,000 hours at maximum cataloged operating speed. Drives shall be sized for a minimum of 150 percent of driven horsepower. Pulley shall be of the fully machined cast iron type, keyed and securely attached to the wheel and motor shafts. Motor pulleys shall be adjustable for final system balancing.
h. A disconnect switch shall be factory installed and wired from the fan motor to a junction box installed within the motor compartment. A fan conduit chase shall be provided through the curb cap to the motor compartment for ease of installation.
i. All fans shall bear the AMCA Certified Ratings Seal for sound and air performance.
j. Each fan shall bear a permanently affixed manufacturer's nameplate containing the model number and individual serial number for future identification.
k. Provide 12-inch high, fully insulated, aluminum roof curbs with each ventilator. Fan and roof curb shall be provided by the same manufacturer.
l. Provide 2-inch aluminum birdscreen with each fan.

m. Motor operated dampers shall be provided by ATC subcontractor and installed by mechanical contractor.

n. Fans shall be Model GB as manufactured by Greenheck Fan Corporation, ACME Engineering, Penn Ventilator, Cook, Twin City Fan and Blower or approved equal.

2.4. AIR CONDITIONING CONDENSATE PUMPS

A. Provide and install air conditioning condensate pumps of the size, capacity, and electrical characteristics as shown on the contract drawings. Units shall be Little Giant, Beckton, Diversitech, or approved equal.

B. Units shall be U.L. listed and CSA certified. Each pump shall include 6 ft power cord with 3 prong molded 115 volt plug and thermal overload protection or with pigtail lead in lieu of plug and cord, removing the plug shall not violate the pump manufacturer's warranty, nor shall it void the pump's U.L. listing. Include low voltage safety switch with polypropylene float that shall be wired to cut-off the indoor unit in the case of malfunction. Safety switch should be connected to a Class II low voltage safety device.

C. Housing shall be constructed of high impact resistant polystyrene, ABS impeller and volute, and stainless steel shaft. Mount units directly below adjacent indoor units as detailed and pipe discharge with check-valve as shown on the drawings.

D. Refer to Division 23 Section, "Instrumentation and Controls of HVAC and Plumbing Systems".

2.5. REFRIGERANT PIPE LINE SET COVERS

A. Furnish and install PVC refrigerant pipe line set covers to conceal all refrigerant line sets and to provide a finished appearance.

B. Furnish all fittings, covers, elbows, wall sleeves, adapters, and stainless steel hardware. Line set covers shall be selected in a color that matches the finished color of the surface they are attached to.

C. Ductless line set covers shall be as manufactured by Fortress or approved equal.

PART 3. EXECUTION

3.1. EXAMINATION

A. Verify all dimensions by field measurements. Verify that all equipment may be installed in accordance with pertinent codes and regulations, the original design, and the referenced standards.

B. Verify structure, mounting supports and membrane installations are completed to the proper point to allow installation of roof mounted equipment, where applicable.

C. Examine rough-in requirements for all piping systems to verify actual locations of piping connections prior to installation.

D. Verify that electrical work installation is in accordance with manufacture's submittal and installation requirements of Division 26 sections. Do not proceed with equipment start-up until electrical work is acceptable to equipment installer. Coordinate sizes of all thermal overloads with Division 26.

E. Do not proceed until unsatisfactory conditions have been corrected.

F. Provide wiring diagrams of all equipment as specified in Division 23 Section, Common Work Results for HVAC.

3.2. GENERAL INSTALLATION REQUIREMENTS

A. Install all equipment in accordance with manufacturer's installation instructions, in accordance with state and local code requirements, and in accordance with the contract drawings. Install all equipment plumb and level, to tolerances as required by the manufacturer of each item of equipment. Maintain manufacturer recommended clearances around and over all equipment.

B. Coordinate vibration isolation requirements with all equipment in accordance with Division 23 Section, Vibration Controls for HVAC, Plumbing and Fire Protection Equipment.

C. Coordinate all electrical requirements with Division 26.

D. Coordinate all indoor and outdoor equipment pad locations and sizes with approved shop drawing submittals. Provide operating weights of equipment to Structural Engineer for review. Coordinate equipment pad locations and sizes with the Concrete Contractor or General Contractor. Furnish anchor bolts which are to be inserted in concrete pads to concrete installer.

E. Verify piping arrangements of all equipment with the contract drawings. Piping details shall be strictly adhered to concerning valves, fittings, components, etc.

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.

3.3. FIELD QUALITY CONTROL

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

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

C. Charge all refrigerant systems with refrigerant and oil and test for leaks. Repair leaks and replace lost refrigerant and oil.

D. Verify proper motor sizes, voltages, thermal overloads, nameplate data, etc. All equipment voltages and current shall be recorded to insure that motors are operating below their service factors. Test and Balance Engineer shall record electrical data before continuous or permanent operation.

3.4. DEMONSTRATION

A. Provide the services of a factory authorized service representative to provide start-up and to demonstrate and train the Owner's maintenance personnel.

B. Place equipment into operation and adjust controls and safeties. Replace damaged or malfunctioning components and controls.

C. Training:

1. Train the Owner's maintenance personnel on start-up and shut-down procedures, trouble shooting procedures, lubrication, servicing procedures and preventative maintenance schedules/procedures. Review with the Owner's personnel, the contents of the operation and maintenance data specified in Division 23 Section, Common Work Results for HVAC.

2. Submit operation and maintenance data as soon as possible prior to project close-out. Operations and maintenance data shall be submitted to the Owner for review and comment prior to submission to the Engineer.

3. Schedule training with the Owner through the Architect and/or Engineer with at least seven (7) days prior notice.

D. Contractor shall demonstrate removal and replacement of filters at all pieces of equipment with filters in the presence of the Owners representative.

3.5. CLEANING

A. After completing installation, inspect exposed finish. Remove burrs, dirt, and construction

debris, and repair damaged finishes including chips, scratches, and abrasions.

B. Clean fan and equipment interiors to remove foreign material and construction dirt and dust. Vacuum clean fan wheels, cabinets, and coils' entering air face.

3.6. RE-LOCATED 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 unit on wall.

E. Install outdoor units on exterior wall supports 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 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.

I. Install refrigerant pipe line set enclosures for exterior and interior exposed piping.

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.

3.9. SPLIT SYSTEM EQUIPMENT INSTALLATION REQUIREMENTS

A. Mount indoor and outdoor units as detailed on contract drawings. Install units level and plumb.

B. Supply initial charge of refrigerant and oil as required.

C. Install all interlock and control wiring between indoor units, outdoor units and thermostats.

D. Install all indoor and outdoor units on vibration isolators.

E. Install outdoor units as indicated on drawings.

F. Install refrigerant suction, and liquid lines between indoor and outdoor units per manufacturer’s instructions. Connect precharged refrigerant tubing to components quick connect fittings. Install tubing to allow access to unit.

G. Size all refrigerant piping per manufacturer’s instructions.

H. Connect drain lines to condensate pans.

I. Provide auxiliary drain pans on all horizontal units. Pipe drain to closest floor drain or as indicated on drawings.

J. Comb out evaporator coil and condensing unit fins.

K. Install refrigerant pipe line set enclosures for exterior and interior exposed piping.

END OF SECTION

DIVISION 23 SECTION 230701
HVAC INSULATION
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SECTION 230701 – HVAC INSULATION

PART 1. GENERAL

1.1. REFERENCE

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

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

1.2. DESCRIPTION

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

1.3. SCOPE

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

1.4. STANDARDS

A. Thermal insulation materials shall meet the property requirements of one or more of the following specifications as applicable to the specific product or use:

1. American Society for Testing of Materials Specifications:

   a. ASTM C 547, "Standard Specification for Mineral Fiber Preformed Pipe Insulation".
   b. ASTM C 533, "Standard Specification for Calcium Silicate Pipe & Block Insulation".
   c. ASTM C 55, "Standard Specification for Mineral Fiber Blanket and Felt Insulation".
   d. ASTM 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, cooling coil drain piping, vapor barrier performance is extremely important. All penetrations and seams of the ASJ and exposed ends of insulation must be sealed with vapor barrier coating. The ASJ must be protected with either a coating or a suitable vapor retarding outer jacket. Vapor seals at butt joints shall be applied at every fourth pipe section joint and at each fitting to provide isolation of water incursion. Vapor Barrier Coating: Foster 30-65; Childers CP-34 or Vimasco 749. Permeance shall be 0.03 perms or less at 45 mils dry as test by ASTM E96.

K. Fittings and valves shall be insulated with pre-formed fiberglass fittings, fabricated sections of fiberglass pipe insulation, Fiberglass pipe and tank insulation, Fiberglass blanket insulation, or insulating cement. Thickness shall be equal to adjacent pipe insulation. Finish shall be with pre-formed PVC fitting covers or as otherwise specified on contract drawings. Where applicable, Victaulic PVC fitting valve and coupling covers shall be utilized. Victaulic PVC covers shall be installed with matching pipe insulation jacketing material, vinyl tape solvent weld adhesive and appropriate fasteners.

1. Flanges, couplings and valve bonnets shall be covered with an oversized pipe insulation section sized to provide the same insulation thickness as on the main pipe section. An oversized insulation section shall be used to form a collar between the two insulation sections with low density blanket insulation being used to fill gaps. Jacketing shall match that used on straight pipe sections. Rough cut ends shall be coated with a suitable weather or vapor-resistant mastic as dictated by the system location and service. Finish valve installation with a Tyvac jacket with ends that secure to adjacent piping.

2. On hot systems where fittings are to be left exposed, insulation ends should be beveled away from bolts for easy access.

3. On cold systems, particular care must be given to vapor sealing the fitting cover or finish to the pipe insulation vapor barrier. All valve stems must be sealed with caulking which allows free movement of the stem but provides a seal against moisture incursion. All gauge and thermometer penetrations and extensions shall be correctly sealed and insulated to prevent surface condensation. Install oversized

hangers to prevent penetrations of pipe insulation vapor barrier.

L. All piping shall be supported in such a manner that neither the insulation or the vapor/weather barrier is compromised by the hanger or the effects of the hanger. In all cases, hanger spacing must be such that the circumferential joint may be made outside the hanger. On cold systems, vapor barrier must be continuous, including material covered by the hanger saddle.

1. Piping systems 3-inches (7.5cm) in diameter or less, insulated with Fiberglass insulation, may be supported by placing saddles of the proper length and spacing, as designated in Owens-Corning Pub. 1-IN-12534, under the insulation. Hangers saddles shall be minimum 16 gauge with a saddle arc of 120 degrees minimum.

2. For hot or cold piping systems larger than 3-inches (7.5 cm) in diameter, operating at temperatures less than +200 degrees F (93 degrees C) and insulated with fiber glass, high density inserts such as foam or wood blocks with sufficient compressive strength shall be used to support the weight of the piping system. At temperatures exceeding +_200 degrees F (93 degrees C), Owens-Corning Pink Calcium Silicate, IIG, or approved equal pipe insulation shall be used for high density inserts.

3. Owens-Corning Pink Calcium Silicate pipe insulation may be used to support the entire weight of the piping system provided the hanger saddle is designed so the maximum compressive load does not exceed 100 psi (7kg/cm).

4. Where pipe shoes and roller supports are required, insulation shall be inserted in the pipe shoe to minimize pipe heat loss. Where possible, the pipe shoe shall be sized to be flush with the outer pipe insulation diameter.

5. Thermal expansion and contraction of the piping and insulation system shall generally be taken care of by utilizing double layers of insulation and staggering both longitudinal and circumferential joints. Where long runs are encountered, expansion joints may be required where single layers of insulation are being used and should be so noted on the contract drawings.

6. On vertical runs, insulation support rings shall be used.

2.3. PIPING INSULATION THICKNESSES SCHEDULE

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

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

2.4. DUCTWORK INSULATION MATERIALS AND THICKNESSES

A. Insulate all supply, return, relief, plenums, exhaust and outside air intake ductwork with fiberglass exterior duct insulation with factory-applied foil facing. All exposed fiberglass duct insulation shall be 2-inch rigid or non-flexible board type 3.0 pcf minimum density, 0.23 max. "K" factor at 75 degrees F mean temperature, with white vinyl A.S.J. max,

polymer coating vapor barrier facing. All concealed fiberglass duct insulation shall be 2-inch flexible blanket type, 1.0 pcf minimum density. All concealed insulation shall be 0.27 max. "K" factor at 75 degrees F mean temperature with reinforced foil-scrim Kraft vapor barrier facing. Unless otherwise noted, the minimum installed R-value shall be 6.0 HR x ft2 x ºF/btu.

B. Refer to Division 23 Section, HVAC Air Distribution System and contract drawings for location of all sound-lined ductwork. Sound-lined ductwork from the discharge or supply side of all air handling units and heat pumps shall require external insulation in addition to internal lining specified hereinafter. All other ducts indicated to be provided with interior lining shall not require additional exterior insulation.

C. Where exhaust ducts carrying moisture-laden air [shower exhaust, etc.] are routed in unconditioned spaces, insulation is required as described above. Insulation shall be continuous through the unconditioned area. The vapor barrier shall be tightly sealed to prevent condensation. Exhaust ducts located within conditioned spaces do not require insulation unless otherwise noted.

D. Where a vapor barrier is required, all joints, seams, tears, punctures, and other penetrations shall be closed with 3-inch (7.5cm) pressure-sensitive tape matching the facing or with vapor barrier coating reinforced with 3-inch (7.5cm) glass scrim tape.

E. 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.

2.5. ACCESSORY MATERIALS

A. Accessory materials installed as part of insulation work under this section shall include, but not be limited to:

1. Closure Materials - Butt strips, bands, wires, staples, mastics, adhesives; pressure-sensitive tapes.

2. Field-applied jacketing materials - sheet metal, plastic, canvas, fiber glass cloth, insulating cement; PVC fitting covers, PVC jacketing.

3. Support Materials - Hanger straps, hanger rods, saddles.

4. Fasteners, weld pins/studs, speed clips, insulation washers.

5. Metal mesh or expanded metal lagging.

B. All accessory materials shall be installed in accordance with project drawings and specifications, manufacturer's instructions, and/or in conformance with the current edition of the Midwest Insulation Contractors Association (MICA) "Commercial & Industrial Insulation Standards."

2.6. FIELD-APPLIED JACKET

A. Field-applied jackets shall comply with ASTM C 921, Type I, unless otherwise indicated.

B. PVC Jacket: High-impact-resistant, UV-resistant PVC complying with ASTM D 1784, Class 16354-C; thickness as scheduled; roll stock ready for shop or field cutting and forming. Thickness is indicated in field-applied jacket schedules.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. Johns Manville; Zeston.
b. P.I.C. Plastics, Inc.; FG Series.
c. Proto PVC Corporation; LoSmoke.
d. Speedline Corporation; SmokeSafe.

2. Adhesive: As recommended by jacket material manufacturer.

3. Color: High gloss white.

4. Factory-fabricated fitting covers to match jacket if available; otherwise, field fabricate.

a. Shapes: 45- and 90-degree, short- and long-radius elbows, tees, valves, flanges, unions, reducers, end caps, soil-pipe hubs, traps, mechanical joints, and P-trap and supply covers for lavatories.

2.7. HANGER BLOCKS

A. For all pipes larger than 3 inches in diameter the hanger blocks shall be high compressive strength foam or wood blocks. Wood blocks shall be precision cut thickness to match specified insulation and shall include flared edge hanger saddle as manufactured by Buckaroo.

B. The wood blocks shall be suitable for temperatures from -120 degrees Fahrenheit to 200 degrees Fahrenheit. Do not utilize the wood blocks for piping systems operating outside

of the indicated temperature range.

C. Wood blocks are not acceptable for use at refrigerant pipe hangers.

PART 3. EXECUTION

3.1. WORKMANSHIP

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

3.2. SITE INSPECTION

A. Before starting work under this section, carefully inspect the site and installed work of other trades and verify that such work is complete to the point where installation of materials and accessories under this section can begin.

B. Verify that all materials and accessories can be installed in accordance with project drawings and specifications and material manufacturers' recommendations.

C. Verify, by inspecting product labeling, submittal data, and/or certifications which may accompany the shipments, that all materials and accessories to be installed on the project comply with applicable specifications and standards and meet specified thermal and physical properties.

3.3. PREPARATION

A. Ensure that all pipe and equipment surfaces over which insulation is to be installed are clean and dry.

B. Ensure that insulation is clean, dry, and in good mechanical condition with all factory-applied vapor or weather barriers intact and undamaged. Wet, dirty, or damaged insulation shall not be acceptable for installation.

C. Ensure that pressure testing of piping 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 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 not be insulated with 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 existing floor drain piping that is indicated to receive A/C condensate shall be fully insulated to prevent condensation.

B. Ductwork Insulation:

1. General:

a. Before installing insulation, ensure that all seams and joints in ductwork have been sealed and leak tested by the contractor responsible for the duct system. Before applying duct insulation, air ducts shall be clean and dry.
b. Install insulation in accordance with manufacturer's published instructions and recognized industry practice to ensure that it will serve its intended purpose.
c. Install insulation materials with smooth and even surfaces. Butt joints firmly together to ensure complete and tight fit over surfaces to be covered.
d. Maintain the integrity of factory-applied vapor barrier jacketing on all insulation, protecting it against puncture, tears or other damage. All staples used on ductwork insulation shall be coated with suitable sealant to maintain vapor barrier integrity and covered with pressure sensitive vapor barrier tape 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. 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.

4. 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.

5. 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, boiler rooms, electric rooms, storage rooms, janitor closets, IDF rooms, and stairwell 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 230900
INSTRUMENTATION AND CONTROLS OF HVAC AND PLUMBING SYSTEMS
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SECTION 230900 - INSTRUMENTATION AND CONTROLS OF HVAC AND PLUMBING SYSTEMS

PART 1. GENERAL

1.1. SUMMARY

A. For General Mechanical Requirements, see Division 23 Section, Common Work Results for HVAC, and Division 01 Sections.

B. Comply with all code requirements and fire safety requirements as specified in Division 23 Section, Common Work Results for HVAC.

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

D. This Section includes control equipment for HVAC systems and components, including control components for terminal heating and cooling units not supplied with factory wired controls.

E. The automatic temperature control system ATC and central control and monitoring system (CCMS) shall be electric/electronic direct digital control (DDC), Alerton. 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. External existing control system to serve the new equipment as required.

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 equipment such as air handlers, fans, heat pumps, condensate pumps, radiant heat panels, relocated ductless units, etc., 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, contacts, 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. Re-Located Ductless Units

2. Electric Radiant Heat Panels

3. General Exhaust Systems

4. Radiant Heat Panels

5. Split System Heat Pumps

6. Condensate Pumps

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: Master slave/token passing.

E. PC: Personal computer.

F. PID: Proportional plus integral plus derivative.

G. RTD: Resistance temperature detector.

H. UPS: Uninterruptible Power Supply.

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. Space Temperature: Plus or minus 1 deg F (0.5 deg C).
b. Ducted Air Temperature: Plus or minus 1 deg F (0.5 deg C).
c. Outside Air Temperature: Plus or minus 2 deg F (1.0 deg C).
d. Temperature Differential: Plus or minus 0.25 deg F (0.15 deg C).
e. Air Pressure (Ducts): Plus or minus 0.1-inch wg (25 Pa).
f. 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 thermostats, humidistats, and other exposed control sensors with plans and room details before installation.

B. Coordinate equipment with Division 28 Section, “Fire Alarm System” to achieve

compatibility with equipment that interfaces with that system.

C. Coordinate supply of conditioned electrical branch circuits for control units and operator workstation.

D. Coordinate equipment with Division 26 Section, Panelboards to achieve compatibility with starter coils and annunciation devices.

1. Coordinate equipment with Division 26 Section, Motor-Controllers to achieve compatibility with motor starters and annunciation devices.

1.6. 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. The automatic temperature control (ATC) system and the central control and monitoring system (CCMS) shall be as manufactured by Alerton.

B. 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.

C. 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.

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, dampers, heat pumps, ductless units. 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.

E. Installer Qualifications: Automatic control system manufacturer's authorized representative who is trained and approved for installation of system components required for this Project.

F. 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.

G. 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. DDC System Hardware:

a. Wiring diagrams for control units with termination numbers.
b. Schematic diagrams and floor plans for field sensors and control hardware.
c. Schematic diagrams for control, communication, and power wiring, showing trunk data conductors and wiring between operator workstation and control unit locations.

8. Control System Software: List of color graphics indicating monitored systems, data (connected and calculated) point addresses, output schedule, and operator notations.

9. Controlled Systems:

a. Schematic diagrams of each controlled system with control points labeled and control elements graphically shown, with wiring.
b. Scaled drawings showing mounting, routing, and wiring of elements including bases and special construction.
c. Written description of sequence of operation including schematic diagram.
d. Points list.

C. Data Communications Protocol Certificates: Certify that each proposed DDC system component complies with LonWorks or Bacnet.

D. Software and Firmware Operational Documentation: Include the following:

1. Software operating and upgrade manuals.

2. Program Software Backup: On a magnetic media or compact disc, complete with data files.

3. Device address list.

4. Printout of software application and graphic screens.

5. Software license required by and installed for DDC workstations and control systems.

E. Software Upgrade Kit: For Owner to use in modifying software to suit future systems revisions or monitoring and control revisions.

F. Qualification Data: For Installer and manufacturer.

G. Field quality-control test reports.

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 School District'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 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.

B. Cost shall include all training material, instruction books, and two copies of video tape with sound DVD of training session.

C. Upon completion of the work, the Control Contractor shall have completely adjusted the entire control system. He shall arrange to instruct the Owner's representative on the operation of the control system for a period of not less than 4 hours. All training shall be by the control contractor and shall utilize specified manuals and as-built documentation.

D. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain control systems and components.

1. Train Owner's maintenance personnel on procedures and schedules for starting and stopping, troubleshooting, servicing, and maintaining equipment and schedules.

2. Provide operator training on data display, alarm and status descriptors, requesting data, executing commands, calibrating and adjusting devices, resetting default values, and requesting logs.

3. Review data in maintenance manuals. Refer to Division 01 Section, Contract Closeout.

4. Review data in maintenance manuals. Refer to Division 01 Section, Operation and Maintenance Data.

5. Schedule training with Owner, through Architect, with at least seven days' advance notice.

1.13. ALTERNATES

A. Refer to Division 01 Section, Alternates for description of work under this section affected by alternates.

1.14. CHRISTINA SCHOOL DISTRICT 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 open or closed position of all dampers.

5. The ATC Computer Graphics shall incorporate the final room numbers actually utilized in the school. 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. All Temperature Sensors, current 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.

8. The exact space temperature set points, 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.

9. The outside air humidity and outside air temperature shall be monitored on ATC system and reported on ATC Computer Graphics. See Floor plans for exact

locations.

10. Provide a graphic of all floor plans indicating location of all equipment interlocked with ATC System including all control panels.

11. Graphic shall also indicate area of building served by each item of equipment. Graphics shall indicate all global sensor readings.

12. All equipment shall be labeled with name of equipment, area served, and area location (room name/number).

13. Scheduling of HVAC equipment/zones shall be such that for afterhours use the ATC system shall allow a temporary override of the pre-set occupied/unoccupied schedule by zone and for specific equipment in a zone. This must allow the school staff the ability to operate as few or many zones as desired without operating entire portions of the building.

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 humidity.
c. 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.
d. 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.
e. Where damper position is indicated ATC graphic shall indicate percentage open or percentage closed.

PART 2. PRODUCTS

2.1. BUILDING MANAGEMENT SYSTEM

A. The Building Management System (BMS) shall use an open architecture and fully support a multi-vendor environment. To accomplish this effectively, the BMS shall support open communication protocol standards and integrate a wide variety of third-party devices and applications. The system shall be designed for use on the Internet, or intranets using off

the shelf, industry standard technology compatible with other owner provided networks.

B. The Building Management System shall consist of the following:

1. Standalone Network Automation Engine(s)

2. Field Equipment Controller(s)

3. Input/Output Module(s)

4. Local Display Device(s)

5. Portable Operator's Terminal(s)

6. Distributed User Interface(s)

7. Network processing, data storage and communications equipment

8. 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. Acceptable Manufacturers

1. Alerton.

F. 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.

G. 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. Alerton.

2. Control networks shall provide either "Peer-to-Peer," Master-Slave, 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 (master or slave) that will communicate on the BACnet MS/TP Bus.

6. The Conformance Statements shall be submitted with the BAS Submittals.

H. 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.

I. 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 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.

J. 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.

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.

2.3. CONTROLLERS

A. Temperature sensor covers shall be stainless steel wire guard type with vandal proof screws. All room temperature sensors shall be mounted 4'-0 inches above the finished floor, except in stairways, corridors and toilets, which shall be 7'-0 inches. Provide insulating bases where temperature sensors are located on exterior or unconditioned walls. Each temperature sensor shall have adjustable limit stops and adjustable sensitivity. User adjustment shall be 2 degrees F above and below set points or as determined by the Owner. Room temperature sensors shall include range of 55 degrees F to 85 degrees F set point adjustment. Temperature sensors shall include set-point adjustors, U.L. approved for mounting base in air plenums, and RJ-11 jack for communications. Room temperature sensors shall be fully adjustable and shall display set point and actual temperature.

B. Space sensor wiring shall be installed concealed where possible. Should the Division 23 Contractor be unable to do so then surface metal raceway shall be utilized as specified in Division 26.

C. Room temperature sensors shall be accessible to ADA occupants.

D. All global sensors shall be monitored in accessible locations. Exterior sensors shall be provided with sun shield and be installed to prevent bird nesting.

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 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 be independent of the damper actuator and 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. Damper Operators

1. Electric damper actuators shall be properly sized to provide sufficient torque to position the damper throughout its operating range.

2. Use devices which are quiet in operation and which in the event of power failure, will "fail safe" by spring action in either the normally open or normally closed position as required for freeze, moisture, smoke, or fire protection.

3. Electric actuators requiring a 24 VAC power supply will be utilized. Motors shall be specifically designed and sized with proper torque according to requirements of the device it is to be used on (i.e.: valve, damper). Each actuator will accept the proper control input as the system is designed, (i.e,: floating, 0-10VDC, 4-20Ma etc.) without the need for any additional interface devices.

4. For all exterior damper operators provide NEMA 4X stainless steel corrosion resistant enclosure. Damper operator enclosure shall be model ZS-300 as manufactured by Belimo or approved equal.

2.5. CONTROL PANELS

A. Furnish and install local panels for ATC devices. Control panels shall be fully enclosed cabinets, all steel construction and shall meet the requirements of NEMA 1 enclosures. Cabinet shall have piano hinged door with a locking latch. All cabinet locks shall use common key. Provide means of storing control system instructions and drawings inside cabinet for future reference. Panel shall be wall mounted or free standing and located where directed by the Contract Drawings or Engineer.

1. Each panel shall have all internal devices factory wired to a numbered terminal strip. Controllers and associated devices shall be mounted within the panel, accessible through a hinged door.

2. All ATC panels shall be provided with integral disconnect, wiring, and control transformers.

3. Any ATC control panel that is serving equipment on the emergency generator must be powered by an emergency generator fed circuit/electrical panel. Refer to electrical contract documents for all emergency powered equipment.

2.6. MISCELLANEOUS ELECTRICAL DEVICES

A. Electric Actuators. All automatically controlled devices, unless specified otherwise elsewhere, shall be provided with electric actuators which shall be sized to operate their appropriate loads with sufficient reserve power to provide smooth modulating action or two-position action and tight close off as specified.

2.7. UNINTERRUPTIBLE POWER SUPPLY

A. Furnish, size and install uninterruptible power supplies (UPS's) at all ATC panels.

B. Provide all interlock and power wiring from U.P.S. to control panels as required such that all components are powered via the UPS. For hard-wired equipment furnished with pigtails/wire leads, e.g. control power transformers, splice pigtails/wire leads in junction box to a flexible cord with NEMA 5-15P Plug, which shall be plugged into the UPS.

C. UPS's shall be sized for the ATC panel load and shall provide at least 10 minutes of full load power in the event of a power outage.

D. UPS shall be furnished with plug and cord and shall be powered from power receptacle(s) in ATC panels.

2.8. CENTRAL CONTROL AND MONITORING SYSTEM (CCMS) (HARDWARE DESCRIPTION)

A. General

1. The Facilities Management Control System (FMCS) shall be comprised of a network of various independent, Stand-alone Digital Controllers (SDC'S), Mechanical System Digital Controllers (MSDC's), Air Handler Digital Controllers (AHDC's), Unitary Digital Controllers (UDC's) together with Centralized Control Stations (CCS), and Centralized Host Stations (CHS) as specified, to provide centralized access and facility wide control functions. The SDC's, MSDC's, AHDC's, 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 School District's Central Maintenance Office shall be utilized with the new CCMS System. Provide wiring as required to interface this school's CCMS system with FMS computer.

C. 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, 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, 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.

D. 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, 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.

E. 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 AHD 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.

2.9. 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 Alerton.

2.10. 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.

2.11. 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.

4. All wall mounted temperature sensors shall be installed with stainless steel wire guard. Set point adjustment shall be achievable without removing the wire guard.

5. 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. 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.

6. Overall system accuracy, including electronic analog sensing elements, shall be as follows:

   a. Air: Plus or minus 1.0 degrees F temperature.
   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 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 if the motors are fractional H.P., and other non-ducted fans.

7. 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.

8. 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.

9. 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.

10. Audible Alarm:

a. All alarms shall annunciate on the ATC system front end computer and via pagers.

2.12. 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.

PART 3. EXECUTION

3.1. GENERAL

A. The Automatic Temperature Control System and Central Control and Management System, shall be designed, installed, and commissioned in a turnkey fully implemented and operational manner.

3.2. BMS SPECIFIC REQUIREMENTS

A. Graphic Displays

1. Provide a color graphic system flow diagram display for each new **[and existing]** system with all points as indicated on the point list. All terminal unit graphic displays shall be from a standard design library.

2. User shall access the various system schematics via a graphical penetration scheme and/or menu selection.

B. Custom Reports:

1. Provide custom reports as required for this project:

3.3. INSTALLATION & SUPERVISION

A. All wiring shall be properly supported and run in a neat and workmanlike manner. All wiring exposed and in equipment rooms shall run parallel to or at right angles to the building structure. All piping and wiring within enclosures shall be neatly bundled and anchored to prevent restriction to devices and terminals.

B. The control contractor shall be responsible for all electrical installation required for a fully functional control and automation system and not shown on the electrical plans or required by the electrical specifications. All wiring shall be in accordance to all local and national codes.

1. All line voltage wiring, all wiring exposed, and all wiring in equipment rooms shall be installed in conduit in accordance to the electrical specifications.

2. All electric and electronic wiring shall be minimum #20 AWG minimum THHN and shielded if required.

3. All wiring in the central control room shall be concealed in an approved manner.

C. Verify locations of temperature 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, humidity sensors, CO2 sensors, and other exposed control sensors with plans and room details before installation. Align with lighting switches and humidistats.

I. Mount outdoor reset thermostats and outdoor sensors indoors, with sensing elements outdoors with sun shield.

J. Provide separable sockets for liquids and flanges for air bulb elements.

K. Mount control panels adjacent to associated equipment on vibration free walls or free standing angle iron supports. One cabinet may accommodate more than one system in same equipment room. Provide engraved plastic nameplates for instruments and controls inside cabinet and engraved plastic nameplates on cabinet face.

L. Install equipment plumb and level.

M. Install all equipment to be accessible for service and maintenance.

3.4. 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 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.

3.5. 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.

3.6. 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.

3.7. 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, 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.

3.8. 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.

3.9. 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.

3.10. 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 temperature instruments and material and length of sensing elements.

6. Check control valves. Verify that they are in correct direction.

7. Check DDC system as follows:

   a. Verify that DDC controller power supply is from emergency power supply, if applicable.
   b. Verify that wires at control panels are tagged with their service designation and approved tagging system.
   c. Verify that spare I/O capacity has been provided.
   d. Verify that DDC controllers are protected from power supply surges.

D. Replace damaged or malfunctioning controls and equipment and repeat testing procedures.

E. All temperature control and interlock wiring shall be installed in conduit unless otherwise noted on the plans. Power or interlock wiring shall be run in separate conduit from sensor and communications wiring.

3.11. 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. 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.

6. Stroke and adjust dampers.

7. Provide diagnostic and test instruments for calibration and adjustment of system.

8. Provide written description of procedures and equipment for calibrating each type of instrument. Submit procedures review and approval before initiating startup procedures.

B. Adjust initial temperature 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.

3.12. 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.

3.13. 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.

3.14. 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 233000
HVAC AIR DISTRIBUTION
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SECTION 233000 - HVAC AIR DISTRIBUTION

PART 1. GENERAL

1.1. SUMMARY

A. For General Mechanical Requirements, see Division 23 Section, "Common Work Results for HVAC" and Division 01, "General Requirements".

B. The fabrication and installation of all ductwork, together with related equipment, shall comply with the standards of the National Fire Protection Association, as set forth in NFPA Standard No. 90A, as well as with the requirements of the Sheet Metal and Air Conditioning Contractors' National Association, Inc., and the latest edition of the ASHRAE Guide.

C. All duct sizes shown are net inside clear dimensions. Where internal duct lining is used, increase duct sizes accordingly to provide the indicated net free area. Unless otherwise indicated size runouts, drops, and connections to grilles, registers, diffusers, fans, coils, louvers, filters, and other equipment to the full size of the equipment connection.

D. Minor changes may be made in duct sizes where required to fit the available space, provided the indicated net free area and approximate aspect ratio are maintained.

E. Smoothly transition all ductwork to prevent excessive or unnecessary turbulence or pressure loss.

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.

1.2. REFERENCES

A. ASTM A 36 - Structural Steel

B. ASTM A 90 - Weight of coating on Zinc-Coated (Galvanized) Iron or Steel Articles

C. ASTM A 167 - Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip

D. ASTM C 916 Type II – Standard Specification for Adhesives for Duct Thermal Insulation

E. ASTM A 366 - Steel, Sheet, Carbon, Cold Rolled, Commercial Quality

F. ASTM A 480 - General Requirements for Flat-Rolled Stainless and Heat-Resisting Steel Plate, Sheet, and Strip

G. ASTM A 525 - General Requirements for Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process

H. ASTM A 527 - Steel Sheet, Zinc-Coated (Galvanized) by Hot-Dip Process, Lock Forming Quality

I. ASTM A 568 - Steel, Sheet, Carbon, and High-Strength, Low-Alloy, Hot-Rolled and

Cold-Rolled

J. ASTM A 569 - Steel, Carbon (0.15 Maximum, Percent), Hot-Rolled Sheet and Strip, Commercial Quality

K. ASTM B209 - Aluminum and Aluminum-Alloy Sheet and Plate

L. NFPA 90A - Installation of Air Conditioning and Ventilating Systems

M. NFPA 90B - Installation of Warm Air Heating and Air Conditioning Systems

N. SMACNA - HVAC Air Duct Leakage Test Manual

O. UL 181 - Factory-Made Air Ducts and Connectors.

P. NFPA 90A - Installation of Air Conditioning and Ventilating Systems

Q. NFPA 70 - National Electrical Code

R. SMACNA - HVAC Duct Construction Standards - Metal and Flexible

S. UL 33 - Heat Responsive Links for Fire-Protection Service.

1.3. PERFORMANCE REQUIREMENTS

A. No variation of duct configuration or sizes permitted except by written permission. Size round ducts installed in place of rectangular ducts in accordance with ASHRAE Table of Equivalent Rectangular and Round Ducts.

1.4. QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing the projects specified in this section with minimum five (5) years documented experience.

B. Installer: Company specializing in performing the work of this section with minimum five (5) years' experience.

1.5. REGULATORY REQUIREMENTS

A. Construct ductwork to NFPA- 90A, and NFPA-90B.

1.6. ENVIRONMENTAL REQUIREMENTS

A. Do not install duct sealants when temperatures are less than those recommended by sealant manufacturer.

B. Maintain temperatures during and after installation of duct sealants.

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. DUCTWORK

A. Unless otherwise indicated or specified, fabricate ductwork of galvanized sheet steel, stainless steel, or aluminum conforming to Commercial Designation 3003 Temper H14 and Duct Sheet. Duct gages, jointing and reinforcement shall conform to Tables 4, 5, 6 and 7, as applicable, Chapter I of the latest ASHRAE Guide and Data Book. Construction details shall conform to Section I and Section II, as applicable, of Duct Manual and Sheet Metal Construction for Ventilation and Air Conditioning Systems as published by Sheet Metal and Air Conditioning Contractors' Association, Inc.

B. Erect sheet metal ductwork in a first-class, workmanlike manner secured in place rigidly and permanently. Provide suitable hangers, securely attached to building construction with bolts, clips or inserts. Hangers shall be structural shapes, flat bars, or formed strap hangers; use of wire will not be permitted. Hangers shall not pass through or be inside duct. Support vertical ducts passing through floors by angles riveted to duct and resting either on floor or on brackets secured to building construction. All space around ducts where they pass through any walls, floors, ceilings, or roofs shall be sealed tight with incombustible inert material. Do not arrange ducts so as to impair the effectiveness of fireproofing around structural members. Provide sheet metal flanged collars around exposed ducts passing through walls, floors, or ceilings to provide finished appearance. Seal all duct joints and seams including supply, return, outside air, combustion air, relief air, ventilation air and exhaust ductwork with Hardcast Sealing System as manufactured by Hardcast, Inc., Foster, Childers, or approved equal.

C. Flexible connections of neoprene or other NFPA approved non-inflammable fabric shall be provided in the duct system at all fan inlet and outlet connections.

D. Provide cut turning vanes in all duct turns where centerline radius is located. Turning vanes shall be air-foil type with extended trailing edges. Fabricate to comply with SMACNA Sheet Metal Construction for Ventilation and Air Conditioning Systems Manual.

E. Provide duct collars and angle iron framework for mounting of automatic dampers.

F. Fabricate and support in accordance with SMACNA HVAC Duct Construction Standards - Metal and Flexible, and as indicated. Provide duct material, gauges, reinforcing, and sealing for operating pressures indicated.

G. Construct T's, bends, and elbows with radius of not less than 1-1/2 times width of duct on centerline. Where not possible and where rectangular elbows are used, provide air foil turning vanes. Where acoustical lining is indicated, provide turning vanes of perforated metal with glass fiber insulation.

H. Increase duct sizes gradually, not exceeding 15 degrees divergence wherever possible; maximum 30 degrees divergence upstream of equipment and 45 degrees convergence downstream.

I. Fabricate continuously welded round and oval duct fittings two gauges heavier than duct gauges indicated in SMACNA Standard. Joints shall be minimum 4-inch (100 mm) cemented slip joint, brazed or electric welded. Prime coat welded joints.

J. Provide standard 45 degree lateral wye takeoffs unless otherwise indicated where 90

degree conical tee connections may be used.

K. Fasteners: Rivets, bolts, or sheet metal screws.

L. Hanger Rods: ASTM A36 - Galvanized steel; threaded both ends, threaded one end, or continuously threaded.

2.2. DUCT SYSTEMS

A. All supply, return, exhaust, fresh air intake, relief, ventilation and outside 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. Aluminum sheet shall be 3003 H14 alloy or duct sheet, 16,000 psi minimum tensile strength, and capable of being formed to a Pittsburgh lock seam.

14. Reinforcing members for aluminum ductwork shall be galvanized steel or aluminum unless otherwise indicated. Where aluminum reinforcing is used, size the member in accordance with ASHRAE recommendations to have rigidity equivalent to listed mild steel angle sizes.

15. Where aluminum ductwork is used, make allowance for increased thermal expansion. Particularly avoid direct contact between aluminum and concrete or masonry walls subject to dampness.

2.4. 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, 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.

2.5. 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.

2.6. DUCT ACCESS DOORS

A. Furnish and install adequately sized duct access doors at, motor-operated 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.

2.7. 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.

2.8. DUCT LINING (LOW PRESSURE DUCTWORK)

A. All low pressure supply and return ductwork within 10 feet of air handling units and as additionally shown on Contract Drawings, shall be lined on the interior for sound attenuation and thermal insulation.

B. All low pressure ductwork within 10 feet of 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.

2.9. AIR TERMINAL DEVICES

A. Furnish and install air supply, return, exhaust devices of sizes and capacities as scheduled on the drawings. Catalog numbers shown are Metalaire, Inc., products for equipment which have been found suitable for the application. Products of Tuttle & Bailey, Anemostat, Division of Hart & Cooley, Carnes, Titus, Price, Nailor, Krueger, 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 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. Device Schedule:

AIR DEVICE SCHEDULE

Device	Accessories	Finish
Supply Diffusers, Lay-in Tile		
Model 5000-A, Rectangular MetalAire Ceiling Diffuser, Throw as Indicated	Integral opposed blade damper	White baked enamel finish
	Removable core	
	Louvered face	
	All aluminum construction	
	Auxiliary panel for lay-in tile installation	
	Adjustable pattern deflector	
Supply Diffuser, Gypboard, Surface Mount		

AIR DEVICE SCHEDULE		
MetalAire Model 5000-A, Rectangular Ceiling Diffuser, Throw as Indicated (Surface or Duct Mount)	Integral opposed blade damper	White baked enamel finish
	Louver face	
	All aluminum construction	
	Removable core	
	Adjustable pattern deflector	
Supply Register, Sidewall, Floor		
MetalAire Model V4004D, Sidewall Supply Register, Throw as Indicated (Surface or Duct Mount)	Integral opposed blade damper	White baked enamel finish
	All aluminum construction	
	22½ inch deflection blades	
	Double deflection spread & drop control	
Return/Exhaust, Transfer Register, Gypboard, Surface Mount		
MetalAire, Model RHD Rectangular Registers (Surface Mount)	Integral opposed blade damper	Off-white baked enamel finish
	45 degree angled deflecting vanes	
	All aluminum construction	
Return/Exhaust Register		
MetalAire Model SRHF Sidewall Return Register with Filter Housing	All steel construction.	Off white electro-deposition finish
	45 degree angled deflecting vanes	
	Opposed blade dampers	
	Filter housing w/ 1 inch thick disposable filter	
	Hinged core	
Return/Exhaust, Transfer Register, Lay-in Tile		

AIR DEVICE SCHEDULE		
MetalAire, Model RHD Rectangular Registers	Integral opposed blade damper	Off-white baked enamel finish
	45 degree angled deflecting vanes	
	All aluminum construction	
	Auxiliary panel for lay-in tile installation	

C. 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.

D. Contractor shall determine frame and mounting type as per type of ceiling as shown on Architectural drawings.

E. Noise Criteria: All air devices shall be sized and selected to limit maximum NC (noise criteria) levels to 30.

2.10. LOUVERS (FIXED BLADE)

A. Furnish and install wall louvers of the size and capacity shown on the contract drawings. Louvers shall be Greenheck Model EHV-901 (high velocity wind driven rain) heavy gauge extruded aluminum stationary type louvers or approved equal. Louvers shall be stationary, dual module type consisting of a “front” louver with J-style blades and a “rear” louver with vertical rain resistant style blades. Louver frame shall be a total depth of 9 inches.

B. Front louvers shall be drainable type fabricated from heavy gauge 6063-T5 aluminum extrusions of .081 inch nominal wall thickness. Blades shall be positioned at 37 degree and 45 degree angles, approximately 4.25 inches on centers. Rear louver shall b vertical rain resistant style, heavy gauge extruded 6063-T5 aluminum, 0.060 nominal thickness, positioned on approximately 1.5 inch blade spacing. Each louver shall be equipped with a frame and removable rear-mounted screen of flattened aluminum. Each factory assembled louver section shall be designed to withstand wind loadings of 25 psf. Louvers too large for complete factory assembly shall be built up by the installing contractor from factory assembled louver sections.

C. Louvers shall be tested in accordance with AMCA 550-L, AMCA-540, and AMCA 550 (Certified High Velocity, Rain Resistant, and Impact Resistant Louver).

D. Louvers shall be supplied with a factory Kynar finish applied after a thorough cleaning and preparation of the metal surface. A total dry film thickness of approximately 1.2 mils

shall be provided. Custom color shall be as selected by Architect.

E. Louvers shall be provided with ¼ inch x ¼ inch aluminum bird screens, factory-furnished and installed. Louver performance data shall be A.M.C.A. certified. All louvers shall be caulked weathertight around entire perimeter.

2.11. LOUVER BLANK-OFF PANELS

A. Insulated, Blank-Off Panels: Laminated panels consisting of insulating core surfaced on back and front with metal sheets and attached to back of louver

1. Thickness: 2 inches (50mm)
2. Metal Facing Sheets: Aluminum sheet, not less than .032 inch (.81mm) nominal thickness.
3. Insulating Core: Rigid, glass-fiber-board insulation or extruded-polystyrene foam
4. Edge Treatment: Trim perimeter edges of blank-off panels with louver manufacturer's standard extruded-aluminum-channel frames, not less than .080 inch (2.03mm) nominal thickness with corners mitered and with same finish as panels.
5. Seal perimeter joints between panel faces and louver frames with gaskets or sealant.
6. Panel Finish: Same finish applied to louvers.
7. Attach blank-off panels with stainless steel sheet metal screws.
8. Cover all unused openings in louvers.

2.12. 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.

2.13. 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".

2.14. 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.

2.15. AUXILIARY DRIP PANS

A. Furnish and install suitable watertight, aluminum drip pans for all suspended air handling units, heat pumps, or air handling units installed on upper floor and/or attic. Each drip pan shall have a 1" copper type "M" drain piped to discharge where shown on drawings. Drain pan shall extend 3" beyond sides of air handling unit/heat pump. Sides shall be minimum 1.5" deep.

B. Drain pans shall be of 16 gauge welded construction. Provide drawings of typical drain pan construction for approval before construction. See Submittals, Division 23 Section, “Common Work Results for HVAC” and Division 01, Section, “General Requirements”.

C. Install U.L. 580 listed condensate float switch in auxiliary drain pan and wire to shut-down unit upon sensing water. All control and interlock wiring to be furnished and installed under Division 23 Section, “Instrumentation & Controls of HVAC & Plumbing Systems”

2.16. FILTER MEDIA DURING CONSTRUCTION

A. Filter media installed during construction: Minimum MERV 8.

PART 3. EXECUTION

3.1. DUCT INSTALLATION REQUIREMENTS

A. Coordinate ductwork with other work and install ducts at proper elevations and locations to maintain indicated ceiling heights and clearances. Provide all elbows, transitions, offsets, connections, and other fittings necessary to fit the work into place or to connect

to equipment or diffusers. Method of duct support connection to structure and slabs shall be approved by Structural Engineer, and Shop Drawings shall be submitted.

B. Substantially support ductwork with structural shapes, flat bars, or formed strap hangers securely attached to the building structure by means of bolts, clamps, or inserts. Support vertical ducts by angles attached to the duct and resting on the floor or supported by brackets or hangers attached to the building structure. Strap hangers shall be 16-gauge minimum galvanized steel formed under the bottom edge of duct. Use square ¼ inch thick washers tight against the bend on upper strap attachments to horizontal surfaces. Place all supports external to the ductwork and out of the air stream. Provide additional supports at coils and other concentrated loads. Arrange supports so that duct weight is not transmitted to ceilings, fans or other equipment.

C. Prevent direct contact between ductwork and building surfaces or other equipment. Where ducts pass through walls, partitions, floors, ceilings, or roofs, pack and seal the space around the duct with an approved fire-safe inert material. Provide flanged duct escutcheons at all exposed ducts that pass through walls, partitions, floors, and ceilings.

D. Use galvanized (compatible) corrosion-resistant hangers, supports, brackets, and hardware.

E. Furnish and install NFPA-approved duct connections where shown and at all connections to fans, air handling units, and similar rotating equipment. Use glass-reinforced neoprene fabric, roll-formed to sheet metal strips or flanges. Support adjacent ductwork to provide sufficient slack in the connection.

F. See NFPA 90A, and latest publication of SMACNA. Prevent direct contact between ductwork and building surfaces or other equipment. The opening in the construction around the duct shall not exceed one-inch average clearance on all sides. Where ducts pass through walls, partitions, 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.

3.2. ACCESSORY INSTALLATION REQUIREMENTS

A. Install accessories in accordance with manufacturer's instruction, NFPA 90A, and SMACNA HVAC Duct Construction Standards - Metal and Flexible.

B. Provide duct 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. 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. 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".

E. 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.

F. Use splitter dampers only where indicated.

G. 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.

H. Install diffusers, registers, and grilles to ductwork with airtight construction.

I. Check location of all air outlets and inlets and make necessary adjustments in position to conform with architectural features, symmetry, and lighting arrangements.

J. Install duct accessories according to applicable details shown in SMACNA's HVAC Duct Construction Standards Metal and Flexible for metal ducts.

K. Install volume dampers in lined duct; avoid damage to and erosion of duct liner.

L. Provide test holes at fan inlet and outlet and elsewhere as indicated.

M. Adjust duct accessories for proper settings.

3.3. DUCT LINING INSTALLATION REQUIREMENTS

A. All portions of duct designated to receive duct liner shall be completely covered with duct liner. Transverse joints shall be neatly butted and there shall be no interruptions or gaps. The black pigmented or mat faced surface of the duct liner shall face the airstream.

B. Duct liner shall be adhered to the sheet metal. with 90 percent coverage of adhesive complying with requirements of ASTM C916. All exposed leading edges and transverse joints shall be factory coated or coated with adhesive during fabrication. Install perforated galvanized inner liner where indicated

C. Duct liner shall be additionally secured with mechanical fasteners, either weld-secured or impact-driven, which shall compress the duct liner sufficiently to hold it firmly in place. Adhesive bonded pins are not permitted due to long term adhesive aging characteristics. Spacing of mechanical fasteners with respect to duct liner interior width shall be in accordance with SMACNA HVAC DGS. Maximum spacing for mechanical fasteners shall be as follows:

Velocity = 0 to 2,500 feet per minute (0 to 12.8m/s):

From transverse end of liner	3: (75mm)
Across width of duct	12 inches (300 mm) O.C.
From corners of duct	4 inches (100mm)
Along length of duct	18 inches (450mm) O.C.

Velocity = 2,501 to 5,000 feet per minute (12.8 to 25.4 m/s):

From transverse end of liner	3 inches (75m)
Across width of duct	6 inches (150mm) O.C.
From corners of duct	4 inches (100mm)
Along length of duct	16 inches (400mm) O.C.

D. When air velocities exceed 4,000 fpm (20.3m/s), galvanized sheet metal nosing shall be applied to all leading edges of duct liner.

E. Acoustical Duct Liner shall be cut to assure overlapping and compressed longitudinal corner joints.

F. Upon completion of installation of duct liner and before operation is to commence, visually inspect the system and verify that the duct liner insulation has been correctly installed.

G. Open all system dampers and turn on fans to blow all scraps and other loose pieces of material out of the duct system. Allow for a means of removal of such material.

H. Check the duct system to ensure that there are no air leaks through joints.

3.4. 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.

3.5. LEAKAGE TESTS

A. All low pressure sheet metal ductwork shall undergo leakage tests at 2 inch W.G. Tests shall be accomplished under this section and witnessed as specified under Division 23 Section, "Testing, Adjusting, and Balancing for HVAC and Plumbing".

B. Leakage from each duct system shall not exceed 5 percent for low pressure systems and 1 percent for medium pressure systems of the normal air handling capacity of the system. If the system ductwork is tested in sections, the leakage shall not exceed ½ of 1 percent of the CFM to be handled by that section, and the total leakage of the system shall not exceed 1 percent of the total system CFM. Test pressure shall not exceed the pressure limits of the duct construction as defined in SMACNA High Pressure Duct Construction Standards. Repair all leaks which are audible, regardless of the leakage rate of the duct system as a whole, by remaking the entire defective joint or seam. Spot sealing of ducts in place will not be acceptable.

C. All duct accessories, including but not limited to volume dampers and ATC sensors shall be installed prior to duct leakage testing.

D. Submit a complete report of the ductwork leakage tests to the Architect and include final approved copies in test and balance reports.

3.6. DUCTWORK IDENTIFICATION

A. Degrease and clean surfaces to receive adhesive for identification materials.

B. All ductwork shall be identified with painted background marked with the name of the service with arrows to indicate flow direction. Color Code and System Identification shall comply with ANSI Standards.

C. Marking shall be plain block letters, stenciled on ductwork (above and below ceilings) and shall be located near each branch connection and at least every ten feet on straight runs of ductwork. Where ductwork is aligned adjacent to each other, markings shall be neatly lined up. All markings shall be located in such a manner as to be easily legible from the floor.

D. Identify ductwork with plastic nameplates or stenciled painting. Identify with air

handling unit identification and area served.

E. Length of color field for ductwork shall be 32 inches. Lettering shall be minimum 3-1/2 inches high.

END OF SECTION

DIVISION 26 SECTION 260501
COMMON WORK RESULTS FOR ELECTRICAL
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SECTION 260501 - COMMON WORK RESULTS FOR ELECTRICAL

PART 1. GENERAL

1.1 GENERAL

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

B. All work under this Division is subject to the General Conditions and Special Requirements for the entire contract.

C. Unless otherwise specified, all shop drawings and submissions required under Division 26 shall be made to, and acceptances and approvals made by, the ENGINEER.

D. Conform to the requirements of all rules, regulations, and codes of local, state, and federal authorities having jurisdiction. Conform to the National Electrical Code and all NECA – National Electrical Installation Standards (NEIS).

E. 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.

F. Coordinate the work of all trades.

G. 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 drawings for approval in accordance with “Submittals” specified below. The right is reserved to make reasonable changes in location of equipment, conduit, and wiring up to the time of rough-in or fabrication.

H. The contract drawings are generally diagrammatic and all offsets, bends, fittings, and accessories are not necessarily shown. Provide all such items as may be required to fit the work to the conditions.

I. 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 a first class, substantial, and workmanlike manner, in accordance with the full intent and meaning of the Contract Documents.

J. The Contractor shall provide other work and services not otherwise included in the Contract Documents that are customarily forwarded in accordance with generally-accepted construction practices.

1.2 PERMITS, INSPECTIONS, AND FEES

A. The Contractor shall obtain and pay for all charges and fees, and deliver all permits, licenses, certificates of inspection, etc., required by the authorities having jurisdiction. Deliver

inspection, approval, and other certificates to the Owner prior to final acceptance of the work.

B. File necessary plans, prepare documents, give proper notices, and obtain necessary approvals.

C. Permits and fees shall comply with the General Requirements of the Specification.

D. Notify Inspection Authorities to schedule inspections of work. All work shall be subject to field inspections.

E. Notify Engineer in advance of scheduled inspections.

F. An electrical foreman, superintendent or other supervisor shall be in attendance for all scheduled inspections.

G. The Contractor shall provide an electrical certificate from an independent electrical inspection agency approved by the Owner and the State of Delaware Fire Marshal. The Contractor shall submit certificate prior to final payment invoice. The Contractor shall pay all fees, including filing fees.

1.3 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 contain starters, contacts, transformers, fuses, wiring, etc., required for fans, pumps, etc., furnished with the equipment from the factory. When this equipment is supplied from the factory, the Contractor must supply power circuit(s) to the unit and a disconnecting means. Coordinate with 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 Mechanical Divisions. Contractor shall install and connect all such equipment as necessary.

4. Controls, wiring, conduit, transformers, etc., for smoke, fire, and motor-operated dampers are provided by Mechanical. Electrical 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. Contractor shall provide power circuits to such equipment and install all electrical control equipment related thereto.

C. Carefully review the contract documents and coordinate the electrical work under the various Divisions.

1.4 CONTRACTOR QUALIFICATION

A. Any Contractor performing work under this Division shall be fully qualified and acceptable to the Engineer. Submit the following evidence for approval:

1. A list of not less than five (5) comparable projects that the Contractor completed.

2. Letters of reference from not less than three (3) registered professional engineers, contractors, or building owners, explaining Contractor proficiency, quality of work, or other attribute on projects of similar size or substance.

3. Local or State license.

4. Membership in trade or professional organization where required.

5. Copy of Master Electrician's License.

B. Contractor is any individual, partnership, corporation, or firm performing work by Contract or subcontract on this project.

C. Acceptance of a subcontractor will not relieve the Contractor of any contractual requirements or his responsibility to supervise and coordinate the various trades.

D. Supervisory Qualifications: The electrical work on the project shall be under the direct supervision of a licensed Master Electrician.

E. Qualifications of Installers:

1. For the actual fabrication, installation, and testing of the work, the Contractor shall use only thoroughly trained and experienced personnel who are completely familiar with the requirements of this work and with the installation recommendations of the manufacturers of the specified items.

2. The Electrical Installer shall utilize a full time project foreman in charge of all electrical work. This person shall be fully qualified and experienced in such work and shall be available, on site, at all times during Construction. All problems, questions, coordination, etc., relating to electrical work shall take place through this person to the Architect.

1.5 FIRE SAFE MATERIALS

A. Unless otherwise indicated, materials and equipment shall conform to UL, NFPA, or ASTM Standards for Fire Safety with Smoke and Fire Hazard Rating not exceeding flame spread of 25 and smoke developed of 50.

1.6 REFERENCED STANDARDS, CODES, ORDINANCES AND SPECIFICATIONS

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

ADA	Americans with Disabilities Act
ANSI	American National Standards Institute
ASHRAE	American Society of Heating, Refrigerating and Air Conditioning Engineers
ASME	American Society of Mechanical Engineers
ASTM	American Society for Testing and Materials
IBC	International Building Code
CABO	Council of American Building Officials
FM	Factory Mutual
IEEE	Institute of Electrical and Electronics Engineers
NEC	National Electrical Code
NECA	National Electrical Contractors Association
NEMA	National Electrical Manufacturers Association
NFPA	National Fire Protection Association
OSHA	Occupational Safety & Health Administration
UL	Underwriters Laboratories
	Applicable State and Local Codes

B. All electrical equipment and materials shall comply with the Codes and Standards listed in the latest edition of IEEE Standard 241, *Electric Power Systems in Commercial Buildings*, Chapter 1, Section 1.6, entitled "Codes and Standards".

C. Comply with all Codes applicable to the work:

1. Bidders shall inform themselves of all local and state codes and regulations.

2. In case of conflict between Contract Documents and governing Codes, the most stringent shall take precedence. Where, in any specific case, different sections of any applicable codes or when Drawings and Specifications specify different materials, methods of Construction, or other requirements, the most restrictive shall govern.

3. Where Contract Documents exceed minimum Code requirements, and are permitted under the Code, the Contract Documents take precedence and shall govern.

4. No extra payment will be allowed for work or changes required by local Code enforcement authorities.

D. Underwriters Laboratories Labels shall apply to all materials and devices, etc., except specified items not covered by existing UL Standards.

E. Conflicts with applicable regulations:

1. Resolve at Contractor's expense.

2. Prepare and submit details of alternate construction:

a. Acceptable solution of conflict.

b. List of substitute materials:

For approval of inspecting authorities.
For approval of Engineer.

F. Comply with all NECA's National Electrical Installation Standards (NEIS), including NECA 1-2000 "Standard Practices for Good Workmanship in Electrical Contracting".

1.7 INTERPRETATION OF DOCUMENTS

A. Any discrepancies between Drawings, Specifications, Drawings and Specifications, or within Drawing and Specifications shall be promptly brought to the attention of the Owner during the bidding period. No allowance shall subsequently be made to the Contractor by reason of his failure to have brought said discrepancies to the attention of the Owner during the bidding period or of any error on the Contractor's part.

B. The locations of products shown on Drawings are approximate. The Contractor shall 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, the Contractor shall 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 "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.

G. Work not specifically outlined, but reasonably incidental to the completion of the work, shall be included without additional compensation from the Owner.

1.8 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.

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 sleeve selection and application with selection and application of firestopping specified in Division 07 Section "Penetration Firestopping."

PART 2. PRODUCTS

2.1 MATERIALS AND EQUIPMENT

A. Material and equipment installed as a part of the permanent installation shall be new, unless otherwise indicated or specified, and shall be approved by the Underwriters' Laboratories, Inc., for installation in each particular case where standards have been established.

B. Where material or equipment is identified by proprietary name, model number, and/or manufacturer, furnish the named item or equivalent thereof, subject to acceptance.

C. Material submissions shall conform to requirements outlined in SUBMITTALS, REVIEW, AND ACCEPTANCE.

D. The suitability of named item only has been verified. Where more than one Manufacturer is named, only the first named Manufacturer has been verified as suitable. Manufacturers and

items other than the 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. The Contractor, by providing other than the first named Manufacturer, assumes responsibility for all necessary adjustments and modifications necessary for a satisfactory installation.

E. The Contractor shall only submit those manufacturers indicated in the Specification. Proposed 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.

F. All items of equipment furnished shall have a service record of at least five (5) years.

2.2 SUBSTITUTIONS

A. Substituted items or items other than those named shall be equal or better in quality and performance and must be suitable for the available space, required arrangement, and application. Submit any and all data necessary to determine the suitability of substituted items. The Contractor shall be responsible for correct application, placement, and installation of substituted equipment. Cost savings data shall also be submitted with submittal data for substituted items. Total cost savings or a per-unit saving to the Owner shall be clearly indicated. If a substituted item is accepted, all cost savings shall be returned to the Owner as a credit.

B. Substitutions will not be permitted for specific items of material or equipment where specifically indicated.

C. 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 (or replacement with the specified item) while maintaining the specification requirements if differences have not been clearly indicated in the submittal.

D. Where the Contractor proposes to use an item of equipment or application other than that specified or detailed on the Drawings, which requires any redesign of the structure, partitions, foundation, HVAC, piping, wiring, or any other part of the mechanical, electrical, or architectural layout, all such redesign and all new drawings and detailing required thereafter shall be prepared by the Contractor at his own expense for review by the Owner representative before any such work is implemented.

E. All Contractor-proposed changes and revisions shall be at the Contractor's risk and expense. The Contractor shall fully coordinate all revisions, substitutions and changes with other trades. The Contractor shall provide all necessary provisions, including HVAC, ventilation, foundations, access, etc., for a complete, code compliant, and fully functional installation.

F. Where the Contractor elects to submit a substitution for equipment or materials, he shall:

1. Submit Shop Drawings that show complete compliance to each statement or requirement of the Specifications.

2. Submit certified test data from an independent testing laboratory for each product.

3. Submit one complete working sample of the equipment or materials to be furnished. In cases involving large or heavy items of equipment, the Owner may waive the requirement to submit the sample.

G. Failure to comply with the above-required submissions shall constitute an automatic rejection of the substitution.

2.3 SUBMITTALS, REVIEW, AND ACCEPTANCE

A. General:

1. The equipment, material, installation, workmanship, arrangement of work, final instruction, and final documentation is subject to review and acceptance. No substitution will be permitted after acceptance of equipment or materials except where such substitution is considered by the Engineer to be in the best interest of the Owner. Submit for review in clear and legible form the following documents:

   a. Material and Equipment List

   b. Descriptive Data

   c. Shop Drawings

   d. Installation and Coordination Drawings

   e. Contractor As-Built Drawings

   f. Owner Instructions and Manuals

   g. Construction Phasing and Outage Schedule

2. Prepare all submittals specifically for this project and stamp each submittal in a form indicating that the documents have been Contractor reviewed, are complete, and are in compliance with the requirements of the plans and specifications. Each submittal item shall be clearly identified and numbered. Each submittal shall contain a complete schedule of Manufacturer's part numbers and quantity listings of all supplied components. Each proposed item shall be highlighted and tagged with a star, an arrow, etc., including all options and accessories.

3. Coordinate the installation requirements and any mechanical requirements for the equipment submitted. Submittals will be reviewed for general compliance with design concept in accordance with the contract documents. The Contractor is responsible for the correctness of all submittals. Reviews will not verify dimensions, quantities, or other details.

4. Identify all submittals, indicating the intended application, location, or service of the submitted item. Refer to specification sections or paragraphs where applicable. Clearly indicate the exact type, model number, size, and special features of the proposed item. 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 (or replacement with the specified item) while maintaining the specification requirements, if differences have not been clearly indicated in the submittal. Submittals of a general nature will not be acceptable.

5. 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. Indicate all options used to meet the specifications. It is not the responsibility of the Engineer or Owner to make selections of factory options other than colors. Submittals lacking proper selection of factory options or special features required by the specification shall be RETURNED WITHOUT REVIEW.

6. Acceptance will not constitute waiver of contract requirements unless deviations are specifically indicated and clearly noted.

7. Documents of general form indicating options shall be clearly marked to show what is specifically proposed for this project.

8. Submittals NOT IN COMPLIANCE with the requirements of this section will be RETURNED WITHOUT REVIEW.

B. Material, Equipment, Manufacturer and Subcontractor List: Within 30 calendar days after the award of contract, submit a complete MATERIAL, EQUIPMENT, MANUFACTURER AND SUBCONTRACTOR LIST for preliminary review. List all proposed materials and equipment, the associated proposed Manufacturer, and any proposed subcontractors. After the receipt of reviewed Material and Equipment List, submit complete Shop Drawings for approval. List all materials and equipment, indicating manufacturer, type, class, model, curves, and other general identifying information. Submittals shall be specific for each building as contained in the individual building Specifications and Drawings.

C. Upon approval of the List of Materials, the Contractor shall prepare a complete Master Submittal Register, listing all products and materials that will be submitted for approval. Items shall be listed by referenced specification paragraph in ascending order. This master list shall be included with each submittal, updated to reflect the status of approval for each item, and shall highlight the items pertaining to the submittal. A suggested Submittal Register Format is shown below:

SUBMITTAL REGISTER					
Item/Material	Ref'd Spec. Paragraph	Specified or Substitute	Submittal Date	Status	Remarks

D. No Shop Drawing Submittals will be considered for approval until the complete List of Subcontractors and the complete List of Materials/Manufacturers and Equipment have been approved.

E. Descriptive Data: After acceptance of the MATERIAL and EQUIPMENT LIST, submit additional DESCRIPTIVE DATA for all items. Data shall consist of specifications, data sheets, samples, capacity ratings, performance curves, operating characteristics, catalog cuts, dimensional drawings, installation instructions, and any other information necessary to indicate complete compliance with the contract documents. Where several ratings or sizes are shown or available, clearly indicate the exact size or rating relating to the particular device being proposed.

F. Submit 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, specific electrical/wiring requirements and connections including control and interlock wiring, installation instructions, and any other information necessary to indicate complete compliance with the Contract Documents. Edit submittal data specifically for application to this project.

G. Shop Drawings shall be submitted and approved for all materials and equipment prior to installation. If any material and/or equipment is installed prior to receipt by the Contractor of approved Shop Drawings, the Contractor is liable for its replacement at no additional cost to the Owner.

H. Data submitted shall include information on all materials and equipment to demonstrate compliance with the Contract Drawings and Specifications. Where installation procedures or any part thereof are required to be in accordance with manufacturer's recommendations, furnish printed copies of the recommendations prior to installation. Installation of the item shall not proceed until recommendations are received. Failure to furnish recommendations shall be cause for rejection of the equipment or material.

I. Any deviation of submitted material or equipment from the Contract Drawings or Specifications shall be clearly marked in red ink on Submittals, and itemized in a transmittal letter, in order to receive consideration for approval.

J. Approval of material or equipment submittals containing deviations not specifically identified by Contractor shall not relieve the Contractor from compliance with specified requirements.

K. All major items of mechanical equipment shall be the latest standard catalog products of reputable manufacturers. Where two (2) or more items of the same kind of equipment are required, they shall be the products of a single manufacturer.

L. 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.

M. 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.

N. Increase, by the quantity listed below, the number of electrical related Shop Drawings, product data, and samples submitted, to allow for required distribution plus two copies of each submittal required, which will be retained by the Electrical Consulting Engineer.

1. Shop Drawings - Initial Submittal: 1 additional blue- or black-line print.

2. Shop Drawings - Final Submittal: 1 additional blue- or black-line print.

3. Product Data: 1 additional copy of each item.

O. Additional copies may be required by individual sections of these Specifications.

P. Shop Drawings:

1. Prepare and submit SHOP DRAWINGS AND/OR DIAGRAMS for all 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 the contract drawings.

2. Shop drawings shall include plans, elevations, sections, mounting details of component parts, point to point interconnection diagrams, elementary diagrams, single line diagrams, and any other drawings necessary to show the fabrication and connection of the complete item or system.

3. Shop drawings shall be provided for, but not limited to the following items:
Basic Electrical Materials

Cable - 600 volt
Circuit Breakers
Conduit and Surface Raceway
Contractor and Subcontractor Qualifications
Controllers & Control Devices
Electrical Connection Coordination Schedule
Equipment Connections
Equipment Pads
Excavation and Backfill
Fire Alarm System
Firestopping
Fuses
Ground Conductors, Rods
Identification System
Material and Equipment List
Motor Starters
Outlet Boxes
Panelboards
Receptacles
Record and Information Booklet

Safety Switches
Schedule of Values
Sleeves, Hangers, Supports
Submittal Schedule
Tests and Reports
Wiring Devices
Wiring Diagrams

Q. The Contractor, additionally, shall submit for approval any other shop drawings as required by the 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.

R. The Contractor shall prepare and submit a Detail Schedule of Values indicating the Contract costs for the major work items. The Contractor shall provide additional detail and information as requested by the Engineer.

S. The Contractor shall prepare and submit a complete Submittal Schedule. The Schedule shall include a listing of all Submittals, Shop Drawings, and Coordination Drawings.

2.4 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. Telecommunication Rooms indicating data rack assemblies, panels, etc.

2. Electrical Rooms indicating switchboard assemblies, transformers, equipment pads, panels, etc.

3. Mechanical Equipment Rooms, including panels, transformers, starters, equipment, etc.

B. Draw plans to a scale not less than 1/4 inch equals one foot. Include plans of the proposed work, showing all equipment, major elements, 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.

D. Prepare, submit, and use scaled layout drawings indicating dimensions, clearances, and actual equipment dimensions. Layout drawing shall include, but not be limited to the following:

1. Pad-mounted equipment and equipment connections.

2. Underground conduits, ductbanks, manholes, handholes, and building penetrations.

2.5 RECORD DRAWINGS

A. As the work progresses, record on a set of white prints the installed locations, sizes of electric feeders, equipment, etc. Upon completion of the work, submit one (1) complete set of white prints with "As-Built" information neatly recorded thereon in red ink. Use other colors to distinguish between variations in separate categories of the work. Note related change-order numbers where applicable.

B. Write step-by-step detailed instructions for turn-on, turn-off, seasonal changeover, and periodic checks of all systems and equipment. Include all precautions and warnings.

C. Prepare a list of the manufacturers of all major equipment, their local service representative and procedures for obtaining service.

D. Post one (1) copy of all instructions, lists, charts, and diagrams at the equipment or where indicated, mounted under glass or approved plastic cover.

E. Furnish to the Owner two (2) copies of the Manufacturer's installation and operations instructions. Include replacement parts lists where applicable. Also include copies of all posted instructions, lists and charts. Assemble the material in one or more heavy duty 8-1/2" x 11" loose leaf binders with tab separators. Submit for approval before final delivery. Binder shall be labeled on spine and on cover with Project Name.

F. Deliver all instruction materials to the Owner prior to the formal instruction period.

G. Deliver two (2) complete sets of all approved submittals to the Owner for filing.

H. Prepare record documents in accordance with the requirements in the specifications. In addition to the requirements specified, indicate installed conditions for:

1. Major raceway systems, size and location, for both exterior and interior; locations of control devices; distribution and branch electrical circuitry; and circuit breaker size and arrangements.

2. Approved Substitutions, Contract Modifications, and actual equipment and materials installed.

I. The Contractor shall keep at the site at all times during construction, one set of up-to-date Contract prints for the express purpose of showing any and all changes made during construction. The Contractor shall make the prints showing each change and shall incorporate all changes in “Record/As-Built Drawings” to be submitted to the Engineer upon completion of the project.

J. The Contractor shall show proof of up-to-date record drawings to the Owner prior to submitting monthly invoice.

K. The Contractor shall conform to all drawings, including all revisions, addendums, alternates, change orders, deletions, existing conditions, and as-built conditions without extra cost to the Owner.

2.6 DEMONSTRATION AND OPERATING INSTRUCTIONS

A. Furnish the necessary technicians, skilled workers, and helpers to operate the electrical systems and equipment of the entire project. The Contractor shall provide a minimum of eight (8) hours of system demonstration and eight (8) hours of system operation for each system.

B. Where specified in technical sections, provide longer periods required for specialized equipment.

C. Contractor shall provide start-up of all systems in an orderly, organized, and coordinated manner to ensure that all systems are functioning as designed. The Contractor shall provide a detailed start-up, testing, and demonstration plan for all systems in a coordinated manner that is documented in writing at least 45 days prior to system start-up. Start-up, testing and demonstration plans shall include detailed point-by-point checklists that clearly show that systems are, in fact, functioning as designed. Instruct the Owner or designated personnel in operation, maintenance, lubrication, and adjustment of systems and equipment.

D. The Operating and Maintenance Manual shall be available at the time of the instructions, for use by Instructors and Owner personnel.

E. Videotape each instruction session, including both the sessions specified above and added sessions required in technical sections for specialized equipment. Provide one complete set of DVD video disks with each Operating and Maintenance Manual.

F. Schedule the general and specialized instruction periods for a time agreed upon by he Owner and Engineer. All operation training and demonstrations shall be complete prior to Owner acceptance of any given system.

2.7 SLEEVES FOR RACEWAYS AND CABLES

A. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, galvanized steel, plain ends.

B. Sleeves for Rectangular Openings: Galvanized sheet steel.

1. Minimum Metal Thickness:

a. For sleeve cross-section rectangle perimeter less than 50 inches (1270 mm) and no side more than 16 inches (400 mm), thickness shall be 0.052 inch (1.3 mm).

b. For sleeve cross-section rectangle perimeter equal to, or more than, 50 inches (1270 mm) and 1 or more sides equal to, or more than, 16 inches (400 mm), thickness shall be 0.138 inch (3.5 mm).

2.8 SLEEVE SEALS

A. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and raceway or cable.

1. Basis-of-Design Product: Subject to compliance with requirements, provide product by one of the following:

   a. Advance Products & Systems, Inc.

   b. Calpico, Inc.

   c. Metraflex Co.

   d. Pipeline Seal and Insulator, Inc.

2. Sealing Elements: EPDM 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: Carbon steel. Include two for each sealing element.

4. Connecting Bolts and Nuts: Carbon steel with corrosion-resistant coating of length required to secure pressure plates to sealing elements. Include one for each sealing element.

2.9 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.

PART 3. EXECUTION

3.1 EXAMINATION OF SITE, SURVEYS, AND MEASUREMENTS

A. Examine the site, determine all conditions and circumstances under which the work must be performed, and make all necessary allowances for same. No additional cost to the Owner shall be permitted for Contractor’s failure to do so.

B. Examine the site and observe the conditions under which the work will be done or other circumstances which will affect the contemplated work. Special attention shall be given to areas where work is to be done in existing buildings. No allowance will be made subsequently in this connection for any error or negligence on the Contractor's part.

C. The Contractor shall base all measurements, both horizontal and vertical, from established benchmarks. All work shall agree with these established lines and levels. Verify all measurements at the site and check the correctness of same as related to the work.

D. Any discovery of discrepancy between actual measurements and those indicated which prevents following good practice or the intent of the Drawings and Specifications shall be brought to the attention of the Owner's Representative. Work shall not proceed until receiving instructions from the Owner's Representative.

E. The Contractor shall follow Drawings in laying out the work and check Drawings of other trades to verify spaces in which work will be installed. Maintain maximum headroom and space conditions at all points. Where headroom or space conditions appear inadequate, the Owner's Representative shall be notified before proceeding with the installation.

F. To prevent conflict with the work of other trades and for proper execution of the work, the Contractor, as directed by the Owner's Representative, shall make the necessary modifications in the layout as needed, at no extra charge to the Owner.

G. The Contractor shall be solely responsible for the proper arrangement of his conduit and equipment.

H. The Engineer shall make all final decisions as to any conditions that require the changing of any work.

I. The Contractor shall have competent supervision on the site at all times to lay out, check, coordinate, and supervise the installation of all electrical work and be responsible for the accuracy thereof. He shall plan the installation of all electrical work, giving consideration to the work of other trades, to prevent interference.

J. The Contractor shall determine the location, size, etc., of all chases, sleeve openings, etc., required for the proper installation of the electrical work and see that such are provided. All chases, sleeves, openings, etc., shall be set prior to erection of new work to prevent delay in the progress of other work or trades.

K. Conditions and/or situations that prevent the proper installation of any equipment or item where shown on the Drawings shall be called to the attention of the Engineer for instructions.

L. The Contractor shall have equipment shipped or fabricated in sections of suitable size for entering the building and being removed from the finished building in the future, if necessary.

M. The Contractor shall fully investigate all peculiarities and space limitations for all materials and equipment.

N. Outlet, pull, and junction boxes and other appliances that require operation, examination, adjustment, servicing or maintenance shall be readily accessible.

O. The Contractor shall take all field measurements necessary for this work and shall assume responsibility for their accuracy.

P. The Contractor shall coordinate the electrical work with all other sub-contractors. All work shall be so arranged that there will be no delay in the proper installation and completion of any part or parts of electrical equipment. All electrical work shall be installed in proper sequence with other trades without any unnecessary delay.

Q. The Drawings are to some extent diagrammatic and indicate the general arrangement of the equipment, the runs of conduit, and the manner of connection.

R. The Contractor shall confer with all sub-contractors engaged in the construction of the project, regarding the work that may, in any way, affect his installation. Whenever interference occurs, before installing any of the work in question, the Contractor shall consult with all sub-contractors and shall come to an agreement with them as to the exact location and level of his conduit parts of his equipment.

S. The Contractor shall be responsible for determining exact property lines and area of work. The Contractor shall not install any equipment or conduits outside of the property lines and/or area of work without written direction from the Owner. Any work indicated diagrammatically on the Contract Documents to be installed beyond the property lines and/or area of work shall be verified with the Owner prior to installation.

3.2 GENERAL RESPONSIBILITIES

A. The Contractor shall be responsible for systems and related damages possible, and shall hold harmless the Owner, the Architect and his consultants from malfunction of systems and equipment installed under this Contract as defined in the laws of the State of Delaware pertaining to real property for the period of time as defined by such laws.

B. It is the intent of these Specifications to fully cover without exception all required labor and materials so that the finished work will be delivered to the Owner in a complete and satisfactory working installation. Excavation, wiring, distribution, etc., shall be performed in compliance with the Contract Documents.

C. Work not specifically outlined, but reasonably incidental to the completion of the work, shall be included without additional compensation from the Owner.

D. Conflicting points in the Specifications or on the Drawings shall be called to the attention of the Architect prior to the execution of the Contract.

3.3 STORAGE AND PROTECTION OF EQUIPMENT

A. All electrical equipment to be used in the construction shall be properly stored and protected against the elements. All equipment shall be stored under cover, and shall not be stored at the construction site on the ground, in mud, water, snow, rain, sleet or dust. Large diameter cables may be stored on reels with weatherproof materials. Such weatherproof materials shall be heavy-duty, securely fastened and made impervious to the elements.

B. Conventional electrical construction materials such as building wire, outlet and junction boxes, wiring devices, conduit, lighting fixtures, fittings, etc., shall be stored in construction buildings, covered trailers or portable covered warehouses. Any equipment subject to damage or corrosion from excessive moisture shall be stored in dry, heated areas. Any equipment containing plastic or material subject to damage caused by excessive heat or sunlight shall be stored to prevent such damage. This includes plastic ducts and lenses.

C. Switchboard, motor controllers, panelboards, breakers, emergency lighting, and supervisory equipment, if delivered to the construction site before the building is under cover, shall be warehoused and protected as follows: All gear and equipment shall be covered and protected from the elements and other damage and shall be stored in a clean, dry, heated atmosphere, under cover.

D. All gear and equipment delivered to the construction site after the building is under cover shall be protected as described above and in addition shall be provided with auxiliary heat to prevent condensation damage. The gear shall also be protected against damage caused by installation of any building systems and equipment; or damage caused by carelessness of workmen who are installing equipment connected to or adjacent to the above electrical equipment.

E. Equipment damaged as a result of the above conditions shall be properly repaired at the Contractor's expense or shall be replaced at the Contractor's expense, if, in the opinion of the Engineer the equipment has been damaged to such an extent it cannot operate properly after repairs are made.

F. All electrical enclosures exposed to construction damages such as paint spots, spackling or plaster spatter, grout splashes, waterproofing compound, tar spots or runs and pipe covering compound splashes, shall be completely covered and protected against damage.

G. In the event leakage into the building of any foreign material or fluid occurs or may occur, the Contractor shall take all steps as described above to protect any and all equipment.

H. After connections to electrical equipment are complete and the equipment is ready for operation, all construction debris shall be removed from all enclosures. Such debris includes dust, dirt, wire clippings, tape and insulation removed in order to make the connection.

3.4 ELECTRICAL INSTALLATIONS

A. General: Sequence, coordinate, and integrate the various elements of electrical systems, materials, and equipment. Comply with the following requirements:

1. Coordinate electrical systems, equipment, materials, and installation with landscape/irrigation contractor(s).

2. Verify all dimensions by field measurements.

3. Install systems, materials, and equipment to conform with approved submittal data, including coordination drawings, to greatest extent possible. Conform to arrangements indicated by the Contract Documents, recognizing that portions of the Work are shown only in diagrammatic form. Where coordination requirements conflict with individual system requirements, refer conflict to the Engineer.

4. Install systems, materials, and equipment level and plumb, parallel and perpendicular to other building systems and components where installed exposed in finished spaces.

5. Install electrical equipment to facilitate servicing, maintenance, and repair or replacement of equipment components. As much as practical, connect equipment for ease of disconnecting, with minimum of interference with other installations. All equipment and disconnects shall maintain proper working space to conform to NEC.

6. Install systems, materials, and equipment giving right-of-way priority to systems that require installation at a specified slope.

7. Arrange for chases, slots and openings in other building components during progress of construction, to allow for electrical installation.

8. Space, coordinate, and integrate installations of electrical materials and equipment for efficient flow of the work.

3.5 SUPERVISION AND COORDINATION

A. Provide complete supervision, direction, scheduling and coordination of all work under the contract, including that of subcontractors, using full attention and the best skill. Be responsible for all work and make all subcontractors, suppliers and manufacturers fully aware of all requirements of the contract.

B. Coordinate the rough-in of all work performed under Divisions Mechanical and Electrical Divisions.

C. The Contractor shall coordinate all electrical rough-ins with approved shop drawings and coordination drawings. Any rough-in installed without complete coordination shall be at the Contractor's risk and expense.

D. Coordinate the installation of all necessary rough-in of work, sleeves, anchors and supports for conduit, wiring, and other work performed under Mechanical and Electrical Divisions. Coordinate Division 26 work with all trades.

E. Where a discrepancy exists within the Specifications or drawings or between the Specifications and Drawings, the more stringent (or costly) requirement shall apply until a 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.

F. Failure of the 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.

G. To ensure proper electrical coordination between the electrical components supplied under the Electrical Divisions and the equipment supplied under the Mechanical Divisions, a schedule shall be submitted, prior to start of work, for review by the Engineer with the following column headings:

1.Equip. or Item	2. HP or KVA	3.Voltage and Phase	4. Power Factor	5. Capacitor	6.Motor Starter	7.Discon.	8.Controls	9.Remarks

Description of Column Headings:

1. List all the approved equipment furnished under Mechanical Division that requires electrical connections and designate the equipment as it appears in the Mechanical Divisions. Indicate the quantity, if more than one, in parentheses of identical equipment being supplied.

2. Indicate the supplied horsepower of the equipment listed under Column No. 1. If equipment listed has more than one motor, indicate each motor and its respective horsepower. Indicate the kVA rating for all other equipment requiring an electrical connection, unless the electrical connection is for a control circuit only.

3. Indicate the voltage and phase requirements for equipment listed under Column No. 1. If more than one electrical circuit or voltage is required for the listed equipment, it shall be so indicated. Indicate wiring required for connection, including all phase, neutral, and ground conductors.

4. Indicate the power factor rating for all motors listed under Column No. 2.

5. Where a capacitor is to be provided, indicate specification it is supplied under and indicate the KVAR size for any capacitor provided under Division 26.

6. Where a motor starter is required, indicate the specification division it is supplied under and the type of motor starter; across-the-line, reversible, variable speed, two speed-single winding, etc. Indicate in Column No. 9 if the motor starter provided under Division 26 is not compatible with the motor specified.

7. Where a disconnect switch is required by the National Electric Code or by the contract documents for the equipment listed under Column No. 1, indicate under which Division the disconnect switch is supplied.

8. Indicate the Division under which the controls for the equipment listed under Column No. 1 are provided.

9. Indicate any discrepancies between what is indicated in the contract documents and what is actually being provided.

H. The Contractor shall fully coordinate the electrical connections to all equipment prior to installations, with the approved Shop Drawings and the trades involved. Coordination shall include voltage, phases, quantity and size of wiring, device sizes, terminations, rough-in work, and other coordination for a complete installation.

I. Coordinate the spacing and arrangement of lighting fixtures, diffusers, grilles and access panels in ceilings to establish a symmetrical pattern.

J. Coordinate light switch locations with door swings prior to rough-in. No switches permitted behind doors.

K. Coordinate electrical work with architectural items and equipment. Typical equipment refers to, but is not limited to, the following:

1. Countertops, Casework and Cabinets.

2. Fume and Exhaust Hoods.

3. Kitchen equipment.

4. Do not install outlets, switches, etc., behind casework, cabinets, etc.

5. Data, phone, and other low voltage system outlets shall be mounted above the counter tops to match power outlets in the same areas.

6. Coordinate counter top outlets with drilling of casework/counters.

7. Coordinate surface raceways and outlets above and below counters with approved casework shop drawings to avoid conflicts with sinks and other appurtenances.

8. Verify lab/kitchen equipment nameplates and connection requirements prior to rough-in.

9. Shop equipment connections, including busways.

L. This Contractor shall make all system connections required to equipment furnished and installed under other divisions. Connections shall be complete in all respects to render this equipment functional to its fullest intent. The Contractor shall make all system connections required to equipment furnished under other Divisions. Circuits shall be extended to all equipment which is incidental to, but not necessarily shown, for equipment specified under other divisions such as magnetic flow meters, ATC panels, liquid level controls, leak detection systems, etc. Connections shall be complete in all respects to render this equipment functional to its fullest extent.

M. Install work with proper clearances and access. Carefully examine all contract drawings and fit the work in each location without substantial alteration. Where departures are proposed or required, submit detailed drawings for acceptance. The right is reserved to make reasonable changes in location of equipment, conduit and wiring up to the time of rough-in or fabrication.

N. It shall be the responsibility of the Contractor to obtain complete instructions for connections.

3.6 GUARANTEE

A. Guarantee obligations shall be as hereinbefore specified in the GENERAL AND SPECIAL CONDITIONS of these specifications, except as follows:

1. Guarantee the complete electrical system free from all mechanical and electrical defects for the period of two (2) years beginning from the day of final acceptance of the work by the Owner.

2. Also, during the guarantee period, be responsible for the proper adjustments of all systems, equipment and apparatus installed by the Contractor and do all work necessary to ensure efficient and proper functioning of the systems and equipment.

3. Upon receipt of notice from the Owner of failure of any part of the electrical installation during the guarantee period, new replacement parts shall be furnished and installed promptly at no cost.

4. Warranty From the Manufacturer: Contractor shall obtain all warranty papers and records from the Original Equipment Manufacturer according to their warranty policy and deliver the same to the Owner. Contractor shall fulfill all the Original Manufacturer's requirements to validate the warranty as offered by the Original Equipment Manufacturer.

B. Provide 24-hour service for any and all warranty problems experience in the operation of the equipment provided.

C. Any equipment or system in need of warranty work whether during regular hours or on an emergency basis, shall be immediately serviced and repaired. The warranty work and guarantee shall include all parts and labor and shall be furnished at no cost to the Owner.

D. The Contractor shall guarantee to make good any and all defects in his work, exclusive of lamps, which may develop due to defective workmanship or materials, within one year from the date of final acceptance of the work by the Owner.

E. In addition to the warranty and correction of work obligations contained in the General and supplementary Conditions, correct the work of the system as embraced by the Specification, free from Mechanical and Electrical defects for the warranty period.

F. During the warranty period, take responsibility for the proper adjustments of systems, equipment and apparatus installed and perform work necessary to ensure the efficient and proper functioning of the systems and equipment.

G. Certain items of equipment hereinafter specified shall be guaranteed for a longer time than the general warranty period. These guarantees shall be strictly adhered to and the Contractor shall be responsible for service or replacement required in connection with guarantee of these items. These guarantees shall commence on the same date as the final acceptance by the Engineer.

H. Submission of a bid proposal for this Project warrants that the Contractor has reviewed the Contract Documents and has found them free from ambiguities and sufficient for the construction and proper operation of systems installed for this project. If discrepancies are found, have them clarified by Addendum.

I. It is possible that certain areas of the building or certain systems will be accepted at a time different than as specified. The date of acceptance by the Architect for beneficial use of the Owner for these building areas or systems will be adjusted accordingly.

3.7 SCHEDULING OF WORK

A. The Contractor shall not be permitted to do any work in any area of any occupied building during normal hours, except in areas specifically assigned.

B. Coordination of work by the Contractor is essential such that power outages are kept to a minimum in quantity and duration. All required outages shall be approved by the Owner for optimum time scheduling. Written notice of not less than 15 calendar days shall precede all power outages.

3.8 TEMPORARY FACILITIES

A. General: Refer to the Division 1 Sections for general requirements on temporary facilities.

B. Remove all temporary power installations and connections after permanent power is established and/or prior to completion of the project.

3.9 DEMONSTRATION

A. As a part of this contract, the Contractor shall provide for the services of equipment manufacturers or their established representatives to demonstrate to selected maintenance personnel the correct operation, safety and maintenance of all electrical equipment under this contract.

3.10 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 galvanized or stainless steel.

B. Clean surfaces prior to application of coatings, paint, or other finishes.

C. Provide factory-applied finishes where specified. Unless otherwise indicated factory-applied paints shall be baked enamel with proper pre-treatment.

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.

F. Remove all construction marking and writing from exposed equipment, conduit, and building surfaces. Do not paint manufacturer's labels or tags.

G. All exposed conduit, etc., shall be painted, except in electrical rooms, mechanical rooms, storage rooms, and crawl spaces. Colors shall be selected by the Architect and conform to ANSI Standards.

H. Submit color of factory-finished equipment for approval prior to ordering.

3.11 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 conduit and equipment to prevent the entrance of water, dirt, debris, or other foreign matter.

C. Cover or otherwise protect all finishes.

D. Replace damaged materials, devices, finishes and equipment.

3.12 OPERATION OF EQUIPMENT

A. Clean all systems and equipment prior to initial operation for testing, retesting, or other purposes. Set, 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.

C. Do not use electrical systems for temporary services during construction unless authorized in writing by the Owner. Where such authorization is granted, temporary use of equipment shall in no way limit or otherwise affect warranties or guaranty period of the work.

D. Upon completion of work, clean and restore all equipment to new conditions; replace expendable items such as filters.

3.13 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.

3.14 IDENTIFICATIONS, ELECTRICAL DIAGRAMS AND OPERATING INSTRUCTIONS

A. Contractor shall 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 where directed. Contractor shall deliver the tracing or sepia from which the diagrams were reproduced to the Owner.

B. All equipment shall be plainly tagged.

C. All items of equipment, including motor starters, panels, etc., shall be furnished with white letters and numbers on black plastic identification plates or aluminum letters and numbers on black engraved aluminum identification plates. Lettering shall be a minimum of 1/4" high. Identification plates shall be securely affixed to each piece of equipment, starters, panels, etc., by screws or adhesive (Tuff-Bond #TB2 or as approved equal). Pressure sensitive tape backing is prohibited.

D. Provide three (3) copies of operating and maintenance instructions for all principal items of equipment furnished. This material shall be bound as a volume of the "Record and Information Booklet" as hereinafter specified.

E. Provide at least 24 hours of straight time instruction to the operating personnel. This instruction period shall consist of not less than three (3) consecutive 8-hour days. Time of instruction shall be designated by the Owner. Provide two DVD copies of all instructional periods/demonstrations.

3.15 RECORD DRAWINGS AND SPECIFICATIONS

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

B. The Contractor shall provide a record specification including all Addenda and other modifications. Record substantial variations in actual work performed. Identify all substitutions.

3.16 RECORD AND INFORMATION BOOKLET

A. The Contractor shall have prepared three (3) copies of the Record and Information Booklet and deliver these copies of the booklet to the Owner. The booklet shall be as specified herein. The booklet must be approved and will not be accepted as final until so stamped.

B. The booklet shall be bound in a three-ring loose-leaf binder similar to "National" No. 3881 with the following title lettered on the front and on the spine of the binder: "Record and Information Booklet (insert name of the project)". No sheets larger than 8-1/2" x 11" shall be used, except sheets that may be neatly folded to 8-1/2" x 11" and used as a pull-out. An Index will include the section tabs for each subject included. If more than one binder is

required, print covers and spines with Volume numbers. Include in the front of every binder an index to all binders.

1. Internally subdivide the binder contents with permanent page dividers, logically organized as described below; with tab titling clearly printed under reinforced laminated plastic tabs.

2. Contents: Prepare a Table of Contents for each volume, with each product or system description identified, typed on white paper.

3. Part 1: Directory, listing names, addresses, and telephone numbers of Electrical Engineers; Contractor; Electrical Subcontractors; and major Electrical equipment suppliers. Provide sales and service representative names and phone numbers of all equipment.

4. Part 2: Operation and Maintenance Instructions, arranged 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. Complete record of material list. Catalog brochures and product data for all components. Include all submittal comments, and corrected catalog data and shop drawings on each piece of equipment and each system.

   c. Parts list for each component, including recommended spare parts list. Include motor starter overload schedules.

   d. Operating instructions, including sequence of operation.

      1) Description of function, normal operating characteristics and limitations, engineering data and tests, and complete nomenclature and commercial numbers of replacement parts. Provide a description of each system installed.

      2) Manufacturer's printed operating procedures to include start-up, break-in, and routine and normal operating instructions; control, stopping.

   e. Maintenance instructions for equipment and systems. Detailed checkout procedures to insure operation of systems and gear, including recommended cleaning methods and materials and special precautions identifying detrimental agents.

   f. Servicing, diagnostic and troubleshooting instructions and procedures for systems and major equipment.

   g. Recommended preventative maintenance program, including a list of items requiring inspection and servicing. Provide Chart Form indicating time and

type of routine and preventative maintenance of electrical equipment, etc. The chart shall also indicate tag number, model number of equipment, location and service.

1) For replacement items, indicate type, size and quantity of the replaceable items.

2) Provide lubrication schedule, including type, grade, temperature range and frequency.

3) Provide a list of each type of lighting fixture lamp used, lamp fixture used, and source.

4) Include estimated mean time between failures for major parts.

h. Wiring Diagrams, Block Diagrams, and Assembly Drawings.

i. Panelboard Circuit Directory for each panelboard, including Panel Name, Panel Location, Panel Ratings, spare circuit breakers, spaces for additional circuit breakers.

j. List of equipment keys turned over to the Owner.

5. Part 3: Project Documents and Certificates, including the following:

a. Shop Drawings and Product Data. Record Documents of the systems.

b. Photocopies of certificates.

c. Photocopies of Manufacturers' and Contractors' warranties, guarantees.

d. Test Reports: Copies of the approved results of all tests required under all sections of specifications.

e. Inspection Certificates.

f. Manufacturer's Conformance Certificates.

6. Provide one copy (DVD video disk) of video instruction session with each booklet set. Label video disk with all pertinent information.

7. Submit one copy of completed volumes in final form 15 days prior to final Inspection. This copy will be returned with Engineer comments. Revise content of documents as required prior to final submittal.

8. Submit final volumes revised, within ten days after final inspection.

C. Upon completion of the project, the Contractor shall furnish the Owner a complete list of suppliers of equipment for parts and maintenance purposes. The list shall include the name, address, and telephone number of the parts and maintenance firm on a single 8-1/2" x 11" sheet of paper.

D. This item shall include the furnishing of a complete list of equipment installed on the project, including the Manufacturer's name, the make and model number of the equipment, and address and telephone number of the nearest supplier who stocks maintenance and/or replacement parts. The list should be submitted along with as-built drawings and be typed in an organized manner.

3.17 INSTALLATION AND COORDINATION DRAWINGS

A. In congested areas, 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: Complete Electrical Drawings showing coordination with lights, electrical equipment, mechanical, plumbing, HVAC, structural, and architectural elements and provision for access.

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 conduit in areas involved. Fully dimension all work including lighting fixtures, conduits, pullboxes, panelboards, and other electrical work, walls, doors, ceilings, columns, beams, joists, mechanical equipment, 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.

3.18 CUTTING AND PATCHING

A. The cutting of walls, floors, partitions, etc., for the passage and/or accommodation of conduits, etc., the closing of superfluous openings and the removal of all debris caused by said work under this contract shall be performed by and at the expense of the Contractor.

B. No cutting of any structure or finishes shall be done until the condition requiring such cutting has been examined and approved by the Architect.

C. All surfaces disturbed as a result of such cutting shall be restored under this division to match original work and all materials used for any patching, mending or finishing must conform to the class of materials originally installed.

D. Openings through precast planks for the passage of hanger rods, conduits, outlet boxes, etc., shall be drilled with power driven carbine tip drills. This drilling shall be done by the trades needing the openings and shall be in accordance with Architect's instructions. <u>No reinforcing bars shall be cut without specific approval of the Structural Engineer.</u>

3.19 WATERPROOFING

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 sleeves, flashings, fittings, and caulking to make penetrations absolutely watertight.

B. Where conduits or other openings penetrate roofs, flash pipe with Stoneman "Stormtite", or approved equal, roof flashing assemblies, with 4-pound lead, 6 inch skirt, and caulked counterflashing sleeve similar to No. 1000-4.

C. Furnish and install pitch pockets where required.

D. Furnish and install conduit sleeves specifically designed for application to the particular roof construction, and install in accordance with the manufacturer's instructions, the National Roofing Contractors' Association, and as required by other divisions of this specification. The Contractor shall be responsible for sleeve sizes and locations.

3.20 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 in Division 07 Section "Joint Sealants".

J. Fire-Rated-Assembly Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at raceway and cable penetrations. Install sleeves and seal raceway and cable penetration sleeves with firestop materials. Comply with requirements in Division 07 Section "Through-Penetration Firestop Systems."

K. Roof-Penetration Sleeves: Seal penetration of individual raceways and cables with flexible boot-type flashing units applied in coordination with roofing work.

L. Aboveground, Exterior-Wall Penetrations: Seal penetrations using steel or cast-iron 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. Underground, Exterior-Wall Penetrations: Install cast-iron pipe sleeves. Size sleeves to allow for 1-inch (25-mm) annular clear space between raceway or cable and sleeve for installing mechanical sleeve seals.

3.21 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.

3.22 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."

END OF SECTION

DIVISION 26 SECTION 260502

ELECTRICAL DEMOLITION FOR REMODELING

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SECTION 260502 - 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. Electrical demolition shall be carried out per the Contract Documents.

B. Provide all cutting and patching for electrical construction.

C. 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. The Contractor shall examine the site, determine all conditions and circumstances and gather all data and information required for the work. Field investigations include, but are not limited to, performing surveys, opening of equipment enclosures, and other work as required to maintain existing systems.

B. The Contractor shall survey all new and existing wiring, circuitry, cabling, equipment and devices. Data gathering shall include, but not be limited to, equipment nameplate information, ratings, voltage, wiring configurations, conductor lengths, conductor routing, conductor sizes, equipment connections, and other information as required to maintain existing systems.

C. The Contractor shall provide complete field investigations to determine existing and new conductor, cable, and conduit routing, points of connections, and tracing of existing systems.

D. Verify that field measurements and circuiting arrangements are as shown on the Drawings.

E. Verify that abandoned wiring and equipment serve only abandoned facilities.

F. Demolition Drawings are based on casual field observation. Report discrepancies to the Owner, Engineer before disturbing existing installation.

G. Beginning of demolition means installer accepts existing conditions.

3.2 PREPARATION

A. Disconnect electrical systems in walls, floors, and ceilings scheduled for removal.

B. Coordinate utility service outages with the Owner, Architect, and Engineer. Also, coordinate utility service outages 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. Contractor shall be responsible for removing and replacing existing ceiling tile within the lay-in ceiling areas as required. Contractor shall 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: 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. 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 inner duct, 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 Contractor 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.

F. Where an existing system is indicated to be removed, the Contractor shall provide complete removal of entire system including all wiring, conduit, and connected/associated fixtures and devices. The system shall be removed in its entirety unless otherwise noted.

3.6 EXISTING CONDUIT WORK

A. Remove all abandoned raceway, including abandoned raceway above accessible ceiling finishes. Cut raceway flush with walls and floors, and patch surfaces. Remove conduit back to point of penetration/exposure.

B. Remove concealed abandoned raceway to its source.

C. Abandoned Work: buried 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 outlets and remove devices. Remove abandoned outlets if raceway servicing them is abandoned and removed. Provide blank cover for abandoned outlets that 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 that remain or are to be reinstalled.

H. Remove all abandoned wiring from exiting conduits and ductbanks. Abandoned wiring that cannot be removed shall be tagged at each end as "Abandoned".

I. Contractor shall provide all cutting and patching required to connect to and extend existing conduits, wiring, circuits, etc.

3.7 EXISTING WIRING AND CABLING WORK

A. Remove all abandoned and unused wire and cable, including abandoned wire and cable above accessible ceiling finishes. Patch surfaces where removed cables pass through building finishes. Remove abandoned and unused cabling and wiring back to the source.

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 that 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 that remain or is to be reinstalled.

F. Provide supports for all wiring and cabling to remain as required by NEC.

G. Contractor shall provide field services for racing out of all existing circuits to be maintained. Contractor shall locate, trace and label, all existing circuits being re-used.

3.8 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.

3.9 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. Trace existing circuits to determine exact location and type of load served by each circuit breaker.

D. Provide new labels on all existing electrical equipment being re-used.

3.10 INSTALLATION

A. Install relocated materials and equipment under the provisions of other sections.

END OF SECTION

DIVISION 26 SECTION 260519
LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES
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END OF SECTION 6

SECTION 260519 - LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1. GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes 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.

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 include, but are not limited to, the following:

1. Alcan Products Corporation; Alcan Cable Division.

2. American Insulated Wire Corp.; a Leviton Company.

3. General Cable Corporation.

4. Senator Wire & Cable Company.

5. Southwire Company.

B. Copper Conductors: Comply with NEMA WC 70.

C. Conductor Insulation: Comply with NEMA WC 70 for Types THHN-THWN, XHHW, USE, and SO.

D. Multiconductor Cable: Comply with NEMA WC 70/ICEA S-95-658 for metal-clad cable, Type MC, with ground wire.

2.2 CONNECTORS AND SPLICES

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. Hubbell Power Systems, Inc.

3. O-Z/Gedney; EGS Electrical Group LLC.

4. 3M; Electrical Products Division.

5. Tyco Electronics Corp.

B. 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.

C. Split Bolt Connectors: Not Acceptable.

D. Solderless Pressure Connectors: High copper alloy terminal. May be used only for cable termination to equipment pads or terminals. Not approved for splicing.

E. 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.

F. 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.

G. Mechanical Connectors: Bolted type tin-plated; high conductivity copper alloy; spacer between conductors; beveled cable entrances.

H. 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.

I. 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.

J. 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.

2.3 SYSTEM DESCRIPTION

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Comply with NFPA 70.

PART 3. EXECUTION

3.1 CONDUCTOR MATERIAL APPLICATIONS

A. Feeders: Copper. Solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.

B. Branch Circuits: Copper. 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. Service Entrance: Type THHN-THWN, single conductors in raceway.

B. Feeders Concealed in Ceilings, Walls, Partitions, and Crawlspaces: Type THHN-THWN, single conductors in raceway.

C. Feeders Concealed in Concrete, below Slabs-on-Grade, and Underground: Type RHW, single conductors in raceway.

D. Exposed Branch Circuits, Including in Crawlspaces: Type THHN-THWN, single conductors in raceway.

E. Branch Circuits Concealed in Ceilings, Walls, and Partitions: Type THHN-THWH, single conductors in raceway, except the last 10' from a junction box to recessed lighting fixture may be type MC cable.

F. Branch Circuits Concealed in Concrete, below Slabs-on-Grade, and Underground: Type THHN-THWN, single conductors in raceway.

G. 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. Complete raceway installation between conductor and cable termination points according to Division 26 "Raceways and Boxes for Electrical Systems" prior to pulling conductors and cables.

C. 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.

D. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips, that will not damage cables or raceway.

E. Install exposed cables parallel and perpendicular to surfaces of exposed structural members, and follow surface contours where possible.

F. Support cables according to Section 260429, "Hangers and Supports for Electrical Systems."

G. Identify and color-code conductors and cables according to Section 260553, "Identification for Electrical Systems."

3.4 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 12 inches (300 mm) of slack.

D. 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.

E. 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.

F. 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.

3.5 SLEEVE INSTALLATION FOR ELECTRICAL PENETRATIONS

A. Coordinate sleeve selection and application with selection and application of firestopping specified in Division 26 Section "Electrical Firestopping." and “Basic Electrical Materials and Methods”.

3.6 SLEEVE-SEAL INSTALLATION

A. 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 "Through Penetration Firestop System."

3.8 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections and prepare test reports.

B. Perform tests and inspections and prepare test reports.

C. Tests and Inspections:

1. After installing conductors and cables and before electrical circuitry has been energized, test service entrance and feeder conductors, and conductors feeding the mechanical equipment and services for compliance with requirements.

2. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.

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.

G. Test Reports: Prepare a written report to record the following:

1. Test procedures used.

2. Test results that comply with requirements.

3. Test results that do not comply with requirements and corrective action taken to achieve compliance with requirements.

H. Remove and replace malfunctioning units and retest as specified above.

END OF SECTION

DIVISION 26 SECTION 260526
GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS
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SECTION 260526 - GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1. GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes grounding and bonding systems and equipment.

B. Section includes grounding and bonding systems and equipment, plus the following special applications:

1. Underground distribution grounding.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

1.4 INFORMATIONAL SUBMITTALS

A. As-Built Data: Plans showing dimensioned as-built locations of grounding features specified in "Field Quality Control" Article, including the following:

1. Test wells.

2. Ground rods.

3. Ground rings.

4. Grounding arrangements and connections for separately derived systems.

B. Qualification Data: For testing agency and testing agency's field supervisor.

C. Field quality-control reports.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For grounding to include in emergency, operation, and maintenance manuals.

1. In addition to items specified in Division 01 Section "Operating, Maintenance, Project Data," include the following:

a. Instructions for periodic testing and inspection of grounding features at test wells, ground rings, grounding connections for separately derived systems based on NETA MTS.

1) Tests shall determine if ground-resistance or impedance values remain within specified maximums, and instructions shall recommend corrective action if values do not.

2) Include recommended testing intervals.

1.6 QUALITY ASSURANCE

A. Testing Agency Qualifications: Member company of NETA or an NRTL.

1. Testing Agency's Field Supervisor: Certified by NETA to supervise on-site testing.

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 UL 467 for grounding and bonding materials and equipment.

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. Burndy; Part of Hubbell Electrical Systems.

2. Dossert; AFL Telecommunications LLC.

3. ERICO International Corporation.

4. Fushi Copperweld Inc.

5. Galvan Industries, Inc.; Electrical Products Division, LLC.

6. Harger Lightning and Grounding.

7. ILSCO.

8. O-Z/Gedney; A Brand of the EGS Electrical Group.

9. Robbins Lightning, Inc.

2.2 SYSTEM DESCRIPTION

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Comply with UL 467 for grounding and bonding materials and equipment.

2.3 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.

C. Grounding Bus: Predrilled rectangular bars of annealed copper, 1/4 by 4 inches (6.3 by 100 mm)] in cross section, unless otherwise indicated, with 9/32-inch (7.14-mm) holes spaced 1-1/8 inches (28 mm) apart. Stand-off insulators for mounting shall comply with UL 891 for use in switchboards, 600 V and shall be Lexan or PVC, impulse tested at 5000 V.

2.4 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. Bolted Connectors for Conductors and Pipes: Copper or copper alloy.

C. Welded Connectors: Exothermic-welding kits of types recommended by kit manufacturer for materials being joined and installation conditions.

D. Bus-Bar Connectors: Mechanical type, cast silicon bronze, solderless exothermic-type wire terminals, and long-barrel, two-bolt connection to ground bus bar.

2.5 GROUNDING ELECTRODES

A. Ground Rods: Copper-clad steel,3/4 inch by 10 feet (19 mm by 3 m).

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. 4/0 AWG minimum.

1. Bury at least 24 inches (600 mm) below grade.

C. Grounding Bus: Install in electrical equipment rooms, in rooms housing service equipment, and elsewhere as indicated.

1. Install bus horizontally, on insulated spacers 2 inches (50 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 GROUNDING SEPARATELY DERIVED SYSTEMS

A. Generator: Install grounding electrode(s) at the generator location. The electrode shall be connected to the equipment grounding conductor and to the frame of the generator.

3.4 GROUNDING UNDERGROUND DISTRIBUTION SYSTEM COMPONENTS

A. Comply with IEEE C2 grounding requirements.

B. Pad-Mounted Transformers and Switches: Install four ground rods and ground ring around the pad. Ground pad-mounted equipment and noncurrent-carrying metal items associated with substations by connecting them to underground cable and grounding electrodes. Install tinned-copper conductor not less than No. 4/0 AWG for ground ring and for taps to equipment grounding terminals. Bury ground ring not less than 6 inches (150 mm) from the foundation.

C. Grounding Manholes and Handholes: Install a driven ground rod through manhole or handhole floor, close to wall, and set rod depth so 4 inches (100 mm) will extend above finished floor. If necessary, install ground rod before manhole is placed and provide No. 1/0 AWG bare, tinned-copper conductor from ground rod into manhole through a waterproof sleeve in manhole wall. Protect ground rods passing through concrete floor with a double wrapping of pressure-sensitive insulating tape or heat-shrunk insulating sleeve from 2 inches (50 mm) above to 6 inches (150 mm) below concrete. Seal floor opening with waterproof, nonshrink grout.

3.5 EQUIPMENT GROUNDING

A. Install insulated equipment grounding conductors with all feeders and branch circuits.

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.

3.6 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.

B. Ground Rods: Drive rods until tops are 2 inches (50 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. For grounding electrode system not detailed on the drawings, install at least three rods spaced at least one-rod length from each other and located at least the same distance from other grounding electrodes, and connect to the service grounding electrode conductor.

C. 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.

3. Use exothermic-welded connectors for outdoor locations; if a disconnect-type connection is required, use a bolted clamp.

D. 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; use a bolted clamp connector or bolt a lug-type connector to a pipe flange by 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.

E. Grounding for Steel Building Structure: Install a driven ground rod at base of each corner column and at intermediate exterior columns at distances not more than 60 feet (18 m) apart.

F. Concrete-Encased Grounding Electrode (Ufer Ground): Fabricate according to NFPA 70; use a minimum of 20 feet (6 m) of bare copper conductor not smaller than No. 4 AWG.

1. If concrete foundation is less than 20 feet (6 m) long, coil excess conductor within base of foundation.

2. Bond grounding conductor to reinforcing steel in at least four locations and to anchor bolts. Extend grounding conductor below grade and connect to building's grounding grid or to grounding electrode external to concrete.

3.7 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Perform tests and inspections.

C. 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 no fewer 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.

D. Grounding system will be considered defective if it does not pass tests and inspections.

E. Prepare test and inspection reports.

F. Report measured ground resistances that exceed the following values:

1. Power and Lighting Equipment or System with Capacity of 500 kVA and Less: 10 ohms.

2. Power and Lighting Equipment or System with Capacity of 500 to 1000 kVA: 5 ohms.

3. Substations and Pad-Mounted Equipment: 5 ohms.

4. Manhole Grounds: 10 ohms.

G. 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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ELECTRICAL FIRESTOPPING
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SECTION 260528 - ELECTRICAL FIRESTOPPING

PART 1. GENERAL

1.1 SUMMARY

A. Section includes:

1. Through-penetration firestopping in fire rated construction.

2. Through-penetration smoke-stopping in smoke partitions.

B. Related items: Raceway seals and manufactured electrical devices: Refer to Section 26 0501.

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: 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, connections with other surfaces or types of construction, at separations required to permit building movement and sound or vibration absorption.

2. Smoke barrier construction: Maintain barrier and structural floor resistance to cold smoke at all penetrations, connections with other surfaces and types of construction and at all separations required to permit building movement and sound or vibration absorption.

1.5 SUBMITTALS

A. Submit in accordance with Section 26 0501, unless otherwise indicated.

B. Product data: Manufacturer's specifications and technical data including the following:

1. Detailed specification of construction and fabrication.

2. Manufacturer’s installation instructions.

C. Shop drawings: Indicate dimensions, description of materials and finishes, general construction, specific modifications, component connections, anchorage methods, hardware, and installation procedures, plus the following specific requirements.

1. Details of each proposed assembly identifying intended products and applicable UL system number, or UL classified devices.

2. Manufacturer or manufacturer's representative shall provide qualified engineering judgment and drawings relating to non-standard applications as needed.

D. Quality control submittals: Statement of qualifications.

E. Applicators' qualifications statement: List past projects indicating required experience.

1.6 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.

D. Manufacturer shall be a member of the International Firestop Council (IFC).

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 conditions:

1. Verify existing conditions and substrates before starting work. Correct unsatisfactory conditions before proceeding.

2. Proceed with installation only after penetrations of the substrate and supporting brackets have been installed.

B. Environmental requirements:

1. Furnish adequate ventilation if using solvent.

2. Furnish forced air ventilation during installation if required by manufacturer.

3. Keep flammable materials away from sparks or flame.

4. Provide masking and drop cloths to prevent contamination of adjacent surfaces by firestopping materials.

1.9 GUARANTEE

A. Submit copies of written guarantee agreeing to repair or replace joint sealers which fall in joint adhesion, extrusion resistance, migration resistance, or general durability or appear to deteriorate in any other manner not clearly specified by submitted manufacturer's data as an

inherent quality of the material for the exposure indicated. The guarantee period shall be two year from date of substantial completion unless otherwise noted.

PART 2. PRODUCT

2.1 MANUFACTURERS

A. Subject to compliance with requirements, manufacturers offering products that may be incorporated into the work include, but are not limited to, the following:

1. Hilti.

2. Nelson.

2.2 THROUGH-PENETRATION FIRESTOPPING OF FIRE-RATED CONSTRUCTION

A. Systems of devices listed in the UL Fire Resistance Directory under categories XHCR and XHEZ may be used, providing that it conforms to the construction type, 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.

b. All firestopping products must be from a single manufacturer. All trades shall use products from the same manufacturer unless otherwise noted.

2.3 SMOKE-STOPPING AT SMOKE PARTITIONS

A. Through-penetration smoke-stopping: Any system complying with the requirements for through-penetration firestopping in fire-rated construction, as specified in The Systems and Applications Schedule in Part 3.6 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.

2.4 ACCESSORIES

A. Fill, void or cavity materials: As classified under category XHHW in the UL Fire Resistance Directory.

B. Forming materials: As classified under category XHKU in the UL Fire Resistance Directory

C. Sleeves: Minimum 24 MSG galvanized steel, 12" diameter or smaller steel pipe. Sleeve shall project 1/2" from each surface of the floor/wall. Size as recommended by firestop manufacturer.

PART 3. EXECUTION

3.1 EXAMINATION

A. Verification of conditions: Examine areas and conditions under which work is to be performed and identify conditions detrimental to proper or timely completion.

1. Verify barrier penetrations are properly sized and in suitable condition for application of materials.

2. Do not proceed until unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Clean surfaces to be in contact with penetration seal materials of dirt, grease, oil, loose materials, rust, or other substances that may affect proper fitting, adhesion, or the required fire resistance.

3.3 INSTALLATION

A. Install penetration seal materials in accordance with printed instructions of the UL Fire Resistance Directory and in accordance with manufacturer's instruction.

B. Seal holes or voids made by penetrations to ensure an effective smoke barrier.

C. Protect materials from damage on surfaces subject to traffic.

D. When large openings are created in walls or floors to permit installation of conduits, cable tray, or other items, close unused portions of opening with firestopping materials tested for the application. See UL Fire Resistance Directory or Paragraph 2.2 of this document.

E. Install smoke stopping as specified for firestopping.

F. Provide sleeves the full thickness of the assembly being penetrated and cut sleeves to a length of 1"more than the over-all thickness of the penetration, or as recommended by the firestop manufacturer.

G. All holes and voids shall be sealed the same day they are made.

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*

SEE NEXT PAGE.

PENETRATING ITEM	CONCRETE	GYPSUM	WOOD FLOOR/ CEILING
Metal Pipe	CAJ1001 CP25S/L, CP25N/S CAJ1006 CS-195+, FS-195+ CAJ1007 FS-195+, 1"& 2" Wide CAJ1009 2000, 2000+, 2003 CAJ1010 2000, 2000+, 2003 CAJ1012 2000, 2000+, 2003 CAJ1013 2000, 2000+, 2003 CAJ1014 2000, 2000+, 2003 CAJ1015 2000, 2000+, 2003 CAJ1017 FD 150 CAJ1021 FD 150 CAJ1027 MPS-2+ CAJ1044 CP 25WB+ CAJ1052 CP 25S/L, CP 25N/S CAJ1058 2000, 2000+, 2003 CAJ1060 2000, 2000+, 2003 CAJ1063 2000, 2000+, 2003 CAJ1066 CP 25N/S,CP 25S/L, CP 25WB+ CAJ1091 CP 25N/S,CP 25S/L, CP 25WB+ CAJ1092 CP 25WB+ CAJ1112 FS-195+ CAJ1160 CP 25S/L, CP 25N/S CAJ1175 CP 25WB+ CAJ1176 CP 25WB+ CAJ1188 2000+ CBJ1020 CS-195+, FS-195+ CBJ1021 CS-195+, MPS-2+ CBJ1031 2001 CBJ1032 2001 FA1002 CP 25WB+ WJ1010 CP 25WB+ WJ1023 2001	WL1001 CP 25 WL1002 FS-195+ WL1003 CP 25WB+,CP 25N/S WL1008 2000+ WL1009 2000+ WL1010 2000+ WL1016 CP 25WB+ WL1017 CP 25WB+,CP 25N/S WL1032 CP 25WB+,CP 25N/S WL1036 FD 150 WL1037 CS-195+,FS-195+ WL1067 CP 25N/S WL1073 CP 25WB+ WL1080 MPS-2+ WL1082 2000+	FC1002 CP 25 FC1003 2000,2000+,20003 FC1006 CP 25WB+
Non-	CAJ2001 FS-195+, 1"& 2"	WL2002 FS-195+, PPD'S	FC2002 FS-195+,

PENETRATING ITEM	CONCRETE	GYPSUM	WOOD FLOOR/ CEILING
Metallic	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" WIDE	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" WIDE	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" WIDE, PPD'S
Insulated Cable	CAJ3001 CP 25N/S, CP 25S/L CAJ3005 CS 195+, FS-195+ CAJ3007 2001 CAJ3009 2000, 2000+, 2003 CAJ3010 2000, 2000+, 2003 CAJ3011 2001 CAJ3014 FD 150 CAJ3015 FD 150 CAJ3021 MPS-2+ CAJ3029 2000, 2000+, 2003 CAJ3030 CP 25WB+ CAJ3031 CP 25N/S, CP 25S/L CAJ3041 2000, 2000+, 2003 CAJ3044 CS-195+, FS-195+ CAJ3058 FS-195+, MPS-2+ CAJ3071 CP 25N/S, CP 25S/L	WL3001 CP 25, MPS-2+ WL3008 2000+ WL3009 2000+ WL3015 CP 25WB+, CP 25N/S WL3022 2000+ WL3030 FS-195+ WL3031 MPS-2+ WL3032 CP 25WB+ WL3041 2000+ WL3051 CP 25N/S WL3056 CP25N/S WL3062 CP 25WB+	FC3001 CP 25S/L, CP 25N/S FC3002 2000+ FC3003 2000, 2000+, 20003 FC3007 CP 25WB+, MPS-2+ FC3008 FS-195+

PENETRATING ITEM	CONCRETE	GYPSUM	WOOD FLOOR/ CEILING
	CAJ3074 CP 25N/S, CP 25S/L CAJ3075 2001 CAJ3080 CP 25WB+ CBJ3016 CS-195+, FS-195+ CBJ3017 CS-195+, MPS-2+ FA3001 CP 25WB+ FB3004 CS-195+, MP WJ3015 2001 WJ3016 2001		
Mixed Penetrating Items Combos	CAJ8001 CS-195+ FS-195+ CAJ8003 2000, 2000+, 20003 CAJ8004 2000, 2000+, 20003 CAJ8006 2001 CAJ8013 FS-195+, CP 25 CBJ8004 CS-195, FS-195+ CBJ8005 CS-195+, MPS-2+ CBJ8008 2001 FA8001 FS-195+, CP 25WB+	WL8002 CS-195+, FS-195+	

* Underwriter's Laboratories, Inc., Fire Resistance Directory.

END OF SECTION

DIVISION 26 SECTION 260529
HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS
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SECTION 260529 - HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1. GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the following:

1. Hangers and supports for electrical equipment and systems.

2. Construction requirements for 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.

1.6 QUALITY ASSURANCE

A. Comply with NFPA 70.

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" and Division 23.

PART 2. PRODUCTS

2.1 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 products by one of the following:

a. Allied Tube & Conduit.

b. Cooper B-Line, Inc.; a division of Cooper Industries.

c. ERICO International Corporation.

d. GS Metals Corp.

e. Thomas & Betts Corporation.

f. Unistrut; Tyco International, Ltd.

g. Wesanco, Inc.

2. Metallic Coatings: Hot-dip galvanized after fabrication and applied according to MFMA-4.

3. Painted Coatings: Manufacturer's standard painted coating applied according to MFMA-4.

4. 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.

2.2 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 and NECA 101 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 required by 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 Section 033000 "Cast-in-Place Concrete."

C. Anchor equipment to concrete base as follows:

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.

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 260533
RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS
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END OF SECTION 9

SECTIN 260533 - RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS

PART 1. GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes raceways, fittings, boxes, enclosures, and cabinets for electrical wiring.

B. Related Requirements: Section 16 "Underground Ducts and Raceways for Electrical Systems" 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, but are not limited to, the following:

1. AFC Cable Systems, Inc.

2. Allied Tube & Conduit; a Tyco International Ltd. Co.

3. Electri-Flex Co.

B. Rigid Steel Conduit: ANSI C80.1.

C. IMC: ANSI C80.6.

D. PVC-Coated Steel Conduit: PVC-coated rigid steel conduit

1. Comply with NEMA RN 1.

2. Coating Thickness: 0.040 inch (1 mm), minimum.

E. EMT: ANSI C80.3.

F. FMC: Zinc-coated steel.

G. LFMC: Flexible steel conduit with PVC jacket.

H. 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 or die-cast or compression type.

3. Expansion Fittings: PVC or steel to match conduit type, complying with UL 651, rated for environmental conditions where installed, and including flexible external bonding jumper.

I. 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. Electri-Flex Co.

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 METAL WIREWAYS AND AUXILIARY GUTTERS

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. Hoffman.

3. Mono-Systems, Inc.

4. Square D.

B. Description: Sheet metal, complying with UL 870 and NEMA 250, Type 1 unless otherwise indicated, and sized according to NFPA 70.

1. Metal wireways installed outdoors shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

C. 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.

D. Wireway Covers: Hinged type unless otherwise indicated.

E. Finish: Manufacturer's standard enamel finish.

2.4 SURFACE RACEWAYS

A. Listing and Labeling: Surface raceways shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Surface Metal Raceways: Galvanized steel, dual compartment type with snap-on covers complying with UL 5. Manufacturer's standard enamel finish in color selected by Architect. Provide devices in multi-outlet assembly as indicated on the drawings. Provide all components, fittings, etc. required for a complete installation.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Wiremold / Legrand

b. Mono-Systems, Inc.

c. Panduit Corp.

d. Hubbell.

2.5 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. Erickson Electrical Equipment Company.

3. Hoffman.

4. O-Z/Gedney; a unit of General Signal.

5. Spring City Electrical Manufacturing Company.

6. Thomas & Betts Corporation.

7. Walker Systems, Inc.; Wiremold Company (The).

B. Sheet Metal Outlet and Device Boxes: NEMA OS 1.

C. Cast-Metal Outlet and Device Boxes: NEMA FB 1, aluminum, Type FD, with gasketed cover.

D. Nonmetallic Outlet and Device Boxes: NEMA OS 2.

E. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.

F. Cast-Metal Access, Pull, and Junction Boxes: NEMA FB 1, cast aluminum with gasketed cover.

G. Box extensions used to accommodate new building finishes shall be of same material as recessed box.

H. Device Box Dimensions: 4 inches square by 2-1/8 inches deep (100 mm square by 60 mm deep.

I. Gangable boxes are allowed.

J. 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.

2. Interior Panels: Steel; all sides finished with manufacturer's standard enamel.

K. 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.

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.

2. Exposed, Not Subject to Severe Physical Damage: EMT.

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.

c. Mechanical rooms to 8’ AFF.

4. Concealed in Ceilings and Interior Walls and Partitions: EMT.

5. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): LFMC.

6. Damp or Wet Locations: Rigid steel conduit.

7. Boxes and Enclosures: NEMA 250, Type 1, except use NEMA 250, Type 4X, 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. EMT: Use compression, steel fittings. Comply with NEMA FB 2.10.

3. Flexible Conduit: Use only fittings listed for use with flexible conduit. Comply with NEMA FB 2.20.

E. Install surface raceways only in finished spaces where concealment of conduit in existing walls is not feasible.

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 accessible ceilings space unless otherwise indicated. Install conduits parallel or perpendicular to building lines.

H. Support conduit within 12 inches (300 mm) of enclosures to which attached.

I. Stub-ups to Above Recessed Ceilings:

1. Use EMT, or RMC for raceways.

2. Use a conduit bushing or insulated fitting to terminate stub-ups not terminated in hubs or in an enclosure.

J. 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.

K. Raceway Terminations at Locations Subject to Moisture or Vibration: Use insulating bushings to protect conductors, including conductors smaller than No. 4 AWG.

L. Install raceways square to the enclosure and terminate at enclosures with locknuts. Install locknuts hand tight plus 1/4 turn more.

M. Do not rely on locknuts to penetrate nonconductive coatings on enclosures. Remove coatings in the locknut area prior to assembling conduit to enclosure to assure a continuous ground path.

N. Cut conduit perpendicular to the length. For conduits 2-inch (53-mm) trade size and larger, use roll cutter or a guide to make cut straight and perpendicular to the length.

O. 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. Cap underground raceways designated as spare above grade alongside raceways in use.

P. Surface Raceways:

1. Install surface raceway with a minimum 2-inch (50-mm) radius control at bend points.

2. Secure surface raceway with screws or other anchor-type devices at intervals not exceeding 48 inches (1200 mm) and with no less than two supports per straight raceway section. Support surface raceway according to manufacturer's written instructions. Tape and glue are not acceptable support methods.

3. Two-hole straps are required.

Q. 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 otherwise required by NFPA 70.

R. Expansion-Joint Fittings for RNC: Install in each run of aboveground conduit that is located where environmental temperature change may exceed 30 deg F (17 deg C), and that has straight-run length that exceeds 25 feet (7.6 m).

1. Install expansion-joint fittings for each of the following locations, and provide type and quantity of fittings that accommodate temperature change listed for location:

a. Outdoor Locations Not Exposed to Direct Sunlight: 125 deg F (70 deg C) temperature change.

b. Outdoor Locations Exposed to Direct Sunlight: 155 deg F (86 deg C) temperature change.

c. Indoor Spaces: Connected with the Outdoors without Physical Separation: 125 deg F (70 deg C) temperature change.

d. Attics: 135 deg F (75 deg C) temperature change.

2. Install fitting(s) that provide expansion and contraction for at least 0.00041 inch per foot of length of straight run per deg F (0.06 mm per meter of length of straight run per deg C) of temperature change.

3. Install each expansion-joint fitting with position, mounting, and piston setting selected according to manufacturer's written instructions for conditions at specific location at the time of installation.

3.3 SLEEVE AND SLEEVE-SEAL INSTALLATION FOR ELECTRICAL PENETRATIONS

A. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies. Comply with requirements in Division 26 Section "Basic Electrical Materials and Methods."

3.4 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 26 Section "Electrical Firestopping."

3.5 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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IDENTIFICATION FOR ELECTRICAL SYSTEMS
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SECTION 260553 - IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1. GENERAL

1.1 RELATED DOCUMENTS

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

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.

E. Adhesive-attached labeling materials, including label stocks, laminating adhesives, and inks used by label printers, shall comply with UL 969.

PART 2. PRODUCTS

2.1 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.

2.2 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.

2.3 POWER AND CONTROL 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 cable size.

B. Snap-Around Labels: Slit, pretensioned, flexible, preprinted, color-coded acrylic sleeve, with diameter sized to suit diameter of cable it identifies and to stay in place by gripping action.

2.4 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.

2.5 UNDERGROUND-LINE WARNING TAPE

A. 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.

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.

C. Tag:

1. Multilayer laminate consisting of high-density polyethylene scrim coated with pigmented polyolefin, bright-colored, continuous-printed on one side with the inscription of the utility, compounded for direct-burial service.

2. Thickness: 12 mils (0.3 mm).

3. Weight: 36.1 lb/1000 sq. ft. (17.6 kg/100 sq. m).

4. 3-Inch (75-mm) Tensile According to ASTM D 882: 400 lbf (1780 N), and 11,500 psi (79.2 MPa).

2.6 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)."

2.7 EQUIPMENT IDENTIFICATION LABELS

A. Engraved, Laminated Acrylic or Melamine Label: Punched or drilled for screw mounting. White letters on a dark-gray background. 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.

2.8 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.

2.9 MISCELLANEOUS IDENTIFICATION PRODUCTS

A. Paint: Comply with requirements in 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.

C. Apply identification devices to surfaces that require finish after completing finish work.

D. Self-Adhesive Identification Products: Clean surfaces before application, using materials and methods recommended by manufacturer of identification device.

E. Attach signs and plastic labels that are not self-adhesive type with mechanical fasteners appropriate to the location and substrate.

F. 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.

G. Cable Ties: For attaching tags. Use general-purpose type, except as listed below:

1. Outdoors: UV-stabilized nylon.

2. In Spaces Handling Environmental Air: Plenum rated.

H. Underground-Line Warning Tape: During backfilling of trenches install continuous underground-line warning tape directly above line at 6 to 8 inches (150 to 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.

I. Painted Identification: Comply with requirements in painting Sections for surface preparation and paint application.

3.2 IDENTIFICATION SCHEDULE

A. Accessible Raceways and Metal-Clad Cables, 600 V or Less, for Service, Feeder, and Branch Circuits More Than 50A, and 120 V to ground: 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. Emergency Power - 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. Telecommunications 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.

c. Colors for 480/277-V Circuits:

1) Phase A: Brown.

2) Phase B: Orange.

3) Phase C: Yellow.

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. Power-Circuit Conductor Identification, More than 600 V: For conductors in vaults, pull and junction boxes, manholes, and handholes, use nonmetallic plastic tag holder with adhesive-backed phase tags, and a separate tag with the circuit designation.

E. Install instructional sign including thecolor-code for grounded and ungrounded conductors using adhesive-film-type labels.

F. Control-Circuit Conductor Identification: For conductors and cables in pull and junction boxes, manholes, and handholes, use self-adhesive vinyl labels with the conductor or cable designation, origin, and destination.

G. Control-Circuit Conductor Termination Identification: For identification at terminations provide self-adhesive vinyl labels with the conductor designation.

H. Conductors to Be Extended in the Future: Attach marker tape to conductors and list source.

I. 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.

J. Locations of Underground Lines: Identify with underground-line warning tape for power, lighting, communication, and control wiring and optical fiber cable.

1. Limit use of underground-line warning tape to direct-buried cables.

2. Install underground-line warning tape for both direct-buried cables and cables in raceway.

K. 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.

L. Warning Labels for Indoor Cabinets, Boxes, and Enclosures for Power and Lighting: Baked-enamel warning signs or 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.

M. 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.

N. 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.

O. 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. 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 acrylic or melamine label. 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. Unless provided with self-adhesive means of attachment, 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 acrylic or melamine label, "Panel (designation), Served from (designation)."

b. Enclosures and electrical cabinets.

c. Access doors and panels for concealed electrical items.

d. Switchgear.

e. Switchboards.

f. Transformers: Label that includes tag designation shown on Drawings for the transformer, feeder, and panelboards or equipment supplied by the secondary.

g. Substations.

h. Emergency system boxes and enclosures.

i. Motor-control centers.

j. Enclosed switches.

k. Enclosed circuit breakers.

l. Enclosed controllers.

m. Variable-speed controllers.

n. Push-button stations.

o. Power transfer equipment.

p. Contactors.

q. Remote-controlled switches, dimmer modules, and control devices.

r. Battery-inverter units.

s. Battery racks.

t. Power-generating units.

u. Monitoring and control equipment.

v. UPS equipment.

END OF SECTION

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LIGHTING CONTROL DEVICES
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END OF SECTION 15

SECTION 260923 - LIGHTING CONTROL DEVICES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. 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. Lighting contactors.
6. Emergency shunt relays.
7. Low voltage switches.

C. Related Sections include the following:

1. Section 262726 "Wiring Devices" for snap switches.

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: Show locations and coverage patterns for all occupancy and vacancy sensors. Alternative manufacturers may have differing coverage patterns. Provide quantity of sensors indicated as a minimum. Provide additional sensors as required to provide full coverage over controlled areas. Full coverage shall provide hand and arm

motion detection, except in corridors which shall provide walking motion coverage. Locate the sensor(s) in accordance with the manufacturer's recommendations to maximize energy savings and to avoid nuisance activation and deactivation due to sudden temperature or airflow changes and usage.

C. Shop Drawings: Show installation details for occupancy, vacancy and light-level sensors.

1. Interconnection diagrams showing field-installed wiring.

D. Field quality-control test reports.

E. 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 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 digital lighting control system for individual rooms 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 Wattstopper Digital Lighting Management System.

2.2 TIME SWITCHES

A. Basis-of-Design product: Subject to compliance with requirements, provide Wattstopper TS-400 Digital Time Switch, or a comparable product by one of the following:

1. Leviton Manufacturing Company, Inc.

2. Pass & Seymour.

3. Cooper Industries, Inc.

4. 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. Cooper Industries.

2. Intermatic, Inc.

3. NSi Industries, LLC; TORK Products.

4. 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 DAYLIGHT-HARVESTING DIMMING CONTROLS

A. Basis-of-Design Product: Subject to compliance with requirements, provide Wattstopper LMLS-400 or comparable product compatible with the digital network lighting control system by one of the following:

1. Sensor Switch nLight

2. Cooper Lighting Controls RC Series.

3. Encelium.

4. Hubbell.

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 power pack/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 power pack/controller.

4. Power Pack/Controller: Dry contacts rated for 20 A ballast load at 120- and 277-V ac, for 20 A tungsten at 120-V ac, and for 1 hp at 120-V ac. Sensor has 24-V dc, 150-mA, Class 2 power source, as defined by NFPA 70.

5. Light-Level Sensor Set-Point Adjustment Range: 10 to 200 fc (108 to 2152 lux).

2.5 INDOOR OCCUPANCY/VACANCY SENSORS

A. Basis-of-Design Product: Subject to compliance with requirements, provide Wattstopper Digital Lighting Management LMDC-100, LMDX-100 or comparable product by one of the following:

1. Sensor Switch nLight.

2. Cooper Lighting Controls RC Series.

3. Encelium.

4. Hubbell.

B. General Requirements for Sensors: Wall- or ceiling-mounted, solid-state digital indoor occupancy/vacancy sensors with a separate power pack/controller.

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 power pack/controller.

5. Power Pack: Dry contacts rated for 20-A ballast load at 120- and 277-V ac, for 20-A tungsten at 120-V ac, and for 1 hp at 120-V ac. Sensor has 24-V dc, 150-mA, Class 2 power source, as defined by NFPA 70. Suitable for mounting in any position on a standard outlet box. Relay(s) externally mounted through a ½-inch (13 mm) knockout in a standard electrical enclosure. Bypass Switch: Override the “on” function in case of sensor failure.

6. Mounting:

a. Sensors: Suitable for wall mounting, ceiling mounting and corner mounting.

b. Time-Delay and Sensitivity Adjustments: Recessed and concealed behind removable cover.

7. 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 (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 (Corridor): Detect occupancy within 90 feet (27.4 m) when mounted on a 10-foot- (3-m-) 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 (Small Room): Detect occupancy anywhere within a circular area of 600 sq. ft. (56 sq. m) when mounted on a 96-inch- (2440-mm-) high ceiling.

3. 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.

4. Detection Coverage (Large Room): Detect occupancy anywhere within a circular area of 2000 sq. ft. (186 sq. m) when mounted on a 96-inch- (2440-mm-) high ceiling.

5. Detection Coverage (Corridor): Detect occupancy anywhere within 90 feet (27.4 m) when mounted on a 10-foot- (3-m-) high ceiling in a corridor not wider than 14 feet (4.3 m).

E. Dual-Technology Type: Ceiling mounted; detect occupants in coverage area using PIR and ultrasonic detection methods. The particular technology or combination of technologies that control on-off functions is selectable in the field by operating controls on unit.

1. Sensitivity Adjustment: Separate for each sensing technology.

2. Detector Sensitivity: Detect occurrences of 6-inch- (150-mm-) minimum movement of any portion of a human body that presents a target of not less than 36 sq. in. (232 sq. cm), and detect a person of average size and weight moving

not less than 12 inches (305 mm) in either a horizontal or a vertical manner at an approximate speed of 12 inches/s (305 mm/s).

3. Detection Coverage (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.

4. 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- (3050-mm-) above the finished floor. Provide stem mount as required to maintain manufacturer's recommended mounting height.

2.6 SWITCHBOX-MOUNTED OCCUPANCY/VACANCY SENSORS

A. Basis-of-Design Product: Subject to compliance with requirements, provide Wattstopper DW-100, DW-103, DW-200, DW-203 (to match function indicated on the drawings) or comparable product by one of the following:

1. Sensor Switch, Inc.

2. Cooper Lighting.

3. Schneider.

4. Hubbell.

B. General Description: Wall-mounting, solid-state units suitable for mounting in a single-gang switchbox

1. Operation:

a. Occupancy Sensor: Automatic-on when coverage area is occupied, and automatic-off when unoccupied.

b. Vacancy Sensor: Manual-on when coverage area is occupied, and automatic-off when unoccupied.

c. Time Delay for turning lights off, adjustable over a minimum range of 1 to 30 minutes in 1-minute increments. Default setting: 15 minutes.

2. Sensor Output: Contacts rated to operate the connected relay, complying with UL 773A.

3. Mounting:

a. Sensor: Suitable for mounting in a standard outlet box.

b. Time-Delay and Sensitivity Adjustments: Recessed and concealed.

4. Indicator: LED, to show when motion is being detected during testing and normal operation of the sensor.

5. Bypass Switch: Override the on function in case of sensor failure.

6. Automatic Light-Level Sensor: Adjustable from 2 to 200 fc (21.5 to 2152 lx); keep lighting off when selected lighting level is present.

C. Dual-Technology Type: Wall mounting; detect occupancy by using a combination of PIR and ultrasonic or microphonic detection methods in area of coverage. Particular technology or combination of technologies that controls on-off functions shall be selectable in the field by operating controls on unit.

1. Sensitivity Adjustment: separate for each sensing technology.

2. Detector Sensitivity: Detect occurrences of 6-inch (150 mm) minimum movement of any portion of a human body that presents a target of not less than 36 sq. in. (232 sq. cm), and detect a person of average size and weight moving not less than 12 inches (305 mm) in either a horizontal or a vertical manner at an approximate speed of 12 inches/s (305 mm/s).

3. Detection Coverage: (Standard Room): Detect occupancy anywhere within a 15 foot radius (4572 mm) when wall mounted at 48 inches (1220 mm) above finished floor.

2.7 HIGH-BAY OCCUPANCY SENSORS

A. Basis-of-Design Product: Subject to compliance with requirements, provide Wattstopper LMPC-100 with extended height lens suitable for the application or comparable product by one of the following:

1. Sensor Switch nLight.

2. Cooper Lighting Controls.

3. Encelium.

4. Hubbell.

B. General Requirements for Sensors: Solid-state, digital indoor occupancy/vacancy sensors with a separate controller unit. The unit is designed to operate with the lamp and ballasts indicated.

1. 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.

2. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application..

3. Operation: Unless otherwise indicated, manual-on when coverage area is occupied, and automatic-off when unoccupied; with a 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. Operating Ambient Conditions: 32 to 149 deg F (0 to 65 deg C).

5. Sensor Output: Digitally communicates with room controller to turn loads on and off based on occupancy. Sensor is powered from the room controller.

6. Mounting: Suitable for mounting in any position.

7. Time-Delay and Sensitivity Adjustments: Recessed and concealed behind removable cover.

8. Detector Technology: PIR.

C. Detector Coverage: User selectable by interchangeable PIR lenses, suitable for mounting heights from 12 to 50 feet (3.7 to 15.2 m).

D. Accessories: Obtain manufacturer's handheld wireless configuration tool.

2.8 DIGITAL ROOM CONTROLLERS

A. Basis-of-Design Product: Subject to compliance with requirements, provide WattStopper LMRC-210 or comparable product by one of the following:

1. Sensor Switch nLight.

2. Cooper Lighting Controls RC Series.

3. Encelium

4. Hubbell.

B. Description: Self configuring, digitally addressable one, two or three relay controllers with 0-10 volt control for ballasts (if applicable) and single relay application-specific plug load controllers. 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 cable.

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.

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 DLM local network ports.

5. One 0-10 volt analog output per relay for control of compatible ballasts and 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 form 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.

D. Digital Keyed switches (where indicated on plans) shall be programmable and connect to the lighting controls system bus. Provide LC&D GR 2400 KeyEnable Switch or similar product. Where manufacturer is unable to provide a digital keyed switch, provide a keyed momentary switch and input/output devices as required to connect to the room controllers.

2.9 CONFIGURATION TOOL

A. Basis-of-Design Product: Subject to compliance with requirements, provide WattStopper LMCT-100, LMCI-100 and LMCS-100, or comparable products by one of the following:

1. Sensor Switch nLight.

2. Cooper Lighting Controls RC Series.

3. Encelium.

4. Hubbell.

B. A configuration tool facilitates optional customization of DLM 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 DLM 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.

2.10 LIGHTING CONTACTORS

A. Basis of Design Product: Subject to compliance with requirements, provide ASCO; 918series 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.

2.11 EMERGENCY SHUNT RELAY

A. Basis-of-Design Product: Subject to compliance with requirements, provide Bodine or comparable product by one of the following:

1. Lighting Control and Design, Inc.

2. Nine Twenty Four.

B. Description: Normally closed, electrically held relay, arranged for wiring in parallel with manual or automatic switching contacts; complying with UL 1008 and/or UL 924.

1. Coil Rating: 120 / 277 V.

2.12 LOW VOLTAGE WALL SWITCHES

A. Basis-of-Design Product: Subject to compliance with requirements, provide Wattstopper LMSW-101, LMSW-102, LMSW-103, LMSW-104, LMSW-105, LMSW-108, LMDM-101, or a comparable product by one of the following:

1. Sensor Switch n Light.

2. Cooper controls RC Series.

3. Encelium.

4. Hubbell.

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 persona, 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. Red configuration LED on each switch that blinks to indicate data transmission.

4. Blue 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 dependant; each button may be bound to multiple loads.

2.13 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 "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 "Low-Voltage Electrical Power Conductors and Cables."

PART 3 - EXECUTION

3.1 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.

3.2 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.

3.3 WIRING INSTALLATION

A. Wiring Method: Comply with Division 26 Section "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.

3.4 IDENTIFICATION

A. Identify components and power and control wiring according to Division 26 Section "Identification for Electrical Systems."

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.

3.5 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.

3.6 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. Align high-bay occupancy sensors using manufacturer's laser aiming tool.

3.7 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 "Demonstration and Training."

END OF SECTION

DIVISION 26 SECTION 262726
WIRING DEVICES
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SECTION 262726 - WIRING DEVICES

PART 1. GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Receptacles, receptacles with integral GFCI, and associated device plates.
2. Weather-resistant receptacles.
3. Wall-switch.

1.3 DEFINITIONS

A. EMI: Electromagnetic interference.

B. GFCI: Ground-fault circuit interrupter.

C. Pigtail: Short lead used to connect a device to a branch-circuit conductor.

D. RFI: Radio-frequency interference.

E. TVSS: Transient voltage surge suppressor.

F. UTP: Unshielded twisted pair.

1.4 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

1. Receptacles for Owner-Furnished Equipment: Match plug configurations.
2. Cord and Plug Sets: Match equipment requirements.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: List of legends and description of materials and process used for premarking wall plates.

1.6 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

1.7 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For wiring devices to include in all manufacturers' packing-label warnings and instruction manuals that include labeling conditions.

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. Floor Service-Outlet Assemblies: One for every 10, but no fewer than one.

PART 2. PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers' Names: Shortened versions (shown in parentheses) of the following manufacturers' names are used in other Part 2 articles:

1. Hubbell Incorporated; Wiring Device-Kellems (Hubbell).

2. Leviton Mfg. Company Inc. (Leviton).

3. Pass & Seymour/Legrand (Pass & Seymour).

B. Source Limitations: Obtain each type of wiring device and associated wall plate from single source from single manufacturer.

2.2 GENERAL WIRING-DEVICE REQUIREMENTS

A. Wiring Devices, Components, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Comply with NFPA 70.

C. Devices that are manufactured for use with modular plug-in connectors may be substituted under the following conditions:

1. Connectors shall comply with UL 2459 and shall be made with stranding building wire.
2. Devices shall comply with the requirements in this Section.

2.3 STRAIGHT-BLADE RECEPTACLES

A. Convenience Receptacles, 125 V, 20 A: Comply with NEMA WD 1, NEMA WD 6 Configuration 5-20R, UL 498, and FS W-C-596.

1. Products: Subject to compliance with requirements, provide one of the following:

   a. Hubbell; HBL5351 (single), HBL5352 (duplex).

   b. Leviton; 5891 (single), 5352 (duplex).

   c. Pass & Seymour; 5361 (single), 5362 (duplex).

2.4 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. Duplex GFCI Convenience Receptacles, 125 V, 20 A:

1. Products: Subject to compliance with requirements provide one of the following:

   a. Hubbell; GFR5352L.

   b. Pass & Seymour; 2095.

   c. Leviton; 7590.

2.5 TOGGLE SWITCHES

A. Comply with NEMA WD 1, UL 20, and FS W-S-896.

B. Switches, 120/277 V, 20 A:

1. Products: Subject to compliance with requirements, provide one of the following:

   a. Single Pole:

      i. Hubbell; HBL1221.

      ii. Leviton; 1221-2.

      iii. Pass & Seymour; CSB20AC1.

   b. Three Way:

      i. Hubbell; HBL1223.

      ii. Leviton; 1223-2.

iii. Pass & Seymour; CSB20AC3.

C. Single-Pole, Double-Throw, Momentary-Contact, Center-off Switches: 120/277 V, 20 A; for use with mechanically held lighting contactors.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Hubbell; HBL1557.

b. Leviton; 1257.

c. Pass & Seymour; 1251.

2.6 WALL PLATES

A. Single and combination types shall match corresponding wiring devices.

1. Plate-Securing Screws: Metal with head color to match plate finish.

2. Material for Finished Spaces: Steel with white baked enamel, suitable for field painting 0.035-inch- (1-mm-) thick, satin-finished, Type 302 stainless steel.

3. Material for Unfinished Spaces: Galvanized steel.

4. Material for Damp Locations: Cast aluminum with spring-loaded lift cover, and listed and labeled for use in wet and damp locations.

B. Wet-Location, Weatherproof Cover Plates: NEMA 250, complying with Type 3R, weather-resistant, die-cast aluminum with lockable cover.

2.7 FINISHES

A. Device Color:

1. Wiring Devices Connected to Normal Power System: Brown unless otherwise indicated or required by NFPA 70 or device listing.

PART 3. EXECUTION

3.1 INSTALLATION

A. Comply with NECA 1, including mounting heights listed in that standard, unless otherwise indicated.

B. Coordination with Other Trades:

1. Protect installed devices and their boxes. 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 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 right 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.

4. Existing Conductors:

a. Cut back and pigtail, or replace all damaged conductors.

b. Straighten conductors that remain and remove corrosion and foreign matter.

c. Pigtailing existing conductors is permitted, provided the outlet box is large enough.

D. Device Installation:

1. Replace devices that have been in temporary use during construction and that 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, two-thirds to three-fourths of the way around terminal screw.

6. Use a torque screwdriver when a torque is recommended or required by 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 left.

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 to suit arrangement of partitions and furnishings.

3.2 GFCI RECEPTACLES

A. Install non-feed-through-type GFCI receptacles where protection of downstream receptacles is not required.

3.3 IDENTIFICATION

A. Comply with Division 26 Section "Identification for Electrical Systems."

B. Identify each receptacle with panelboard identification and circuit number. Use hot, stamped, or engraved machine printing with black-filled lettering on face of plate, and durable wire markers or tags inside outlet boxes.

3.4 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:

1. Test Instruments: Use instruments that comply with UL 1436.

2. Test Instrument for Convenience Receptacles: Digital wiring analyzer with digital readout or illuminated digital-display 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 unacceptable.

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. 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.

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INTERIOR LIGHTING
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END OF SECTION 10

SECTION 265100 - INTERIOR LIGHTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Interior lighting fixtures, lamps, and ballasts.
2. Emergency lighting units.
3. Exit signs.
4. Lighting fixture supports.
5. Exterior building mounted fixtures.

B. Related Sections:

1. Section 260923 "Lighting Control Devices" for automatic control of lighting, including time switches, photoelectric relays, occupancy sensors, and multipole lighting relays and contactors.
2. Section 262726 "Wiring Devices" for manual wall-box dimmers for incandescent lamps.
3. Section 265561 "Theatrical Lighting" for theatrical lighting fixtures and their controls.

1.3 DEFINITIONS

A. BF: Ballast factor.

B. CCT: Correlated color temperature.

C. CRI: Color-rendering index.

D. HID: High-intensity discharge.

E. LER: Luminaire efficacy rating.

F. Lumen: Measured output of lamp and luminaire, or both.

G. Luminaire: Complete lighting fixture, including ballast housing if provided.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of lighting fixture, arranged in order of fixture designation. Include data on features, accessories, finishes, and the following:

1. Physical description of lighting fixture including dimensions.

2. Emergency lighting units including battery and charger.

3. Ballast, including BF.

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, of each lighting fixture type. The adjustment factors shall be for lamps, ballasts, and accessories identical to those indicated for the lighting fixture as applied in this Project.

a. Manufacturer Certified Data: Photometric data shall be certified by a manufacturer's laboratory with a current accreditation under the National Voluntary Laboratory Accreditation Program for Energy Efficient Lighting Products.

B. Shop Drawings: For nonstandard or custom lighting fixtures. Include plans, elevations, sections, details, and attachments to other work.

1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.

2. Wiring Diagrams: For power, signal, and control wiring.

C. Samples: For each lighting fixture indicated in the Interior Lighting Fixture Schedule. Each Sample shall include the following:

1. Lamps and ballasts, installed.

2. Cords and plugs.

3. Pendant support system.

D. Installation instructions.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified agencies providing photometric data for lighting fixtures.

B. Product Certificates: For each type of ballast for bi-level and dimmer-controlled fixtures, from manufacturer.

C. Field quality-control reports.

D. Warranty: Sample of special warranty.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For lighting equipment and fixtures to include in emergency, operation, and maintenance manuals.

1. Provide a list of all lamp types used on Project; use ANSI and manufacturers' codes.

1.7 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Lamps: 10 for every 100 of each type and rating installed. Furnish at least one of each type.

2. Plastic Diffusers and Lenses: One for every 100 of each type and rating installed. Furnish at least one of each type.

3. Fluorescent-fixture-mounted, emergency battery pack: One for every 20 emergency lighting unit.

4. Ballasts: One for every 100 of each type and rating installed. Furnish at least one of each type.

5. Globes and Guards: One for every 20 of each type and rating installed. Furnish at least one of each type.

6. LED Modules (light engine and driver): Furnish at least (1) of each type.

1.8 QUALITY ASSURANCE

A. Luminaire Photometric Data Testing Laboratory Qualifications: Provided by manufacturers' laboratories that are accredited under the National Volunteer Laboratory Accreditation Program for Energy Efficient Lighting Products.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

C. Comply with NFPA 70.

D. FM Global Compliance: Lighting fixtures for hazardous locations shall be listed and labeled for indicated class and division of hazard by FM Global.

1.9 COORDINATION

A. Coordinate layout and installation of lighting fixtures and suspension system with other construction that penetrates ceilings or is supported by them, including HVAC equipment, fire-suppression system, and partition assemblies.

1.10 WARRANTY

A. Special Warranty for Emergency Lighting Batteries: Manufacturer's standard form in which manufacturer of battery-powered emergency lighting unit agrees to repair or replace components of rechargeable batteries that fail in materials or workmanship within specified warranty period.

1. Warranty Period for Emergency Lighting Unit Batteries: 10 years from date of Substantial Completion. Full warranty shall apply for first year, and prorated warranty for the remaining nine years.

2. Warranty Period for Emergency Fluorescent Ballast 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.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Products: Subject to compliance with requirements, under base bid provide the products indicated on Drawings or approved equal. Under Alternate No. 7, provide only the product identified as Alternate for that fixture type. The following requirements apply to product selection.

2.2 GENERAL REQUIREMENTS FOR LIGHTING FIXTURES AND COMPONENTS

A. Recessed Fixtures: Comply with NEMA LE 4 for ceiling compatibility for recessed fixtures.

B. Fluorescent Fixtures: Comply with UL 1598. Where LER is specified, test according to NEMA LE 5 and NEMA LE 5A as applicable.

C. Metal Parts: Free of burrs and sharp corners and edges.

D. Sheet Metal Components: Steel unless otherwise indicated. Form and support to prevent warping and sagging.

E. Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions, and designed to permit relamping without use of tools. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position.

F. Diffusers and Globes:

1. Acrylic Lighting Diffusers: 100 percent virgin acrylic plastic. High resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.

a. Lens Thickness: At least 0.125-inch (3.175 mm) minimum unless otherwise indicated.

b. UV stabilized.

2. Glass: Annealed crystal glass unless otherwise indicated.

G. Factory-Applied Labels: Comply with UL 1598. Include recommended lamps and ballasts. Labels shall be located where they will be readily visible to service personnel, but not seen from normal viewing angles when lamps are in place.

1. Label shall include the following lamp and ballast characteristics:

a. "USE ONLY" and include specific lamp type.

b. Lamp diameter code (T-4, T-5, T-8, T-12, etc.), tube configuration (twin, quad, triple, etc.), base type, and nominal wattage for fluorescent and compact fluorescent luminaires.

c. Lamp type, wattage, bulb type (ED17, BD56, etc.).

d. Start type (preheat, rapid start, instant start, etc.) for fluorescent and compact fluorescent luminaires.

e. CCT and CRI for all luminaires.

2.3 LED LUMINAIRES

A. A LED luminaire consists of LED light engine and driver, heat-sink, fixture housing, and optic assembly where applicable.

1. Temperature: Minimum starting temperature of -30 deg C (-22 deg F), minimum 40 deg C (104 deg F) ambient temperature rating.

2. Life and Lumen Maintenance: Plus 50,000 hours rated life at greater than 70% lumen maintenance.

3. CRI and CCT: 3500 deg K (+/- 275 K) CCT and greater than 80 CRI.

4. Transient Voltage Protection: Rated to withstand 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.

14. LED luminaires must be listed with the Design Lights Consortium or Energy Star Qualified Products list.

2.4 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-cadmium 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.

C. Self-Luminous Signs: Using strontium oxide aluminate compound to store ambient light and release the stored energy when the light is removed. Provide with universal bracket for flush-ceiling, wall, or end mounting.

2.5 EMERGENCY LIGHTING UNITS

A. General Requirements for Emergency Lighting Units: Self-contained units complying with UL 924.

1. Battery: Sealed, maintenance-free, nickel metal hydride type.

2. Charger: Fully automatic, solid-state type with sealed transfer relay.

3. Operation: Relay automatically turns lamp on when power-supply circuit voltage drops to 80 percent of nominal voltage or below. Lamp automatically disconnects from battery when voltage approaches deep-discharge level. When normal voltage is restored, relay disconnects lamps from battery, and battery is automatically recharged and floated on charger.

4. Test Push Button: Push-to-test type, in unit housing, simulates loss of normal power and demonstrates unit operability.

5. LED Indicator Light: Indicates normal power on. Normal glow indicates trickle charge; bright glow indicates charging at end of discharge cycle.

6. Wire Guard: Heavy-chrome-plated wire guard protects lamp heads or fixtures.

7. Integral Self-Test: Factory-installed electronic device automatically initiates code-required test of unit emergency operation at required intervals. Test failure is annunciated by an integral audible alarm and a flashing red LED.

2.6 LIGHTING FIXTURE SUPPORT COMPONENTS

A. Comply with Section 260529 "Hangers and Supports for Electrical Systems" for channel- and angle-iron supports and nonmetallic channel and angle supports.

B. Single-Stem Hangers: 1/2-inch (13-mm) steel tubing with swivel ball fittings and ceiling canopy. Finish same as fixture.

C. Twin-Stem Hangers: Two, 1/2-inch (13-mm) steel tubes with single canopy designed to mount a single fixture. Finish same as fixture.

D. Wires: ASTM A 641/A 641M, Class 3, soft temper, zinc-coated steel, 12 gage (2.68 mm.

E. Wires for Humid Spaces: ASTM A 580/A 580M, Composition 302 or 304, annealed stainless steel, 12 gage (2.68 mm.

F. Rod Hangers: 3/16-inch (5-mm) minimum diameter, cadmium-plated, threaded steel rod.

G. Hook Hangers: Integrated assembly matched to fixture and line voltage and equipped with threaded attachment, cord, and locking-type plug.

PART 3 - EXECUTION

3.1 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 Ballasts: Distance between the ballast and fixture shall not exceed that recommended by ballast manufacturer. Verify, with ballast manufacturers, maximum distance between ballast and luminaire.

D. Lay-in Ceiling Lighting Fixtures Supports: Use grid as a support element.

1. Install ceiling Solid #12AWG safety wires, independent of the ceiling suspension devices, for each fixture. Locate not more than 6 inches (150 mm) from lighting fixture corners.

2. Support Clips: Fasten to lighting fixtures and to ceiling grid members at or near each fixture corner with clips that are UL listed for the application.

3. Fixtures of Sizes Less Than Ceiling Grid: Install as indicated on reflected ceiling plans or center in acoustical panel, and support fixtures independently with at least two 3/4-inch (20-mm) metal channels spanning and secured to ceiling tees.

4. Install at least one independent support wire from structure to a tab on lighting fixture. Wire shall have breaking strength of the weight of fixture at a safety factor of 3.

E. Suspended Lighting Fixture Support:

1. Pendants and Rods: Where longer than 48 inches (1200 mm), brace to limit swinging.

2. Stem-Mounted, Single-Unit Fixtures: Suspend with twin-stem hangers.

3. Continuous Rows: Use tubing or stem for wiring at one point and tubing or rod for suspension for each unit length of fixture chassis, including one at each end.

4. Do not use grid as support for pendant luminaires. Connect support wires or rods to building structure.

F. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

3.2 IDENTIFICATION

A. Install labels with panel and circuit numbers on concealed junction and outlet boxes. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

3.3 FIELD QUALITY CONTROL

A. Test for Emergency Lighting: Interrupt power supply to demonstrate proper operation. Verify transfer from normal power to battery and retransfer to normal.

B. Verify that self-luminous exit signs are installed according to their listing and the requirements in NFPA 101.

C. Prepare a written report of tests, inspections, observations, and verifications indicating and interpreting results. If adjustments are made to lighting system, retest to demonstrate compliance with standards.

3.4 STARTUP SERVICE

A. Burn-in all lamps that require specific aging period to operate properly, prior to occupancy by Owner. Burn-in fluorescent and compact fluorescent lamps intended to be dimmed, for at least 100 hours at full voltage.

3.5 ADJUSTING

A. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting aimable luminaires to suit actual occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose. Some of this work may be required after dark.

1. Adjust aimable luminaires in the presence of Architect.

END OF SECTION

DIVISION 26 SECTION 283111
FIRE-ALARM SYSTEM
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SECTION 283111 - FIRE-ALARM SYSTEM

PART 1. GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This specification section provides the requirements for the installation, programming and configuration of an extension of the existing Fire Alarm System. The system shall include, but not be limited to: Fire Alarm Control Panel, 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. System smoke detectors.
2. Heat detectors.
3. Carbon monoxide detectors.
4. Notification appliances.
5. Addressable interface device.

B. The system shall include all wiring, raceways, pull boxes, terminal cabinets, outlet and mounting boxes, alarm initiating devices, alarm indicating devices, and control equipment, and all other accessories and miscellaneous items required for an operating system.

C. 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. Existing system devices shall be re-used and maintained fully operational unless otherwise noted. Reconnect and reprogram existing system circuits/devices as required, including interface with security system for system monitoring at Pulaski Highway facility, for a fully functional system.

E. *Test system prior to performing any modifications and report any defects, etc. to the owner in writing. Any defects, malfunctions of the system not reported in advance of performing work shall be the responsibility of the contractor to correct*

F. All related work specified in other sections shall be properly coordinated with the fire alarm equipment.

1.3 REFERENCES

A. The system, equipment, installation, and operation shall comply with the current provisions of the following standards and publications:

1. National Electric Code, Article 70.

2. National Fire Protection Association Standards:

   a. NFPA72 National Fire Alarm Code

   b. NFPA 90A Air Conditioning & Ventilation Systems

   c. NFPA101 Life Safety Code

3. Local and State Building Codes.

4. Local Authorities Having Jurisdiction.

5. Underwriters Laboratories Inc.: The system and all components shall be listed by Underwriters Laboratories Inc. for use in fire protective signaling system under the following standards as applicable:

   a. UL 864/UOJZ, APOU - Control Units for Fire Protective Signaling Systems.

   b. UL 268 - Smoke Detectors for Fire Protective Signaling Systems.

   c. UL 268A - Smoke Detectors for Duct Applications.

   d. UL 217 - Smoke Detectors Single Station.

   e. UL 521 - Heat Detectors for Fire Protective Signaling Systems.

   f. UL 228 - Door Holders for Fire Protective Signaling Systems.

   g. UL 464 - Audible Signaling Appliances.

   h. UL 1638 - Visual Signaling Appliances.

   i. UL 38 - Manually Activated Signaling Boxes.

   j. UL 346 - Waterflow Indicators for Fire Protective Signaling Systems.

   k. UL 1971 - Standard for Signaling Devices for the Hearing Impaired.

   l. UL 1481 - Power Supplies for Fire Protective Signaling Systems.

m. UL 1711 - Amplifiers for Fire Protective Signaling Systems.

n. UL Fire Protection Equipment Directory.

o. UL Electrical Construction Materials Directory.

UL Electrical Construction Materials Directory.

6. Americans with Disabilities Act (ADA)

7. International Standards Organization (ISO)

a. ISO-9000

b. ISO-9001

8. Factory Mutual Approval Guide.

9. State Delaware Fire Prevention Code.

10. American Insurance Association Fire Protection Code (Article 14).

11. Delaware Occupational Safety & Health Act.

12. International Building Code (IBC).

1.4 DEFINITIONS

A. FACP: Fire Alarm Control Panel.

B. HLI: High Level Interface.

C. NICET: National Institute for Certification in Engineering Technologies.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product, including furnished options and accessories.

1. Include construction details, material descriptions, dimensions, profiles, and finishes.

2. Include rated capacities, operating characteristics, and electrical characteristics.

B. Shop Drawings: For fire-alarm system.

1. Comply with recommendations and requirements in the "Documentation" section of the "Fundamentals" chapter in NFPA 72.

2. Include plans, elevations, sections, details, and attachments to other work.

3. 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. 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.

14. Submit wiring diagrams for all equipment connected to fire alarm system. Examples are monitoring of hood extinguishing systems, sprinkler systems, HVAC control, damper control, elevator recall and elevator power shunt trip of the elevator system control.

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 WARRANTY

A. For materials and workmanship for a period of two years from final system acceptance.

1.8 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For fire-alarm systems and components to include in emergency, operation, and maintenance manuals.

1. In addition to items specified in Section 017823 "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.

B. Software and Firmware Operational Documentation:

1. Software operating and upgrade manuals.

2. Program Software Backup: On magnetic media or compact disk, complete with data files. A total of two copies shall be provided; one read only type and one writeable type.

3. Device address list.

4. Printout of software application and graphic screens.

5. All passcode information required to make alternations to the Fire Alarm Control Panel.

1.9 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Lamps for Remote Indicating Lamp Units: Quantity equal to 10 percent of amount installed, but no fewer than one unit.

2. Smoke Detectors, Fire Detectors: Quantity equal to 10 percent of amount of each type installed, but no fewer than one unit of each type.

3. Detector Bases: Quantity equal to two percent of amount of each type installed, but no fewer than one unit of each type.

4. Keys and Tools: One extra set for access to locked or tamperproofed components.

5. Audible and Visual Notification Appliances: One of each type installed.

6. Fuses: Two of each type installed in the system. Provide in a box or cabinet with compartments marked with fuse types and sizes.

1.10 QUALITY ASSURANCE

A. Installer Qualifications: Personnel shall be trained and certified by manufacturer for installation of units required for this Project.

B. Installer Qualifications: Installation shall be by personnel certified by NICET as fire-alarm Level III technician.

C. NFPA Certification: Obtain certification according to NFPA 72 by a UL-listed alarm company.

1.11 PROJECT CONDITIONS

A. Use of Devices during Construction: Protect devices during construction unless devices are placed in service to protect the facility during construction.

1.12 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace fire-alarm system equipment and components that fail in materials or workmanship within specified warranty period.

1. Warranty Extent: All equipment and components not covered in the Maintenance Service Agreement.

2. Warranty Period: Five years from date of Substantial Completion.

PART 2. PRODUCTS

2.1 SYSTEM DESCRIPTION

A. Source Limitations for Fire-Alarm System and Components: Components shall be compatible with, and operate as an extension of, existing system. Provide system manufacturer's certification that all components provided have been tested as, and will operate as, a system.

B. Noncoded, UL-certified addressable system, with multiplexed signal transmission and voice/strobe evacuation.

C. Automatic sensitivity control of certain smoke detectors.

D. All components provided shall be listed for use with the selected system.

E. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.2 SYSTEM OPERATIONAL DESCRIPTION

A. Fire-alarm signal initiation shall be by one or more of the following devices and systems:

Manual stations.

1. Manual stations.

2. Heat detectors.

3. Smoke detectors.

4. Automatic sprinkler system water flow.

5. Fire-extinguishing system operation.

6. Dry system pressure flow switch.

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 emergency shutoffs for gas and fuel supplies.

10. Record events in the system memory.

11. 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. High- or low-air-pressure switch of a dry-pipe or preaction sprinkler system.

3. Duct smoke detectors.

4. Independent fire-detection and -suppression systems.

5. User disabling of zones or individual devices.

6. 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. Identify specific device initiating the event at fire-alarm control unit, connected network control panels, and remote annunciators.

2. After a time delay of 200 seconds, transmit a trouble or supervisory signal to the remote alarm receiving station.

3. Transmit system status to building management system.

4. Display system status on graphic annunciator.

2.3 PERFORMANCE REQUIREMENTS

A. Seismic Performance: Fire-alarm control unit and raceways shall withstand the effects of earthquake motions determined according to ASCE/SEI 7

1. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event.

2.4 SYSTEM SMOKE DETECTORS

A. General Requirements for System Smoke Detectors

1. Comply with UL 268; operating at 24-V dc, nominal.

2. Detectors shall be two-wire type.

3. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to fire-alarm control unit.

4. Base Mounting: Detector and associated electronic components shall be mounted in a twist-lock module that connects to a fixed base. Provide terminals in the fixed base for connection to building wiring.

5. Self-Restoring: Detectors do not require resetting or readjustment after actuation to restore them to normal operation.

6. Integral Visual-Indicating Light: LED type, indicating detector has operated and power-on status.

7. Remote Control: Unless otherwise indicated, detectors shall be digital-addressable type, individually monitored at fire-alarm control unit for calibration,

sensitivity, and alarm condition and individually adjustable for sensitivity by fire-alarm control unit.

a. Multiple levels of detection sensitivity for each sensor.

b. Sensitivity levels based on time of day.

B. 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 related to interrupt fan motor-control circuit.

2.5 CARBON MONOXIDE DETECTORS

A. Provide carbon monoxide detector listed for connection to fire-alarm system.

1. Mounting: Adapter plate for outlet box mounting.

2. Testable by introducing test carbon monoxide into the sensing cell.

3. Detector shall provide alarm contacts and trouble contacts.

4. Detector shall send trouble alarm when nearing end-of-life, power supply problems, or internal faults.

5. Comply with UL 2075.

6. Locate, mount, and wire according to manufacturer's written instructions.

7. Provide means for addressable connection to fire-alarm system.

8. Test button simulates an alarm condition

2.6 ADDRESSABLE INTERFACE DEVICE

A. General:

1. Include address-setting means on the module.

2. Store an internal identifying code for control panel use to identify the module type.

3. Listed for controlling HVAC fan motor controllers.

B. Monitor Module: Microelectronic module providing a system address for alarm-initiating devices for wired applications with normally open contacts. Provide for all sprinkler flow and tamper switches, and as required.

C. Integral Relay: Capable of providing a direct signal to elevator controller to initiate elevator recall, to circuit-breaker shunt trip for power shutdown, etc.

1. Allow the control panel to switch the relay contacts on command.

2. Have a minimum of two normally open and two normally closed contacts available for field wiring.

D. Control Module:

1. Operate notification devices.

2. Operate solenoids for use in sprinkler service.

3. Mute sound system(s).

4. Unlock security doors.

2.7 REMOTE TEST/INDICATING STATION

Provide keyed test switch with LED indicating light for each duct detector. Locate 12” below accessible ceiling.

PART 3. EXECUTION

3.1 EXAMINATION

A. Examine areas and conditions for compliance with requirements for ventilation, temperature, humidity, and other conditions affecting performance of the Work.

1. Verify that manufacturer's written instructions for environmental conditions have been permanently established in spaces where equipment and wiring are installed, before installation begins.

B. Examine roughing-in for electrical connections to verify actual locations of connections before installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 EQUIPMENT INSTALLATION

A. Comply with NFPA 72, NFPA 101, and requirements of authorities having jurisdiction for installation and testing of fire-alarm equipment. Install all electrical wiring to comply with requirements in NFPA 70 including, but not limited to, Article 760, "Fire Alarm Systems."

1. Devices placed in service before all other trades have completed cleanup shall be replaced.
2. Devices installed but not yet placed in service shall be protected from construction dust, debris, dirt, moisture, and damage according to manufacturer's written storage instructions.

B. Install wall-mounted equipment, with tops of cabinets not more than 78 inches (1980 mm) above the finished floor.

C. 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.

D. 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.

E. Duct Smoke Detectors: Comply with NFPA 72 and NFPA 90A. Install sampling tubes so they extend the full width of duct. Tubes more than 36 inches (9100 mm) long shall be supported at both ends.

F. 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.

G. Device Location-Indicating Lights: Locate in public space near the device they monitor.

3.3 PATHWAYS

A. Pathways above recessed ceilings and in nonaccessible locations may be routed exposed.

1. Exposed pathways located less than 96 inches (2440 mm) above the floor shall be installed in EMT.

B. Pathways shall be installed in EMT.

C. Exposed EMT shall be painted red enamel.

3.4 CONNECTIONS

A. For fire-protection systems related to doors in fire-rated walls and partitions and to doors in smoke partitions, comply with requirements in Division 08 "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 shutoffs for gas and fuel supplies.

5. Supervisory connections at valve supervisory switches.

6. Supervisory connections at low-air-pressure switch of each dry-pipe sprinkler system.

7. 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.

3.5 IDENTIFICATION

A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

B. Install framed instructions in a location visible from fire-alarm control unit.

3.6 GROUNDING

A. Ground fire-alarm control unit and associated circuits; comply with IEEE 1100. Install a ground wire from main service ground to fire-alarm control unit.

B. Ground shielded cables at the control panel location only. Insulate shield at device location.

3.7 FIELD QUALITY CONTROL

A. Field tests shall be witnessed by 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. Test audible appliances for the public operating mode according to manufacturer's written instructions. Perform the test using a portable sound-level meter complying with Type 2 requirements in ANSI S1.4.

4. Test audible appliances for the private operating mode according to manufacturer's written instructions.

5. Test visible appliances for the public operating mode according to manufacturer's written instructions.

6. Factory-authorized service representative shall prepare the "Fire Alarm System Record of Completion" in the "Documentation" section of the "Fundamentals" chapter in NFPA 72 and the "Inspection and Testing Form" in the "Records" section of the "Inspection, Testing and Maintenance" chapter in NFPA 72.

E. Reacceptance Testing: Perform reacceptance testing to verify the proper operation of added or replaced devices and appliances.

F. Fire-alarm system will be considered defective if it does not pass tests and inspections.

G. Prepare test and inspection reports.

H. Maintenance Test and Inspection: Perform tests and inspections listed for weekly, monthly, quarterly, and semiannual periods. Use forms developed for initial tests and inspections.

I. Annual Test and Inspection: One year after date of Substantial Completion, test fire-alarm system complying with visual and testing inspection requirements in NFPA 72. Use forms developed for initial tests and inspections.

3.8 MAINTENANCE SERVICE

A. Initial Maintenance Service: Beginning at Substantial Completion, maintenance service shall include 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.

3.9 SOFTWARE SERVICE AGREEMENT

A. Comply with UL 864.

B. Technical Support: Beginning at Substantial Completion, service agreement shall include software support for two years.

C. Upgrade Notice: At least 30 days to allow Owner to schedule access to system and to upgrade computer equipment if necessary.

3.10 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain fire-alarm system.

END OF SECTION