PROJECT MANUAL

FOR

CHESTER UPLAND SCHOOL DISTRICT
ESSER FUNDS

Toby Farms Intermediate School
HVAC and Window Upgrades

Prepared By: MGE Associates

March 15, 2023

NOTICE OF ADVERTISEMENT FOR BIDS:

Chester Upland School District – ESSER Projects

1. **Toby Farms Intermediate School, HVAC and Window Upgrades**
2. **CUSA Chiller Replacement**

Public notice is given that sealed bids/proposals will be received online via the PennBid Program by Chester Upland School District by April 14, 2023 until 4:00 PM prevailing time.

There will be a Non-Mandatory Pre-Bid Conference on Wednesday, March 22, 2023 at 9:00 AM. The meeting will be held on-site the Toby Farms Intermediate School Any questions or clarifications regarding attendance of this meeting can be submitted via the web-based system.

Bidders are required to submit a surety in the form of a bond or equivalent meeting 10% of the overall bid price in compliance with the contract documents. Bid bonds will be returned to the non-awarded bidders upon the execution of the contract. The successful Bidder shall also be required to provide a Performance Bond in an amount of one hundred percent (100%) of the Contract amount within ten (10) calendar days of receipt of written notice of acceptance of the Bid.

There is no physical public bid opening for this project, bids will be revealed via the PennBid website.

A uniform fee of 0.333% (⅓ of 1 percent) of the bid amount (up to $5,000) is applied only to bidders who are awarded contracts. No fees apply to bidders who submit without being awarded the contract.

All interested parties must submit questions via the web based system, by the posted deadline for questions. Bidders are not permitted to contact the Engineer or staff directly.

The Bidder's attention is called to the fact that this project is assisted with federal funds, and various federal requirements apply as noted in the bid documents, including but not limited to equal opportunity provisions. Davis-Bacon and Related Acts.

The Bidder’s attention is called to the fact that is project is subject to the Pennsylvania Department of Education Standard Terms and Conditions for federally funded grants.

The Contract Documents contain all pertinent regulations. Award of the contract will be to the lowest responsible bidder. The Owner reserves the right to reject any or all bids or to accept any portion of any bid, and to award Contracts as is deemed best for the Owner.

Receiver Nafis Nichols
Chester Upland School District

Advertised in the Delaware County Times:
Wednesday, March 15, 2023 and Sunday March 19, 2023

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NOTICE TO CONTRACTORS

Sealed proposals for the Toby Farms Intermediate School, HVAC and Window Upgrades will be received electronically via the PennBid Program by the Chester Upland School District until April 14, 2023 until 4:00 PM prevailing time, at which time said bids will be publicly opened with the results made available via PennBid.

Plans, Specification, and bid forms may be obtained at no cost on PennBid (www.pennbid.net).

Each bid must be accompanied by either a bid bond in an amount of ten (10%) of the bid amount from a surety satisfactory to the District or by certified check or letter of credit upon a solvent bank in the amount of ten (10%) of the bid amount in favor of the District. Bid Bonds shall be accompanied by Proof of Authority of the official or agent signing the bond.

The Bidder's attention is called to the fact that this project is assisted with federal funds, and various federal requirements apply as noted in the bid documents, including but not limited to equal opportunity provisions. Davis-Bacon and Related Acts, various insurance requirements, various equal opportunity provisions, and the requirement of a payment bond and performance bond for 100% of the contract price.

The Bidder’s attention is called to the fact that is project is subject to the Pennsylvania Department of Education Standard Terms and Conditions for federally funded grants.

The Contract Documents contain all pertinent regulations. Award of the contract will be to the lowest responsible bidder. The Owner reserves the right to reject any or all bids or to accept any portion of any bid, and to award Contracts as is deemed best for the Owner.

All prospective bidders are required to present proof of an acceptable disposal method approved by the Pennsylvania Department of Environmental Resources or counterpart Agency in another State. The proof may consist of a copy of a State Solid Waste Disposal Permit to the prospective bidder or a Letter of Approval for the use of a proposed or existing disposal facility which has a permit or is under review for a permit.

Attention is called to the fact that the Contractor must ensure that employees and applicants for employment are not discriminated against because of their race because of their race, color, religion, sex, handicap, familial status, or national origin.

No bidder may withdraw his bid within sixty (60) days after the actual date of the opening thereof Chester Upland School District reserves the right to waive any informalities or to reject any or all bids.

NONCOLLUSION AFFIDAVIT

State of

BID Identification: Toby Farms Intermediate School, HVAC and Window Upgrades

CONTRACTOR _____, being first duly sworn, deposes and says that he is _____(sole owner, a partner, president, secretary, etc.) of the party making the foregoing BID; that such BID is not made in the interest of or on behalf of any undisclosed person, partnership, company, association, organization, or corporation; that such BID is genuine and not collusive or sham; that said BIDDER has not directly or indirectly induced or solicited any other BIDDER to put in a false or sham BID, and has not directly or indirectly colluded, conspired, connived, or agreed with any BIDDER or any one else to put in a sham BID, or that any one shall refrain from bidding; that said BIDDER has not in any manner, directly or indirectly, sought by agreement, communication or conference with any one to fix the BID price of said BIDDER or of any other BIDDER, or to fix any overhead, profit, or cost element of such BID price, or of that of any other BIDDER, or to secure any advantage against the OWNER awarding the contract or anyone interested in the proposed contract; that all statements contained in such BID are true; and, further, that said BIDDER has not, directly or indirectly, submitted his BID price or any breakdown thereof, or the contents thereof, or divulged information or data relative thereto, or paid and will not pay any fee in connection therewith, to any corporation, partnership, company, association, organization, BID depository, or to any member or agent thereof, or to any other individual except to such person or persons as have a partnership or other financial interest with said BIDDER in his general business.

Signed:

_____

Subscribed and sworn to before me this _____ day of _____, 20___.

Seal of Notary

_____

BID BOND

KNOW ALL MEN BY THESE PRESENTS, THAT WE, _____as PRINCIPAL, and _____as SURETY, are held and firmly bound unto the _____(hereinafter called the OWNER), in the penal sum of _____ DOLLARS ($_____) lawful money of the United States, for payment of which sum well and truly to be made, we bond ourselves, our heirs, executors, administrators, and successors, jointly and severally, firmly by these presents.

THE CONDITION OF THE OBLIGATION IS SUCH that whereas the Principal has submitted the accompanying Bid dated _____for _____.

NOW, THEREFORE, if the Principal shall not withdraw said Bid within the time specified therein after the opening of the same, and shall within ten (10) days after the Principal is notified by the Owner of the award of such Contract to him, enter into a written contract with the Owner, in accordance with the Bid as accepted; and give bond with good and sufficient surety or sureties as may be required for the faithful performance and proper fulfillment and labor supplied, if required in said Contract; or in event of the withdrawal of said Bid within the period specified, or the failure to enter into such Contract and give such bonds within the time specified if the Principal shall pay the Owner the difference between the amount specified in said Bid and the amount for which the Owner may procure the required materials or supplies, or both, if the latter amount of the former, together with any other expenses and costs that may have been incurred by the Owner, then the above obligation shall be void and of no effect, otherwise to remain in full force and virtue.

IN WITNESS WHEREOF, the above bonded parties have executed this instrument under their several seals this day of _____, 20_____, the name and corporate seal of each corporate party being hereto affixed and these presents duly signed by its undersigned representative, pursuant to authority of its governing body.

WITNESSED BY:

_____

(Individual Principal)

Business Address:

ATTEST:

_____

Corporate Principal

Corporate Surety

By:

SEAL

(Power of Attorney for person signing for Surety Company must be attached to bond.)

INSTRUCTIONS TO BIDDERS

1. RECEIPT AND OPENING OF BIDS: Chester Upland School District (herein called the "Owner"), invites bidders to submit sealed bids that will be received online via the PennBid Program by the Chester Upland School District by April 14, 2023, 4:00 PM prevailing time. There is no physical bid opening for this project, bids will be revealed via the PennBid website.

   A uniform fee of 0.333% (1/3 of 1 percent) of the bid amount (up to $5,000.00) is applied only to bidders who area awarded contracts. No fees apply to bidders who submit without being awarded the contract.

   The Owner may consider informal any bid not prepared and submitted in accordance with the provisions hereof and may waive any informalities or reject any and all bids. Any bid may be withdrawn prior to the above scheduled time for the opening of bids or authorized postponement thereof. Any bid received after the time and date specified shall not be considered. No bidder may withdraw a bid within thirty (30) days after the actual date of the opening thereof.

2. PREPARATION OF BID: Each bid must be submitted electronically via PennBid, on the prescribed form and accompanied by a Bid Bond, Certified Check, or Letter of Credit, the Non-collusion Affidavit, and Subcontractor Declaration Form. All blank spaces for bid prices must be completed, in ink or typewritten, in both words and figures, and the foregoing Certifications must be fully completed and executed when submitted. In case of discrepancies of written words and figures, the prices written in words shall govern.

   All bids will be received through the PennBid Program and bidder shall adhere to requirements detailed on the Bid located on the website.

3. MODIFICATION OF BIDS: Any bidder may modify his/her bid within PennBid at any time prior to the due date and time listed in the invitation to bid.

4. METHOD OF BIDDING: The Owner invites unit price/lump sum price bids as indicated in the Bid Form.

   If the lowest total responsive bid received exceeds the amount of funds available to finance the contract, the Owner may:

   a. Reject all bids;

   b. Augment the funds available in an amount sufficient to enable award to the lowest responsive bidder or bidders;

   c. Take the base bid less the alternative deductible (if any) as listed on the proposal form as to produce a net amount which is within available funds.

5. QUALIFICATIONS OF BIDDER: The Owner may make such investigations as he/she deems necessary to determine the ability of the bidder to perform the work, and the bidder shall furnish to the Owner all such information and data for this purpose as the Owner may request. The Owner reserves the right to reject any bid if the evidence submitted by, or investigation of, such bidder fails to satisfy the Owner that such bidder is properly qualified to carry out the obligations of the contract and to complete the work contemplated therein. Conditional bids will not be accepted.

6. BID SECURITY: Each bid must be accompanied by cash, certified check of the bidder, or a bid bond prepared on the form of bid bond attached hereto, duly executed by the bidder as principal and having as surety thereon a surety company approved by the Owner. Such cash, checks or bid bonds will be returned to all except the three lowest bidders within three days after the opening of bids, and the remaining cash, checks or bid bonds will be returned promptly after the Owner and the accepted bidder have executed the contract,

or, if no award has been made within thirty (30) days after the date of the opening of bids, upon demand of the bidder at any time thereafter, so long as he/she has not been notified of the acceptance of his/her bid. Attorneys-in-fact who sign bid bonds or contract bonds must file with each bond a certified and effectively dated copy of their power of attorney.

7. LIQUIDATED DAMAGES FOR FAILURE TO ENTER INTO CONTRACT: The successful bidder, upon his/her failure or refusal to execute and deliver the contract and bonds required within ten (10) days after he/she has received notice of the acceptance of his/her bid, shall forfeit to the Owner, as liquidated damages for such failure or refusal, the security deposited with his/her bid.

8. CONDITIONS OF WORK: Each bidder must inform himself/herself fully to the conditions relating to the construction of the project and the employment of labor thereon. Failure to do so will not relieve a successful bidder of his/her obligation to furnish all material and labor necessary to carry out the provisions of his/her contract. Insofar as possible, the contractor in carrying out the work, must employ such methods or means as will not cause any interruption of or interference with the work of any other contractor.

9. OBLIGATION OF BIDDER: At the time of the opening of bids each bidder will be presumed to have inspected the site and to have read and to be thoroughly familiar with the plans and contract documents (including all addenda). The failure or omission of any bidder to examine any form, instrument or document shall in no way relieve any bidder from any obligation in respect of his/her bid.

10. EXAMINATION OF SITE: Each bidder shall, and is hereby directed to inspect the entire site of the proposed work and judge for himself/herself as to all the circumstances affecting the cost and progress of the work and shall assume all patent and latent risks in connection therewith.

11. SOIL CONDITIONS: NA

12. WORKING FACILITIES: The plans show, in the general manner, the existing structures and the land available for construction purposes. The bidders must satisfy themselves of the conditions and difficulties that may be encountered in the execution of the work at this site.

13. ADDENDA AND INTERPRETATIONS: No official interpretation of the meaning of the plans, specifications or other pre-bid documents will be made to any bidder orally.

    Every request for such interpretation should be in writing and will be submitted via the “Clarifications” feature within PennBid, and to be given consideration, must be received at least five (5) days prior to the date fixed for the opening of bids. Any and all such interpretations and any supplemental instructions will be in the form of written addenda to the specifications which, if issued, will be distributed to all prospective bidders, not later than three (3) days prior to the date fixed for the opening of bids. Failure of any bidder to receive any such addendum or interpretation shall not relieve such bidder from any obligation under his/her bid as submitted. All addenda so issued shall become part of the contract documents.

14. WATER SUPPLY: All water for construction purposed, as well as the expense of having water conveyed about the work, must be provided by the Contractor and the cost of this work shall be included in the unit prices stipulated for the various items of the work to be done under this contract.

    The source, quality and quantity of water furnished shall at all times be satisfactory to the Engineer.

15. SIGNATURE OF BIDDERS: The firm, corporate or individual name of the bidder must be signed in ink in the space provided for the signatures on the proposed blanks. In the case of a corporation, the title of the officer signing must be stated and such officer must be thereunto duly authorized and the seal of said corporation duly affixed. In the case of a partnership, the signature of at least one of the partners must follow the firm name, using the term "member of the firm". In the case of an individual, use the terms "doing business as", or "sole owner". The bidder shall further state in his proposal the name and address of each

person or corporation interested therein.

16. NOTICE OF SPECIAL CONDITIONS: Attention of the bidder is particularly called to those parts of the General Contract Conditions and other contract documents and specifications which deal with the following:

a. Insurance requirements
b. Davis Bacon and Related Acts Provisions, including Davis-Bacon Act wage rates
c. Requirement for a payment bond and performance bond for 100% of contract price
d. Requirement that all subcontractors be approved by the Owner
e. Time-for-completion and liquidated damages requirements
f. Safety standards
g. Contractor's responsibility to obtain permits
h. Affirmative Action and Equal Opportunity provisions
i. PDE Master Standard Terms and Conditions

17. ADDITIONAL OBLIGATIONS UPON CONTRACT AWARD: Upon award of the contract but prior to issuance of the notice to proceed, the contractor shall submit all of the following documents, completed as required:

(a) Acceptance of Notice of Award
(b) Contract
(c) Insurance certificate(s) and/or policy(ies)
(d) Performance & Payment bonds
(e) Subcontractor declaration form
(g) (If over $10,000:) Certification of Bidder Regarding Equal Employment Opportunity
(h) (If over $10,000:) Certification(s) by (all) Proposed Subcontractors Regarding Equal Employment Opportunity
(k) (If over $100,000:) Certification by Contractor and Subcontractors of Compliance with Clean Air and Water Acts
(l) Contractor's Certification Concerning Labor Standards and Prevailing Wage Requirements
(m) (All) Subcontractor's Certification(s) Concerning labor Standards and Prevailing Wage Requirements

GENERAL CONTRACT CONDITIONS

ARTICLE 1 - CONTRACT AND CONTRACT DOCUMENTS

A. All applicable State laws, municipal ordinances, and the rules and regulations of all authorities having jurisdiction over construction of the project shall apply to the contract throughout, and they will be deemed to be included in the contract the same as though herein written out in full.

B. The Plans, Specifications and Addenda, hereinafter enumerated in Paragraph 1 of the Supplemental General Conditions shall form part of this Contract and the provisions thereof shall be as binding upon the parties hereto as if they were herein fully set forth. The table of contents, titles, headings, running headlines and marginal notes contained herein and in said documents are solely to facilitate reference to various provisions of the Contract Documents and in no way affect, limit or cast light on the interpretation of the provisions to which they refer.

ARTICLE 2 - PERFORMANCE AND PAYMENT BONDS

Simultaneously with his/her delivery of the executed contract, the Contractor shall furnish a surety bond or bonds as security for faithful performance of this contract and for the payment of all persons performing labor on the project under this contract and furnishing materials in connection with this contract, as specified in the General Conditions included herein. The surety on such bond or bonds shall be a duly authorized surety company satisfactory to the Owner. The bond shall be for 100 percent of the contract price. A Payment Bond and Performance Bond are required. Attorneys-in-fact who sign bid bonds or contract bonds must file with each bond a certified and effectively dated copy of their power of attorney. Under certain conditions, and within the limits of State and local laws and regulations, the Owner may waive the requirement that the Payment and Performance Bond be underwritten by a surety company and may authorize in lieu thereof, a personal bond backed by a letter of credit from a local lending institution for the full value of the Contract.

ARTICLE 3 - WAGE RATES

In the event that the rate of wages paid for any trade or occupant in the locality where such work is being performed are under current collective agreements or understandings between bona fide organizations of labor and employer, then the wages to be paid shall be not less than such agreed wage rates, nor less than the minimum rates compiled by the Federal Labor Standard Provision. A copy of these prevailing rates of wages has been included in these specifications.

Every Contractor and Subcontractor who is subject to this contract shall, as soon as he/she begins performance under his/her contract with the Owner, supply the Owner a schedule of the dates on which he/she is required to pay wages to employees. After construction begins he/she shall also deliver to the prevailing wage coordinator a weekly, a certified copy of his/her payroll which shall exhibit for each employee paid any wages, name, current address, identification number, number of hours worked each day of the pay period and the total for each week, hourly rate of pay, job classification, fringe payments, and deductions from wages. The certification of each payroll shall be executed by the Contractor, Subcontractor, or duly appointed agent thereof and shall recite that the payroll is correct and complete and that the wage rate shown is not less than those required by the contract.

ARTICLE 4 - AFFIRMATIVE ACTION

Each bidder, Contractor or Subcontractor (hereinafter the Contractor) must fully comply with Executive Order 11246, during the performance of this contract or sub-contract. The Contractor commits itself to the goals for minority manpower utilization, as applicable, and all other requirements, terms and conditions of these bid conditions by submitting a properly signed bid.

The Contractor shall appoint a company executive to assume the responsibility of the Implementation of the requirements, terms and conditions of these bid conditions.

ARTICLE 5 - INSURANCE

A. The contractor shall not commence work under this contract until he/she has obtained all the insurance required hereunder and such insurance has been approved by the Owner, nor shall the Contractor allow any Subcontractor to commence work on his/her subcontract until similar insurance required of the Subcontractor has been so obtained and approved. Approval of the insurance by the Owner shall not relieve or decrease the liability of the Contractor hereunder.

B. The Contractor shall file with the Owner all Certificate(s) of Insurance as are necessary to document the insurance coverage required hereunder, subject to the approval of the Owner and receipt of any additional forms/documentation requested, prior to final execution of Agreement Contract and issuance of the Notice to Proceed.

C. Worker's Compensation.

All contractors and subcontractors shall acquire and maintain, during the term of the contract, Worker's Compensation insurance in full compliance with the laws of the State of Pennsylvania. The contractor shall at all times indemnify and save harmless the Owner from all claims for worker's compensation which may be made by any of the employees of any subcontractor to whom the Contract may have let the performance of any part of the work embraced in this contract, and the Contractor will appear for and defend the Owner against any and all such claims.

D. Contractor's Liability Insurance.

(i) The Contractor shall acquire and maintain during the term of the Contract Bodily Injury and Property Damage Liability Insurance under a standard Comprehensive General/Automobile Liability Policy which shall provide and include coverage on all Contractor's Operations, Contractor's Protective (Sublet) Liability, Contractual Liability, Completed Operations Liability, Owned Automobiles and Non-owned and Hired Automobiles.

(ii) Property Damage Liability Insurance shall be provided on any demolition, blasting, excavating, shoring or similar operation on an "if any" basis.

(iii) Bodily Injury Liability limits shall be for an amount of no less the Five Hundred Thousand ($500,000) Dollars for injuries, including wrongful death to any one person and subject to the same limit for each person, in amount of not less than One Million ($1,000,000) Dollars on the account of any one occurrence.

(iv) Property Damage Liability Insurance shall be in an amount of not less than Five Hundred Thousand ($500,000) Dollars per occurrence. General Liability shall be extended to provide "Broad Form Property Damage Liability," and in an amount of not less the One Million ($l,000,000) dollars aggregate for damage on account of all occurrences.

(v) Any combination of underlying Comprehensive General/Automobile Liability coverage with Umbrella/Excess Liability coverage which provides no less than One Million ($1,000,000) Dollars Single Limit Bodily Injury & Property Damage Liability Insurance for the Contractor will also be acceptable.

(vi) The owner may adjust the liability limits to coincide with local government procurement policies and practice within the limits of state and local law.

E. Builder's Risk Insurance.

Each Contractor shall maintain insurance to protect himself and the Owner, jointly, from loss incurred by fire, lightning, extended coverage hazards, vandalism, theft, explosion and malicious mischief in the full amount of the Contract and such insurance shall cover all labor and materials connected with the work, including materials delivered to the site but not yet installed.

F. Installation Floater Insurance.

When a Contractor is involved solely in the installation of materials and not in the construction of a building, an Installation Floater is required in lieu of a Builder's Risk Policy with the same general conditions applying as set forth in paragraph E.

G. The Policies as listed above shall all contain the following special provisions:

(i) "The Company agrees that thirty (30) days prior to cancellation or reduction of the insurance afforded by this policy with respect to the Contract involved, written notice will be mailed to the Chester Upland School District."

(ii) The maintaining of such insurance as outlined herein shall in no way constitute a waiver of legal liability for damage to any adjoining buildings or their contents or the work and property of others on the site beyond the limits of insurance thus maintained. The Contractor shall hold the Owner free and harmless from any injury and damage resulting from the negligent or faulty performance of the Contract by the Contractor or by his/or her Subcontractors.

H. Additional Insured: Chester Upland School District, MG Engineering Associates, LLC, and Northstar Museums & Education.

ARTICLE 6 - PENNSYLVANIA STEEL PRODUCTS PROCUREMENT ACT

REFER TO PDE MASTER STANDARD TERMS AND CONDITIONS.

ARTICLE 7 - SAFETY

A. The Contractor will be responsible for initiating, maintaining, and supervising all safety precautions and programs in connection with the Work. He/She will take all necessary precautions for the safety of, and will provide the necessary protection to prevent damage, injury, or loss to all employees on the work and other persons who may be affected thereby, all the work and all materials or equipment to be incorporated therein, whether in storage on or off the site, and other property at the site or adjacent thereto, including trees, shrubs, lawns, walks, pavements, roadways, structures, and utilities not designated for removal, relocation, or replacement in the course of construction.

B. The Contractor will erect and maintain, as required by the conditions and progress of the Work, all necessary safeguards for safety protection. He/She will notify owners of adjacent utilities when prosecution of the work may affect them.

C. The Contractor shall comply with the safety standards provisions of applicable laws, building and construction codes and the manual of Accident Prevention in Construction published by the Associated General Contractors of America, the requirements of the Occupational Safety and Health Act of 1970 (Public Law 91-596), and the requirements of Title 29 of the Code of Federal Regulations, Section 1518 as published in the "Federal Register" Volume 36, No. 75, Saturday, April 17, 1971.

D. The Contractor shall maintain at his/her office or other well known place at the job site, all articles necessary for giving first aid to the injured, and shall make standing arrangements for the immediate removal to a hospital or a doctor's care of persons (including employees) who may be injured at the job site. In no case shall employees be permitted to work at a job site before the employer has made a standing arrangement for removal of injured persons to a hospital or a doctor's care.

E. Lights, signs and barricades shall be used to maintain traffic and safety for vehicular and pedestrian traffic during the course of this contract in accordance with the specifications.

ARTICLE 8 - PERMITS

The Contractor is responsible for obtaining and paying for all necessary permits and Licenses from the proper authorities. The Contractor shall give all notices and comply with all laws, ordinances, rules, and regulations bearing on the conduct of the work as drawn and specified. If the Contractor observes that the Contract Documents are at variance therewith, he/she shall promptly notify the Owner in writing.

ARTICLE 9 - SUPERVISION

A. The Contractor will supervise and direct the work. He/She will be solely responsible for the means, methods, techniques, sequences, and procedures of construction. The Contractor will employ and maintain on the work a qualified supervisor or superintendent who shall have been designated in writing by the Contractor as the Contractor's representative at the site. The Supervisor shall have full authority to act on behalf of the Contractor and communications given to the supervisor shall be as binding as <u>if given to the Contractor</u>. The supervisor shall be present and on the site at all times as required to perform adequate supervision and coordination of the work.

B. The Owner and its representatives will at all times have access to the work. In addition, authorized representatives and agents of any participating federal or County agency shall be permitted to inspect all work, materials, payrolls, records of personnel, invoices of materials, and other relevant data and records. The Contractor will provide proper facilities for such access and observation of the work and also for any inspection or testing thereof.

C. The Contractor shall submit a proposed program of operation, showing clearly how he/she proposed to conduct the work as to bring about the completion of his/her work within the time limit specified. This program shall outline the proposed sequence of operations, the rates of progress and the dates when his/her work will be sufficiently advanced to permit the installation of the work under other contracts, and the estimated progress payments due under the Contract. The work under this contract shall be so scheduled that as structures are completed, they can be placed into useful operation with a minimum of delay. The program shall be subject to the approval of the Owner.

D. All construction as proposed along all City, Township, County, State and Federal roads including storage and stockpiling of materials, is to be conducted within the limits of the public right-of-way. Bracing, sheeting and shoring shall be used to keep all construction work within the construction limits unless work agreements are secured from the adjacent property Owners. It is the Contractor's

responsibility to secure these work agreements, if deemed necessary. Copies of the work agreements shall be delivered to the Engineer and the Owner prior to any work beginning on the effected property.

ARTICLE 10 - CLAIMS AGAINST CONTRACTOR

The Contractor shall indemnify and save the Owner or the owner's agents harmless from all claims growing out of the lawful demands of Subcontractor's laborers, workmen, mechanics, material men, and furnishers of machinery and parts thereof, equipment, tools, and all supplies, incurred in the furtherance of the performance of the work. The Contractor shall, at the Owner's request, furnish satisfactory evidence that all obligations of the nature designated above have been paid, discharged or waived. If the Contractor fails to do so the Owner may, after having notified the Contractor, either pay unpaid bills or withhold from the Contractor's unpaid compensation a sum of money deemed reasonably sufficient to pay any and all such lawful claims until satisfactory evidence is fully finished that all liabilities have been fully discharged whereupon payment to the Contractor shall be resumed, in accordance with the terms of the Contract Documents, but in no event shall the provisions of this sentence be construed to impose any obligations upon the Owner to either the Contractor, his Surety, or any third party. In paying any unpaid bills of the Contractor, any payment so made by the Owner shall be considered as a payment made under the Contract Documents by the owner to the Contractor and the Owner shall not be liable to the Contractor for any such payments in good faith.

ARTICLE 11 - SUBCONTRACTING

A. Neither the Contractor nor the owner shall sell, transfer, assign, or otherwise dispose of the Contract or any portion thereof, or of his right, title, or interest therein, or his obligations thereunder.

B. The Contractor shall not sublet, sell, transfer or assign any portion of the contract without consent of the Owner or his/her designated agent. No subcontract, or transfer of contract, shall in any way release the Contractor of his/her liability under the contract and bonds.

C. The Contractor shall not award work to Subcontractor(s) not identified on the Subcontractors Declaration Form as submitted with bid, without

i) Prior approval of the Owner

ii) Submission of all certifications as required in the INSTRUCTIONS TO BIDDERS. The Contractor shall be fully responsible to the Owner for the acts and omissions of the subcontractor(s), and of persons, either directly or indirectly employed by them, as he/she is for the acts and omissions of persons directly employed by him/her.

iii) Submission of all certifications as required in the INSTRUCTIONS TO BIDDERS. The Contractor shall be fully responsible to the Owner for the acts and omissions of the subcontractor(s), and of persons, either directly or indirectly employed by them, as he/she is for the acts and omissions of persons directly employed by him/her.

ARTICLE 12 - CHANGE OF WORK

A. The Owner reserves the right to make, at any time during the progress of the work, such increases or decreases in quantities and such alterations in details of work as may be deemed necessary or desirable. Such increases or decreases and alterations shall not invalidate the contract nor release the surety, and the Contractor agrees to perform the work as altered, the same as if it had been a part of the original contract.

B. Authorized alterations in plans or quantities of work involving work not covered by unit prices in the proposal shall be paid for as stipulated in the change order authorizing such work.

C. No changes in work covered by the approved Contract shall be made without having prior written approval of the Owner.

ARTICLE 13 - TIME

A. The Date of beginning and the time for completion of the work are essential conditions of the Contract Documents and the work embraced shall be commenced on a date specified in the Notice to Proceed.

B. The Contractor will proceed with the work at such rate of progress to ensure full completion within the Contract Time. It is expressly understood and agreed, by and between the Contractor and the Owner, that the Contract Time for the completion of the work described herein is a reasonable time, taking into consideration the average climatic and economic conditions and other factors prevailing in the locality of the work.

C. The Contract Time to fully complete the project shall be consecutive calendar days following the date of commencement of work to be specified in a written "Notice to Proceed".

D. If the Contractor shall fail to complete the work within the Contract Time, or extension of time granted by the Owner, the Contractor will pay to the Owner for liquidated damages $500.00 for each calendar day that the Contractor shall be in default after the time stipulated in the Contract Documents.

ARTICLE 14 - COMPLETION OF WORK

A. The Contractor shall guarantee all materials and equipment furnished and work performed for a period of one year from the date of Substantial Completion. The Contractor warrants and guarantees for a period of one year from the date of Substantial Completion of the improvement that it is free from all defects due to faulty materials or workmanship, and the Contractor shall promptly make corrections as may be necessary by reason of such defects. The owner will give notice of observed defects with reasonable promptness. In the event that the Contractor should fail to make repairs, adjustments, or other work, which may be made necessary by such defects, the Owner may do so and charge the Contractor the cost thereby incurred. Upon 100% completion of improvements, the contractor shall provide a Maintenance Bond in the amount of 15% of the cost of improvements for a period of 1-year.

B. When the work, including that performed by Subcontractors, is completed, the site shall be cleaned of all rubbish and debris caused by the construction. All sheds or other temporary structures, surplus materials, and equipment shall be removed and the project left in a neat and presentable condition.

ARTICLE 15 - TERMINATION

After ten (10) days from delivery of a Written Notice to the Contractor, the Owner may, without cause and without prejudice to any other right or remedy elects to terminate the Contract. In such case the Contractor shall be paid for all work executed and any expense sustained plus reasonable profit, unless such termination was due to the act or conduct of the Contractor.

ARTICLE 16 - PAYMENT

Payment to the Contractor shall be made by the Chester Upland School District upon receiving invoice from contractor and inspection of work completed. The Owner's representative and the project engineer shall certify on the pay request that the completed work has been approved prior to the submission of the invoice. Retainage to be held should be reflected by the engineer/architect on the contractor's original invoice. A turn-around time of 3-4 weeks is expected before said funds are forwarded to the contractor.

It is important that the progress schedule be based on achievable goals, and that the Contractor makes every effort to meet target dates. The Chester Upland School District may hold the pay request, or a portion of the pay request, in cases where the Contractor is found to be in violation of any of the terms and conditions in this contract, e.g. federal labor standards compliance, until such violations are corrected.

ARTICLE 17 - LIVE UTILITIES AND OTHER PROPERTY

The contractor shall assume all responsibility for damage attributed to him to any property upon, or passing through, the Project Area, but excluded from the work or not owned by the Local Public Agency, such as utility lines, surface improvements, or like items.

If disconnections of underground utility services are required to be made in public thoroughfares, the Contractor shall comply with all local requirements and regulations respecting the barricade of streets, the removal and restoration of pavement, and other pertinent matters.

ARTICLE 18 - LIVE UTILITIES AND OTHER PROPERTY

The contractor shall well, truly and faithfully perform its duties, all the undertakings, covenants, terms conditions and agreements of said contract.

If disconnections of underground utility services are required to be made in public thoroughfares, the Contractor shall comply with all local requirements and regulations respecting the barricade of streets, the removal and restoration of pavement, and other pertinent matters.

ARTICLE 19 - HOLD HARMLESS

The contractor shall well, truly and faithfully perform its duties, all the undertakings, covenants, terms, conditions and agreements of said contract during the original term thereof, and any extensions thereof which may be granted by the Local Public Agency, with or without notice to the Surety, and he shall satisfy all claims and demands incurred under such contract and shall fully indemnify and save harmless the Local Public Agency from all costs and damages which it may suffer by reason of failure to do so, and shall reimburse and repay the Local Public Agency all outlay and expense which the Local Public Agency may incur in making good any default.

SUPPLEMENTAL GENERAL CONDITIONS

1. ENUMERATION OF PLANS, SPECIFICATIONS AND ADDENDA

Following are the Plans, Specifications, and Addenda which form a part of this contract, as set forth in Article I of the General Contract Conditions, "Contract and Contract Documents".

Drawings:		Dated Per Plan
Architectural Sheet Set		
MEP Sheet Set		
Specifications:		Dated Per Plans
Technical Specifications		
Addenda:	Number	Date

2. STATED ALLOWANCES: Not Included

3. SPECIAL HAZARDS : Not Included

4. CONTRACTOR'S AND SUBCONTRACTOR'S PUBLIC LIABILITY, VEHICLE LIABILITY, AND PROPERTY DAMAGE INSURANCE

See Article 5 of General Contract conditions.

The Contractor shall either (1) require each of his/her subcontractors to procure and to maintain during the life of his/her subcontract, Subcontractor's Public Liability and Property Damage of the type and in the same amounts as specified in Article 5, or (2) insure the activities of his/her subcontractors in his/her own policy.

6. BUILDER'S RISK INSURANCE

The Contractor will maintain Builder's Risk Insurance (fire and extended coverage) on a 100 percent completed value basis on the insurable portions of the project for the benefit of the Owner, the Contractor, and all subcontractors, as their interests may appear.

CONTRACT

THIS AGREEMENT made this _____ day of _____, 20___, by and between_____ _____hereinafter called the "Contractor, and _____hereinafter called the "Owner".

WITNESSETH, that the Contractor and the Owner for the considerations stated herein mutually agree as follows:

ARTICLE 1. Statement of Work.

The Contractor shall furnish all supervision, technical personnel, labor, materials, machinery, tools, equipment and services, including utility and transportation services, and perform and complete all work required for the construction of the Improvements embraced in the project; namely, _____, and required supplemental work for the_____all in strict accordance with the Contract Documents including all addenda thereto, numbered _____, dated _____, and _____dated _____, all as prepared by _____ acting and in these Contract documents preparation, referred to as the "Engineer".

ARTICLE 2. The Contract Price.

The Owner will pay the Contractor for the total quantities of work performed at the unit prices stipulated in the Bid for the respective items of work completed for the sum not to exceed _____ (Dollars) subject to additions and deductions as provided in Section ___ hereof.

ARTICLE 3. Contract.

The executed contract documents shall consist of the following:

a. This Agreement
b. Addenda
c. Invitation for Bids
d. Instructions to Bidders
e. Signed copy of Bid
f. General Conditions, Parts I and II
g. Special Conditions
h. Technical Specifications
i. Drawings (as listed in the Schedules of Drawings)
j. Other Contract Provisions required by District
k. Federal Contract Provisions

This Agreement, together with other documents enumerated in this ARTICLE 3, which said other documents are as fully a part of the Contract as if hereto attached or herein repeated, forms the Contract between the parties hereto. In the event that any provision in any component part of this Contract conflicts with any provision of any other component part, the provision of the component part first enumerated in this ARTICLE 3 shall govern, except as otherwise specifically stated.

IN WITNESS WHEREOF, the parties hereto have caused this AGREEMENT to be executed in _____original copies on the day and year first above written.

CONTRACTOR:	OWNER:
_____	_____
Signature	Signature
_____	_____
Typed/printed name	Typed/printed name
_____	_____
Title	Title

Certifications:

I, _____, certify that I am the _____ of the corporation named as Contractor herein; that _____who signed this Agreement on behalf of the Contractor, was then _____ of said corporation; that said Agreement was duly signed for and in behalf of said corporation by authority of its governing body, and is within the scope of its corporate powers.

_____ (Corporate Seal)

PERFORMANCE AND PAYMENT BOND (OR BONDS)

Following the Form of Agreement, attach the approved form of the statutory surety bond or bonds to insure the performance of the Contract and payment of labor and materials. In addition to the corporation signatures of the surety company(ies) on the bond(s), each bond should be countersigned by the surety company's attorney-in-fact, authorized to act within the state in which the Project is situated.

MS-944S

PAYMENT BOND

KNOW ALL MEN BY THESE PRESENTS, that we, _____ of _____ , as PRINCIPAL and _____ a corporation incorporated under the laws of the State of _____ as Surety, are held and firmly bond unto the _____ in the full and just sum of _____ ($_____) dollars, lawful money of the United States of America, to be paid to the said _____ or its assigns, to which payment well and truly to be made, we bind ourselves, our heirs, executors, administrators, successors and assigns, jointly and severally, firmly by these presents.

WHEREAS, the above bounden Principal has entered into a contract with the above, hereinafter called Obligee, bearing even date herewith, for the improvement of:

_____

_____

for approximately the sum of _____ ($_____) dollars.

NOW, THEREFORE, the condition of this obligation is such that the above bounden PRINCIPAL shall and will promptly pay cause to be paid in full all sums of money which may be due by contractor or otherwise, to any individual, firm, partnership, association or corporation, for all material furnished or labor supplied or performed in the prosecution of the work, whether or not the said material or labor entered into and became component parts of the work and for rental of the equipment used and services rendered by public utilities in, or in connection with the prosecution of such work, then this obligation to be void, otherwise to remain in full force and effect.

THE PRINCIPAL and SURETY, hereby, jointly and severally, agree with the Obligee herein that any individual firm, partnership, association or corporation, which has performed labor or furnished material in the prosecution of the work as provided, and any public utility which has not been paid in full therefore, may sue in assumpsit on this Payment Bond, in his, their, or its own name and may prosecute the same to final judgment for such sum or sums as may be justly due him, them or it, and have execution thereon. Provided, however, that the Obligee shall not be liable for the payment of any costs of expenses of such suit.

RECOVERY by any individual, firm, partnership, association or corporation hereunder shall be subject to the provisions of the "Public Works Contractor's Bond Law of 167", Act No. 385, approved December 20, 1967, P.L. 869, which Act shall be incorporated herein and made a part hereof, as fully and completely as though its provisions were fully and at length herein recited.

It is further provided that any alteration which may be made in the terms of the contract or its work to be done or materials to be furnished or labor to be supplied or performed under it or the giving by the Obligee of any extension of time for the performance of the contract or any other forbearance on the part of either the Obligee or the Principal to the other, shall not in any way release the PRINCIPAL and the SURETY or SURETIES of any such alteration, extension or forbearance being hereby waived.

IN WITNESS WHEREOF, the said PRINCIPAL and SURETY have duly executed this Bond under seal the _____ day of _____, 20_____.

WITNESS:
PLACE
SEAL
HERE

_____
Title:

_____
Contractor

BY

_____
Title:

WITNESS:
PLACE
SEAL
HERE

_____
Title:

_____
Surety Company

_____
Title:

MS-944S (10-83)

PERFORMANCE BOND
(With Corporate Surety)

KNOW ALL MEN BY THESE PRESENTS, that we, _____
(Name and Address of Contractor)

as Principal and _____
(Surety Company)

a corporation incorporated under the laws of the State of _____as Surety.
(Name of State)

are held and firmly bound unto _____ in
(Name of Contract Owner)
the full and just sum of _____ ($_____) dollars lawful money of the United States of America, to be paid to the above Owner or its assigns, to which payment well and truly to be made, we bind ourselves, our heirs, executors, administrators, successors and assigns, jointly and severally, firmly by these presents.

WHEREAS, the above bounden Principal has entered into a contract with the above Municipality, bearing even date herewith, for the undertaking of certain obligations as therein set forth.

NOW, THEREFORE, the condition of this obligation is such that if the above bounden Principal, as Contractor, shall in all respects comply with and faithfully perform the terms and conditions of said Contract, including the Specifications and conditions referred to and made a part thereof, and such alterations as may be made in said specifications as therein set forth, then this Obligation shall be void, but otherwise the same shall be and remain in full force, virtue and effect.

It is further provided that any alteration which may be made in the terms of the contract or its specifications with the express approval of the Municipality or the Principal to the other, shall not in any way release the Principal and the Surety or either of any of them, their heirs, executors, administrators, successors or assigns from their liability hereunder, notice to the Surety of any such alteration or forbearance being hereby waived.

IN WITNESS WHEREOF, the said Principal and Surety have duly executed this Bond under Seal, pursuant to due and legal action authorizing the same to be done on _____.
(Date of Bond)

Attest/Witness: _____
Contractor

PLACE
SEAL
HERE

_____ BY _____
Title: Title:

Attest/Witness: _____
Surety Company

PLACE
SEAL
HERE

_____ _____
Title: Title:

NOTICE OF AWARD

To: _____

_____

_____

PROJECT Description: _____

_____

The OWNER has considered the BID submitted by you on _____, 20__ (BID Date) for the above described WORK in response to its Advertisement for BIDS and Information for BIDDERS.

You are hereby notified that your BID has been accepted for items in the amount of $_____.

You are required by the Information for BIDDERS to execute the Agreement and furnish the required CONTRACTOR's Contract BOND, if applicable, and Certificates of Insurance within 10 calendar days from the date of this notice to you.

If you fail to execute said Agreement and to furnish said BOND within 10 days from the date of this notice, said OWNER will be entitled to consider all your rights arising out of the OWNER's acceptance of your BID as abandoned and as a forfeiture of your BID guaranty. The OWNER will be entitled to such other rights as may be granted by law.

You are required to return an acknowledged copy of this NOTICE OF AWARD to the OWNER.

Dated this ____ day of _____, 20__.

_____
Owner

By: _____

Name: _____

Title: _____

ACCEPTANCE OF NOTICE

Receipt of the above NOTICE OF AWARD is hereby acknowledged by: _____ on this _____day of _____, 20__.

By: _____

Name and Title: _____

cc: CONTRACTOR's Surety
Surety's Agent

NOTICE TO PROCEED

To: _____ Date: _____

_____

_____

PROJECT Description: _____

_____

You are hereby notified to commence WORK in accordance with the Agreement dated _____, 20__, on or

after _____, 20__, and you are to complete the WORK within _____ consecutive calendar days thereafter.

The date of completion of all WORK is therefore _____, 20__.

_____
Owner

By: _____

Name: _____

Title: _____

ACCEPTANCE OF NOTICE

Receipt of the above NOTICE TO PROCEED is hereby acknowledged by _____
on this _____ day of _____, 20___.

By: _____

Name: _____

Title: _____

CONTRACT CHANGE ORDER

Contract No._____ Date _____
Change Order No._____ Project No._____

To: (Contractor) _____

You are hereby requested to comply with the following changes from the contract plans and specifications:

ITEM NO. (1)	DESCRIPTION OF CHANGES – QUANTITIES, UNIT, UNIT PRICES, CHANGE IN COMPLETION SCHEDULE, ETC. (2)	DECREASE IN CONTRACT PRICE (3)	INCREASE IN CONTRACT PRICE (4)
	Change in contract price due to this change order	$	$
	Total decrease	$	$
	Total increase	$	$
	Difference between Columns (3) and (4)	$	$
	Net (increase) (decrease) contract price	$	$

The sum of $_____ is hereby added to, deducted from, the total contract price and the total adjusted price to date thereby is $_____.

The time provided for completion in the contract is unchanged, increased, decreased, by _____ calendar days. This document shall become an amendment to the contract and all provisions of the contract will apply hereto.

Accepted by: _____ _____
Contractor Date

Recommended by: _____ _____
Architect/Engineer Date

Recommended by: _____ _____
Northstar Museums and Education Date

Approved by: _____ _____
Chester Upland School District Date

Note: Work performed under this change order prior to District concurrence is at owner's risk. District concurrence will be evidenced by signature of Engineer, Owners Representative and Owner.

004116 - BID FORM - STIPULATED SUM

1.1 BID INFORMATION

A. Bidder: _____.

B. Project Name: **Toby Farms Intermediate School, HVAC and Window Upgrades**

C. Project Location:
1. 201 Bridgewater Rd, Brookhaven, PA 19015

D. Owner: Chester Upland School District

1.2 CERTIFICATIONS AND BASE BID

A. Base Bid, Contract: The undersigned Bidder, having carefully examined the Procurement and Contracting Requirements, Conditions of the Contract, Drawings, Specifications, and all subsequent Addenda, having visited the site, and being familiar with all conditions and requirements of the Work, hereby agrees to furnish all material, labor, equipment and services, including all scheduled allowances, necessary to complete the construction of the above-named project, according to the requirements of the Procurement and Contracting Documents, for the stipulated sum of:

1. _____Dollars ($_____).
2. The above amount may be modified by amounts indicated by the Bidder on the attached Document 004322 "Unit Prices Form"

1.3 BID GUARANTEE

A. The undersigned Bidder agrees to execute a contract for this Work in the above amount and to furnish surety as specified within **10** days after a written Notice of Award, if offered within **60** days after receipt of bids, and on failure to do so agrees to forfeit to Owner the attached cash, cashier's check, certified check, U.S. money order, or bid bond, as liquidated damages for such failure, in the following amount constituting five percent (5%) of the Base Bid amount above:

1. _____ Dollars ($_____).

B. In the event Owner does not offer Notice of Award within the time limits stated above, Owner will return to the undersigned the cash, cashier's check, certified check, U.S. money order, or bid bond.

1.4 TIME OF COMPLETION

A. The undersigned Bidder proposes and agrees hereby to commence the Work of the Contract Documents on a date specified in a written Notice to Proceed to be issued by Engineer, and shall fully complete the Work within 365 calendar days.

1.5 ACKNOWLEDGEMENT OF ADDENDA

A. The undersigned Bidder acknowledges receipt of and use of the following Addenda in the preparation of this Bid:

1. Addendum No. 1, dated _____.
2. Addendum No. 2, dated _____.
3. Addendum No. 3, dated _____.
4. Addendum No. 4, dated _____.

1.6 BID SUPPLEMENTS

A. The following supplements are a part of this Bid Form and are attached hereto.

1. Bid Form Supplement - Alternates.
2. Bid Form Supplement - Unit Prices.
3. Bid Form Supplement - Bid Bond Form (AIA Document A310-2010).

1.7 CONTRACTOR'S LICENSE

A. The undersigned further states that it is a duly licensed contractor, for the type of work proposed, in the Commonwealth of Pennsylvania, and that all fees, permits, etc., pursuant to submitting this proposal have been paid in full.

1.8 SUBMISSION OF BID

A. Respectfully submitted this ____ day of _____, 2023

B. Submitted By:_____(Name of bidding firm or corporation).

C. Authorized Signature:_____(Handwritten signature).

D. Signed By:_____(Type or print name).

E. Title:_____(Owner/Partner/President/Vice President).

F. Witness By:_____(Handwritten signature).

G. Attest:_____(Handwritten signature).

H. By:_____(Type or print name).

I. Title:_____(Corporate Secretary or Assistant Secretary).

J. Street Address:_____.

K. City, State, Zip:_____.

L. Phone:_____.

M. License No.:_____.

N. Federal ID No.:_____(Affix Corporate Seal Here).

END OF DOCUMENT 004116

004322 - UNIT PRICES FORM

1.1 BID INFORMATION

A. Bidder: _____.

B. Project Name: **Toby Farms HVAC and Window Upgrades**

C. Project Location: 201 Bridgewater Road, Brookhaven, PA 19015

D. Owner: **Chester Upland School District**

1.2 BID FORM SUPPLEMENT

A. This form is required to be attached to the Bid Form.

B. The undersigned Bidder proposes the amounts below be added to or deducted from the Contract Sum on performance and measurement of the individual items of Work.

C. If the unit price does not affect the Work of this Contract, the Bidder shall indicate "NOT APPLICABLE."

1.3 UNIT PRICES

A. Unit-Price No. 1: Abatement of 9” x 9” Tile & Mastic, Cost Per SF Up to 5,000 SF. Cost Per SF

1. _____ dollars ($_____) per unit.

1.4 SUBMISSION OF BID SUPPLEMENT

A. Respectfully submitted this ____ day of _____, 2023

B. Submitted By:_____(Insert name of bidding firm or corporation).

C. Authorized Signature:_____(Handwritten signature).

D. Signed By:_____(Type or print name).

E. Title:_____(Owner/Partner/President/Vice President).

END OF DOCUMENT 004322

DOCUMENT 004323 - ALTERNATES FORM

1.1 BID INFORMATION

A. Bidder: _____.

B. Project Name: **Toby Farms Intermediate School, HVAC and Window Upgrades**

C. Project Location: 201 Bridgewater Road, Brookhaven, PA 19015

D. Owner: **Chester Upland School District**

1.2 BID FORM SUPPLEMENT

A. This form is required to be attached to the Bid Form.

1.3 DESCRIPTION

A. The undersigned Bidder proposes the amount below be added to or deducted from the Base Bid if particular alternates are accepted by Owner. Amounts listed for each alternate include costs of related coordination, modification, or adjustment.

B. If the alternate does not affect the Contract Sum, the Bidder shall indicate "NO CHANGE."

C. If the alternate does not affect the Work of this Contract, the Bidder shall indicate "NOT APPLICABLE."

D. The Bidder shall be responsible for determining from the Contract Documents the affects of each alternate on the Contract Time and the Contract Sum.

E. Owner reserves the right to accept or reject any alternate, in any order, and to award or amend the Contract accordingly within [**60**] days of the Notice of Award unless otherwise indicated in the Contract Documents.

F. Acceptance or non-acceptance of any alternates by the Owner shall have no affect on the Contract Time unless the "Schedule of Alternates" Article below provides a formatted space for the adjustment of the Contract Time.

1.4 SCHEDULE OF ALTERNATES

A. Alternate No.#1: Deduct Gymnasium Rooftop Units and Window Treatments

1. Description: Reduce project scope by elimination of the proposed HVAC and window work within both Gymnasiums. Includes elimination of all proposed equipment, ductwork, air devices, controls, lighting and any electrical work associated with the new rooftop units. Includes any lighting work associated with both gymnasiums. All existing windows within the Gymnasiums will remain.

2. DEDUCT ALTERNATE

3. _____ Dollars ($_____).

B. Alternate No.#2: Reduction of Lighting Control System

1. Description: Work includes elimination of teaching area lighting control zone for new light fixtures.

2. DEDUCT ALTERNATE

3. _____ Dollars ($_____).

C. Alternate No.#3: Repainting of all classroom walls.

1. Description: The scope of work includes moving of all classroom furniture and fixed wall mounted wall coverings to prepare and repaint classroom that are proposed to receive new window treatments. Once painting is completed, all furniture and wall coverings shall be put back in place.

2. ADD ALTERNATE

3. _____ Dollars ($_____).

D. Alternate No.#4: Repainting of all hallway common areas.

1. Description: The scope of work includes moving of all furniture and fixed wall mounted wall coverings to prepare and repaint common hallway areas that are proposed to receive new window treatments. Once painting is completed, all furniture and wall coverings shall be put back in place.

2. ADD ALTERNATE

3. _____ Dollars ($_____).

E. Alternate No.#5: Floor Tile Removal and Replacement

1. Description: The scope of work includes removal of all Floor Tile within classrooms, hallways and multi-purpose rooms and replacement with new floor tile coverings. Contractor is required to abate all asbestos containing floor tile and mastic as part of the installation. Contractor shall assume that all 9" x 9" floor tile is asbestos containing and abide by all indoor air quality measure as part of the abatement. All abatement work shall be completed by a Licensed Asbestos Abatement contractor in the Commonwealth of Pennsylvania.

2. ADD ALTERNATE

3. _____ Dollars ($_____).

1.5 SUBMISSION OF BID SUPPLEMENT

A. Respectfully submitted this ____ day of _____, 2023

B. Submitted By:_____(Insert name of bidding firm or corporation).

C. Authorized Signature:_____(Handwritten signature).

D. Signed By:_____(Type or print name).

E. Title:_____(Owner/Partner/President/Vice President).

END OF DOCUMENT 004323

SECTION 006000 - PROJECT FORMS

1.1 FORM OF AGREEMENT AND GENERAL CONDITIONS

A. The following form of Owner/Contractor Agreement and form of the General Conditions shall be used for Project:

1. The General Conditions are included in the Project Manual
2. The Supplementary Conditions for Project are separately prepared and included in the Project Manual.

1.2 ADMINISTRATIVE FORMS

A. Copies of AIA standard forms may be obtained from the American Institute of Architects; www.aiacontractdocsaiacontracts.org; (800) 942-7732.

B. Preconstruction Forms:

1. Form of Performance Bond and Labor and Material Bond: included in Project Manual
2. Form of Certificate of Insurance: AIA Document G715-2017 "Supplemental Attachment for ACORD Certificate of Insurance 25."

C. Information and Modification Forms:

1. Form for Requests for Information (RFIs): AIA Document G716-2004 "Request for Information (RFI)."
2. Form of Request for Proposal: AIA Document G709-2018 "Proposal Request."
3. Change Order Form: AIA Document G701-2017 "Change Order."
4. Form of Architect's Memorandum for Minor Changes in the Work: AIA Document G710-2017 "Architect's Supplemental Instructions."
5. Form of Change Directive: AIA Document G714-2017 "Construction Change Directive."

D. Payment Forms:

1. Schedule of Values Form: AIA Document G703-1992 "Continuation Sheet."
2. Payment Application: AIA Document G702-1992/703-1992 "Application and Certificate for Payment and Continuation Sheet."
3. Form of Contractor's Affidavit: AIA Document G706-1994 "Contractor's Affidavit of Payment of Debts and Claims."
4. Form of Affidavit of Release of Liens: AIA Document G706A-1994 "Contractor's Affidavit of Payment of Release of Liens."
5. Form of Consent of Surety: AIA Document G707-1994 "Consent of Surety to Final Payment."

END OF SECTION 006000

SUBCONTRACTOR DECLARATION FORM

Each prime contractor is required to submit a list of subcontractors it intends to use on the project.

Subcontractor	Business Address	Type of Work

_____

Project Name

_____

Prime Contractor

_____

Signature Title Date

NONDISCRIMINATION CLAUSE

During the term of this contract, Contractor agrees as follows:

1. In the hiring of any employee(s) for the manufacture of supplies, performance of work, or any other activity required under the grant agreement or any subgrant agreement, contract, or subcontract, the Grantee, a subgrantee, a contractor, a subcontractor, or any person acting on behalf of the Grantee shall not discriminate by reason of race, gender, creed, color, sexual orientation, gender identity or expression, or in violation of the *Pennsylvania Human Relations Act* (PHRA) and applicable federal laws, against any citizen of this Commonwealth who is qualified and available to perform the work to which the employment relates.

2. The Grantee, any subgrantee, contractor or any subcontractor or any person on their behalf shall not in any manner discriminate by reason of race, gender, creed, color, sexual orientation, gender identity or expression, or in violation of the PHRA and applicable federal laws, against or intimidate any of its employees.

3. Neither the Grantee nor any subgrantee nor any contractor nor any subcontractor nor any person on their behalf shall in any manner discriminate by reason of race, gender, creed, color, sexual orientation, gender identity or expression, or in violation of the PHRA and applicable federal laws, in the provision of services under the grant agreement, subgrant agreement, contract or subcontract.

4. Neither the Grantee nor any subgrantee nor any contractor nor any subcontractor nor any person on their behalf shall in any manner discriminate against employees by reason of participation in or decision to refrain from participating in labor activities protected under the *Public Employee Relations Act, Pennsylvania Labor Relations Act or National Labor Relations Act,* as applicable and to the extent determined by entities charged with such Acts' enforcement, and shall comply with any provision of law establishing organizations as employees' exclusive representatives.

5. The Grantee, any subgrantee, contractor or any subcontractor shall establish and maintain a written nondiscrimination and sexual harassment policy and shall inform their employees in writing of the policy. The policy must contain a provision that sexual harassment will not be tolerated and employees who practice it will be disciplined. Posting this Nondiscrimination/Sexual Harassment Clause conspicuously in easily-accessible and well-lighted places customarily frequented by employees and at or near where the grant services are performed, shall satisfy this requirement for employees with an established work site.

6. The Grantee, any subgrantee, contractor or any subcontractor shall not discriminate by reason of race, gender, creed, color, sexual orientation, gender identity or expression, or in violation of the PHRA and applicable federal laws, against any subgrantee, contractor, subcontractor or supplier who is qualified to perform the work to which the grant relates.

7. The Grantee, and each subgrantee, contractor and subcontractor represents that it is presently in compliance with and will maintain compliance with all applicable federal, state, and local laws and regulations relating to nondiscrimination and sexual harassment. The Grantee and each subgrantee, contractor and subcontractor further represents that it has filed a Standard Form 100 Employer Information Report ("EEO-1") with the U.S. Equal Employment Opportunity Commission ("EEOC") and shall file an annual EEO-1 report with the EEOC as required for employers' subject to *Title VII* of the *Civil Rights Act of 1964*, as amended, that have 100 or more employees and employers that have federal government contracts or first-tier subcontracts and have 50 or more employees. The Grantee, any subgrantee, any contractor or any subcontractor shall, upon request and within the time periods requested by the Commonwealth, furnish all necessary employment documents and records, including EEO-1 reports, and permit access to their books, records, and accounts by the granting agency and the Bureau of Diversity, Inclusion and Small Business Opportunities for the purpose of ascertaining compliance with the provisions of this Nondiscrimination/Sexual Harassment Clause.

8. The Grantee, any subgrantee, contractor or any subcontractor shall include the provisions of this Nondiscrimination/Sexual Harassment Clause in every subgrant agreement, contract or subcontract so that those provisions applicable to subgrantees, contractors or subcontractors will be binding upon each subgrantee, contractor

or subcontractor.

9. The Granter's and each subgrantee's, contractor's and subcontractor's obligations pursuant to these provisions are ongoing from and after the effective date of the grant agreement through the termination date thereof. Accordingly, the Grantee and each subgrantee, contractor and subcontractor shall have an obligation to inform the Commonwealth if, at any time during the term of the grant agreement, it becomes aware of any actions or occurrences that would result in violation of these provisions.

10. The Commonwealth may cancel or terminate the grant agreement and all money due or to become due under the grant agreement may be forfeited for a violation of the terms and conditions of this Nondiscrimination/Sexual Harassment Clause. In addition, the granting agency may proceed with debarment or suspension and may place the Grantee, subgrantee, contractor, or subcontractor in the Contractor Responsibility File.

CONTRACTOR_____ Date _____

CONFLICT OF INTEREST

Interest of Local Public Officials

No member of the governing body of the locality or entity and no other officer, employee, agent or public official of such locality, who exercises any functions or responsibilities in connection with the planning and carrying out of the program, shall have any personal financial interest, direct or indirect, in this contract; and the governing body contractor shall take appropriate steps to assure compliance.

Interest of Contractor and Employees

The Contractor covenants that he presently has no interest and shall not acquire interest, direct or indirect, in the study area or any parcels therein or any other interest which would conflict in any manner or degree with the performance of his services hereunder. The Contractor further covenants that in the performance of this Contract, no person having any such interest shall be employed.

RECORDS AND AUDITS

The Contractor shall maintain accounts and records, including personnel, property and financial records, adequate to identify and account for all costs pertaining to the Contract and such other records as may be deemed necessary by the Municipality and County to assure proper accounting for all project funds. These records will be made available for audit purposes to the Municipality and County or any authorized representative, and will be retained for three years after the close out of the project by the County unless stipulated otherwise by the County.

The undersigned contractor agrees to abide by the above provisions.

By: _____ _____
Contractor Date

AFFIDAVIT RE

ACCEPTING PROVISIONS OF THE WORKMEN'S COMPENSATION ACT

State of)
)
) ss:
)
County of)

being duly sworn according to law deposes and says that he/she/it has (they have) accepted the provisions of the Workmen's Compensation Act of 1916 of the Commonwealth of Pennsylvania, with its supplements and amendments, and has (have) insured his/her (their) liability thereunder in accordance with the terms of said Act with

_____
(Surety Company)

_____
(Type or Print) Contractor

BY_____
Signature

Sworn to and subscribed before me this _____ day of _____ A.D. 20__

_____

My Commission Expires_____

STANDARD FEDERAL EQUAL EMPLOYMENT OPPORTUNITY
CONSTRUCTION CONTRACT SPECIFICATIONS
(EXECUTIVE ORDER 11246)

1. As used in these specifications:

   A. "Covered Area" means the geographical area described in the solicitation from which this Contract resulted.

   B. "Director" means Director, Office of Federal contract Compliance Programs, United States Department of Labor, or any person to whom the Director delegates authority.

   C. "Employer identification number" means the Federal Social Security number used on the Employer's Quarterly Federal Tax Return, U. S. Treasury Department Form 941.

   D. "Minority" includes:

      (i) Black (all persons having origins in any of the black African racial groups not of Hispanic origin);

      (ii) Hispanic (all persons of Mexican, Puerto Rican, Cuban, Central or South American or other Spanish Culture or origin, regardless of race);

      (iii) Asian and Pacific Islander (all persons having origins in any of the original peoples of the Far East, Southeast Asia, the Indian Subcontinent, or the Pacific Island); and

      (iv) American Indian or Alaska native (all persons having origins in any of the original peoples of North America maintaining identifiable tribal affiliations through membership and participation or community identification.

2. Whenever the CONTRACTOR, or subcontractor at any tier, subcontracts any portion of the work involving any construction trade, it shall physically include in each subcontract in excess of $10,000, the provisions of these specifications and the Notice which contains the applicable goals for minority and female participation and which is set forth in the solicitations from which this Contract resulted.

3. If the CONTRACTOR is participating (pursuant to 41 CFR 60-4.5) in any Hometown Plan approved by the U. S. Department of Labor in the covered area either individually or through an association, its affirmative action obligations on all work in the Plan area (including goals and timetables) shall be in accordance with that Plan for those trades which have unions participating in the Plan. CONTRACTOR must be able to demonstrate their participation in and compliance with the provisions of any such Hometown Plan. Each CONTRACTOR or subcontractor participating in an approved Plan is individually required to comply with its obligations under the EEO Clause, and to make a good faith effort to achieve each goal under the Plan in each trade in which it has employees. The overall good faith performance by other CONTRACTOR or subcontractors toward a goal in an approved Plan does not excuse any covered CONTRACTOR'S or subcontractor's failure to take good faith efforts to achieve the Plan goals and timetables.

4. The CONTRACTOR shall implement the specific affirmative action standards provided in Paragraphs 7A through P of these specification. The goals set forth in the solicitation from which this Contract resulted are expressed as percentages of the total hours of employment and training of minority and

female utilization the CONTRACTOR shall reasonably be able to achieve in each construction trade in which it has employees in the covered area. The CONTRACTOR is expected to make substantially uniform progress toward its goals in each craft during the period specified.

5. Neither the provisions of any collective bargaining agreement, nor the failure by a union with whom the CONTRACTOR has a collective bargaining agreement, to refer either minorities or women shall execute the CONTRACTOR'S obligations under these specifications, Executive Order 11246, or the regulations promulgated pursuant thereto.

6. In order for the nonworking training hours of apprentices and trained to be counted in meeting the goals, such apprentices and trainees must be employed by the CONTRACTOR during the training period, and the CONTRACTOR must have made a commitment to employ the apprentices and trainees at the completion of their training, subject to the availability of employment opportunities. Trainees must be trained pursuant to training programs approved by the U.S. Department of Labor.

7. The CONTRACTOR shall take specific affirmative actions to ensure equal employment opportunity. The evaluation of the Contractor's compliance with these specifications shall be used upon its effort to achieve maximum results from its actions. The CONTRACTOR shall document these efforts fully, and shall implement affirmative action steps at least as extensive as the following:
   A. Ensure and maintain a working environment free of harassment, intimidation and coercion at all sites, and in all facilities at which the CONTRACTOR'S employees are assigned to work. The CONTRACTOR, where possible, will assign two or more women to each construction project. The CONTRACTOR shall specifically ensure that all foremen, superintendents and other on site supervisory personnel are aware of and carry out the CONTRACTOR's obligation to maintain such working environment, with specific attention to minority or female individuals working at such sites or in such facilities.

   B. Establish and maintain a current list of minority and female recruitment sources, provide written notification to minority and female recruitment sources and to community organizations when CONTRACTOR or its unions have employment opportunities available and maintain a record of the organizations responses.

   C. Maintain a current file of the names, addresses and telephone numbers of each minority and female off-the-street applicant and minority or female referral from a union, a recruitment source or community organization and of what action was taken with respect to each such individual. If such individual was sent to the union hiring hall for referral and was referred back to the CONTRACTOR by the union or, if referred, not employed by the CONTRACTOR, this shall be documented in the file with the reason therefore; along with whatever additional actions the CONTRACTOR may have taken.

   D. Provide immediate written notification to the Director when the union or unions with which the CONTRACTOR has a collective bargaining agreement has not referred to the CONTRACTOR a minority person or woman sent by the CONTRACTOR, or when the CONTRACTOR has other information that the union referral process has impeded the CONTRACTOR's efforts to meet its obligations.

   E. Develop on-the-job training opportunities and/or participate in training programs for the area which expressly include minorities and women, including upgrading programs and apprenticeship and trainee programs relevant to the CONTRACTOR's employment needs, especially those programs funded or approved by the Department of Labor. The CONTRACTOR shall provide notice of these programs to the sources compiled under 7B above.

F. Disseminate the CONTRACTOR's EEO policy by providing notice of policy to unions and training programs and requesting their cooperation in assisting the CONTRACTOR in meeting its EEO obligations; by including it in any policy manual and collective bargaining agreement, by publicizing it in the company newspaper annual report, etc.; by specific review of the policy with all management personnel and with all minority and female employees at least once a year; and by posting the company EEO policy on bulletin boards accessible to all employees at each location when construction work is performed.

G. Review, at least annually, the company's EEO policy and affirmative action obligations under these specifications with employees having any responsibility for hiring, assignment, layoff, termination or other employment decisions including specific review of these items with on site supervisory personnel such as Superintendents, General Foremen, etc., prior to the initiation of construction work at any job site. A written record shall be made and maintained identifying the time and place of these meetings and persons attending, subject matter discussed and disposition of the subject matter.

H. Disseminate the CONTRACTOR'S EEO policy externally by including in any advertising in the news media, specifically including minority and female news media, and providing written notification to and discussing the CONTRACTOR'S EEO policy with other CONTRACTORS and subcontractors with whom the CONTRACTOR does or anticipates doing business.

I. Direct its recruitment efforts, both oral and written, to minority, female and community organizations, to schools with minority and female students and to minority female recruitment and training organizations serving the CONTRACTOR'S recruitment area and employment needs. Not later than one month prior to the date for the acceptance of applications for apprenticeship or other training by any recruitment source, the CONTRACTOR shall send written notification to organizations such as the above, describing the openings, screening procedures, and tests to be used in the selection process.

J. Encourage present minority and female employees to recruit other minority persons and women and, where reasonable, provide after school, summer and vacation employment to minority and female youth both on the site and in other areas of a CONTRACTOR'S workforce.

K. Validate all tests and other selection requirements where there is an obligation to do so under 41 CFR Part 60-3.

L. Conduct, at least annually, an inventory and evaluation at least of all minority and female personnel for promotional opportunities and encourage these employees to seek or to prepare for, through appropriate training, etc., such opportunities.

M. Ensure that seniority practices, job classifications, work assignments and other personnel practices, do not have a discriminatory effect by continually monitoring all personnel and employment related activities to ensure that the EEO policy and the CONTRACTOR'S obligations under these specification are being carried out.

N. Ensure that all facilities and company activities are nonsegregated except that separate or single-user toilet and necessary changing facilities shall be provided to assure privacy between the sexes.

O. Document and maintain a record of all solicitations of offers for subcontracts from minority and female construction contractors and suppliers, including circulation of solicitations to

minority and female contractor associations and other business associations.

P. Conduct a review, at least annually, of all supervisors adherence to and performance under the CONTRACTOR'S EEO policies and affirmative action obligations.

8. CONTRACTORS are encouraged to participate in voluntary associations, which assist in fulfilling one or more of their affirmative action obligations (7A through P). The efforts of a contractor association, joint contractor-union, contractor- community, or other similar group of which the CONTRACTOR is a member and participant, may be assertee as fulfilling any one or more of its obligations under 7A through P of these specifications provided that the CONTRACTOR actively participates in the group, makes every effort to assure that the group has a positive impact on the employment of minorities and women in the industry, ensures that the concrete benefits of the program reflected in the CONTRACTOR'S minority and female workforce participation, makes a good faith effort to meet its individual goal and timetables, and can provide access to documentation which demonstrates the effectiveness of actions taken on behalf of the CONTRACTOR. The obligation to comply, however, is the CONTRACTOR'S and failure of such a group to fulfill an obligation shallnot be a defense for the CONTRACTOR'S noncompliance.

9. A single goal for minorities and a separate single goal for women has been established. The CONTRACTOR, however, is required to provide equal employment opportunity and to take affirmative action for all minority groups, both male and female, and all women, both minority and nonminority. Consequently, the CONTRACTOR may be in violation of the Executive Order if a particular group is employed in a substantially disparate manner (for example, even though the CONTRACTOR may be in violation of the Executive Order if a specific minority group of women is underutilized).

10. The CONTRACTOR shall not use the goals and timetables or affirmative action standards or discriminate against any person because of race, color, religion, sex or national origin.

11. The CONTRACTOR shall not enter into any subcontract with any person or firm disbarred from Government contracts pursuant to Executive Order 11246.

12. The CONTRACTOR shall carry out such sanctions and penalties for violations of these specifications and or the Equal Opportunity Clause, including suspension, termination and cancellation of existing subcontracts as may be imposed or ordered pursuant to Executive Order 11246, as amended, and its implementing regulations by the Office of Federal Contract Compliance Programs. Any CONTRACTOR who fails to carry out such sanctions and penalties shall be in violation of the Specifications and Executive Order 11246, as amended.

13. The CONTRACTOR, in fulfilling its obligations under these specifications, shall implement specific affirmative action steps, at least as extensive as those standards prescribed in Paragraph 7 of these specifications, so as to achieve maximum results from its efforts to ensure equal employment opportunity. If the CONTRACTOR fails to comply with the requirements of the Executive Order, the implementing regulations, or these specifications, the Director shall proceed in accordance with 41 CFR 60-4.8.

14. The CONTRACTOR shall designate a responsible official to monitor all employment related activity to ensure that the company EEO policy is being carried out, to submit reports relating to the provisions herein as may be required by the Government and to keep records. Records shall at least include for each employee the name, address, telephone numbers, construction trade, union affiliation if any, employee identification number when assigned, social security number, race, sex, status (e.g. mechanic, apprentice, trainee, helper, or laborer), dates of changes in status, hours worked per week in the indicated trade, rate of Pay, and locations at which the work was performed. Records shall be maintained in an easily understandable and retrievable form; however, to the degree that existing records satisfy this requirement, CONTRACTORS shall be required to maintain separate records.

15. Nothing herein provided shall be construed as a limitation upon the application of other laws which establish

different standards of compliance or upon the application of requirements for the hiring of local or other area residents (e.g., those under the Public Works Employment Act of 1977 and the Community Development Block Grant Program).

MBE/WBE Outreach

The undersigned prime contractor agrees to solicit at least 5 bids and/or quotes from minority-/female-owned businesses and record them on the **MBE/WBE Contact/Solicitation Statement** form. The prime contractor is not required to use these businesses, but these contacts must at least be made. An MBE/WBE directory of minority- and/or female-owned contractors and businesses in the Delaware County area is available and can be used to facilitate this requirement, although Primes are free to use any other MBE/WBE contractors as well. **This form must be submitted with the Prime Contractor Questionnaire.**

_____ _____

Contractor Date

CERTIFICATION OF COMPLIANCE WITH AIR AND WATER ACTS

(Applicable to Federally assisted construction contracts and related subcontracts exceeding $100,000)

Compliance with Air and Water Acts

During the performance of this contract, the contractor and
all subcontractors shall comply with the requirements of the Clean Air Act, as amended, 42 USC 1857 et seq., the Federal Water Pollution Control Act, as amended, 33 USC 1251 et seq., and the regulations of the Environmental Protection Agency with respect thereto, at 40 CFR Part 15, as amended.

In addition to the foregoing requirements, all nonexempt contractors and subcontractors shall furnish to the owner, the following:

(1) A stipulation by the Contractor or subcontractors, that any facility to be utilized in the performance of any nonexempt contract or subcontract, is not listed on the List of Violating Facilities issued by the Environmental Protection Agency (EPA) pursuant to 40 CFR 15.20.

(2) Agreement by the contractor to comply with all the requirements of Section 114 of the Clean Air Act, as amended, (42 USC 1857c-8) and Section 308 of the Federal Water Pollution Control Act, as amended, (33 USC 1318) relating to inspection, monitoring, entry, reports and information, as well as all other requirements specified in said Section 114 and Section 308, and all regulations and guidelines issued thereunder.

(3) A stipulation that as a condition for the award of the contract, prompt notice will be given of any notification received from the Director, Office of Federal Activities, EPA, indicating that a facility utilized, or to be utilized for the contract, is under consideration to be listed on the EPA List of Violating Facilities.

(4) Agreement by the Contractor that he/she will include, or cause to be included, the criteria and requirements in paragraph (1) through (4) of this section in every nonexempt subcontract and requiring that the Contractor will take such action as the Government may direct as a means of enforcing such provisions.

_____
Name and Title of Signer (Print or type)

_____ _____
Signature Date

Certificate of Compliance with Federal Labor Standards Provisions

I, the undersigned _____, the duly authorized representative of _____ (hereinafter referred to as the "contractor"), do hereby certify that I have examined the Federal Labor Standards Provisions (HUD-4010) with related certificates and documents, and all of the conditions surrounding these provisions including, but not limited to the following:

1. The contractor is responsible for employing only eligible subcontractors who have certified eligibility in written contracts containing Federal Labor Standards Provisions.

2. The contractor is responsible for the payment of federal prevailing wage rates by its subcontractors while performing work under this contract. If the subcontractor fails to pay the prevailing wages as specified in this contract, the prime contractor may be required to make appropriate restitution to the underpaid workers.

3. The contractor is responsible for collecting weekly certified payrolls from its subcontractors, review said payrolls for compliance with the federal wage rates, and forward same to the local government contract authority.

4. The contractor also understands that only those classifications listed in the original bid documents are applicable to this job, and no special classifications may be incorporated after contract award.

The prime contractor hereby agrees to perform all of its responsibilities in conformance with the Federal Labor Standards Provisions both diligently and effectively.

BY: _____ DATE: _____

TITLE: _____

Applicability

The Project or Program to which the construction work covered by this contract pertains is being assisted by the United States of America and the following Federal Labor Standards Provisions are included in this Contract pursuant to the provisions applicable to such Federal assistance.

A. 1. (i) Minimum Wages. All laborers and mechanics employed or working upon the site of the work, will be paid unconditionally and not less often than once a week, and without subsequent deduction or rebate on any account (except such payroll deductions as are permitted by regulations issued by the Secretary of Labor under the Copeland Act (29 CFR Part 3), the full amount of wages and bona fide fringe benefits (or cash equivalents thereof) due at time of payment computed at rates not less than those contained in the wage determination of the Secretary of Labor which is attached hereto and made a part hereof, regardless of any contractual relationship which may be alleged to exist between the contractor and such laborers and mechanics. Contributions made or costs reasonably anticipated for bona fide fringe benefits under Section l(b)(2) of the Davis-Bacon Act on behalf of laborers or mechanics are considered wages paid to such laborers or mechanics, subject to the provisions of 29 CFR 5.5(a)(1)(iv); also, regular contributions made or costs incurred for more than a weekly period (but not less often than quarterly) under plans, funds, or programs, which cover the particular weekly period, are deemed to be constructively made or incurred during such weekly period.

Such laborers and mechanics shall be paid the appropriate wage rate and fringe benefits on the wage determination for the classification of work actually performed, without regard to skill, except as provided in 29 CFR 5.5(a)(4). Laborers or mechanics performing work in more than one classification may be compensated at the rate specified for each classification for the time actually worked therein: Provided, That the employer's payroll records accurately set forth the time spent in each classification in which work is performed. The wage determination (including any additional classification and wage rates conformed under 29 CFR 5.5(a)(1)(ii) and the Davis-Bacon poster (WH-1321) shall be posted at all times by the contractor and its subcontractors at the site of the work in a prominent and accessible, place where it can be easily seen by the workers.

(ii) (a) Any class of laborers or mechanics which is not listed in the wage determination and which is to be employed under the contract shall be classified in conformance with the wage determination. HUD shall approve an additional classification and wage rate and fringe benefits therefor only when the following criteria have been met:

(1) The work to be performed by the classification requested is not performed by a classification in the wage determination; and

(2) The classification is utilized in the area by the construction industry; and

(3) The proposed wage rate, including any bona fide fringe benefits, bears a reasonable relationship to the wage rates contained in the wage determination.

(b) If the contractor and the laborers and mechanics to be employed in the classification (if known), or their representatives, and HUD or its designee agree on the classification and wage rate (including the amount designated for fringe benefits where appropriate), a report of the action taken shall be sent by HUD or its designee to the Administrator of the Wage and Hour Division, Employment Standards Administration, U.S. Department of Labor, Washington, D.C. 20210. The Administrator, or an authorized representative, will approve, modify, or disapprove every additional classification action within 30 days of receipt and so advise HUD or its designee or will notify HUD or its designee within the 30-day period that additional time is necessary. (Approved by the Office of Management and Budget under OMB control number 1215-0140.)

(c) In the event the contractor, the laborers or mechanics to be employed in the classification or their representatives, and HUD or its designee do not agree on the proposed classification and wage rate (including the amount designated for fringe benefits, where appropriate), HUD or its designee shall refer the questions, including the views of all interested parties and the recommendation of HUD or its designee, to the Administrator for determination. The Administrator, or an authorized representative, will issue a determination within 30 days of receipt and so advise HUD or its designee or will notify HUD or its designee within the 30-day period that additional time is necessary. (Approved by the Office of Management and Budget under OMB Control Number 1215-0140.)

(d) The wage rate (including fringe benefits where appropriate) determined pursuant to subparagraphs (1)(ii)(b) or (c) of this paragraph, shall be paid to all workers performing work in the classification under this contract from the first day on which work is performed in the classification.

(iii) Whenever the minimum wage rate prescribed in the contract for a class of laborers or mechanics includes a fringe benefit which is not expressed as an hourly rate, the contractor shall either pay the benefit as stated in the wage determination or shall pay another bona fide fringe benefit or an hourly cash equivalent thereof.

(iv) If the contractor does not make payments to a trustee or other third person, the contractor may consider as part

of the wages of any laborer or mechanic the amount of any costs reasonably anticipated in providing bona fide fringe benefits under a plan or program, Provided, That the Secretary of Labor has found, upon the written request of the contractor, that the applicable standards of the Davis-Bacon Act have been met. The Secretary of Labor may require the contractor to set aside in a separate account assets for the meeting of obligations under the plan or program. (Approved by the Office of Management and Budget under OMB Control Number 1215-0140.)

2. Withholding. HUD or its designee shall upon its own action or upon written request of an authorized representative of the Department of Labor withhold or cause to be withheld from the contractor under this contract or any other Federal contract with the same prime contractor, or any other Federally-assisted contract subject to Davis-Bacon prevailing wage requirements, which is held by the same prime contractor so much of the accrued payments or advances as may be considered necessary to pay laborers and mechanics, including apprentices, trainees and helpers, employed by the contractor or any subcontractor the full amount of wages required by the contract In the event of failure to pay any laborer or mechanic, including any apprentice, trainee or helper, employed or working on the site of the work, all or part of the wages required by the contract, HUD or its designee may, after written notice to the contractor, sponsor, applicant, or owner, take such action as may be necessary to cause the suspension of any further payment, advance, or guarantee of funds until such violations have ceased. HUD or its designee may, after written notice to the contractor, disburse such amounts withheld for and on account of the contractor or subcontractor to the respective employees to whom they are due. The Comptroller General shall make such disbursements in the case of direct Davis-Bacon Act contracts.

3. (i) Payrolls and basic records. Payrolls and basic records relating thereto shall be maintained by the contractor during the course of the work preserved for a period of three years thereafter for all laborers and mechanics working at the site of the work. Such records shall contain the name, address, and social security number of each such worker, his or her correct classification, hourly rates of wages paid (including rates of contributions or costs anticipated for bona fide fringe benefits or cash equivalents thereof of the types described in Section l(b)(2)(B) of the Davis-bacon Act), daily and weekly number of hours worked, deductions made and actual wages paid. Whenever the Secretary of Labor has found under 29 CFR 5.5 (a)(1)(iv) that the wages of any laborer or mechanic include the amount of any costs reasonably anticipated in providing benefits under a plan or program described in Section l(b)(2)(B) of the Davis-Bacon Act, the contractor shall maintain records which show that the commitment to provide such benefits is enforceable, that the plan or program is financially responsible, and that the plan or program has been communicated in writing to the laborers or mechanics affected, and records which show the costs anticipated or the actual cost incurred in providing such benefits. Contractors employing apprentices or trainees under approved programs shall maintain written evidence of the registration of apprenticeship programs and certification of trainee programs, the registration of the apprentices and trainees, and the ratios and wage rates prescribed in the applicable programs. (Approved by the Office of Management and Budget under OMB Control Numbers 1215-0140 and 1215-0017.)

(ii) (a) The contractor shall submit weekly for each week in which any contract work is performed a copy of all payrolls to HUD or its designee if the agency is a party to the contract, but if the agency is not such a party, the contractor will submit the payrolls to the applicant sponsor, or owner, as the case may be, for transmission to HUD or its designee. The payrolls submitted shall set out accurately and completely all of the information required to be maintained under 29 CFR 5.5(a)(3)(i) except that full social security numbers and home addresses shall not be included on weekly transmittals. Instead the payrolls shall only need to include an individually identifying number for each employee (e.g., the last four digits of the employee's social security number). The required weekly payroll information may be submitted in any form desired. Optional Form WH-347 is available for this purpose from the Wage and Hour Division Web site at http://www.dol.gov/esa/whd/forms/wh347instr.htm or its successor site. The prime contractor is responsible for the submission of copies of payrolls by all subcontractors. Contractors and subcontractors shall maintain the full social security number and current address of each covered worker, and shall provide them upon request to HUD or its designee if the agency is a party to the contract, but if the agency is not such a party, the contractor will submit the payrolls to the applicant sponsor, or owner, as the case may be, for transmission to HUD or its designee, the contractor, or the Wage and Hour Division of the Department of Labor for purposes of an investigation or audit of compliance with prevailing wage requirements. It is not a violation of this subparagraph for a prime contractor to require a subcontractor to provide addresses and social security numbers to the prime contractor for its own records, without weekly submission to HUD or its designee. (Approved by the Office of Management and Budget under OMB Control Number 1215-0149.)

(b) Each payroll submitted shall be accompanied by a "Statement of Compliance," signed by the contractor or subcontractor or his or her agent who pays or supervises the payment of the persons employed under the contract and shall certify the following:

(1) That the payroll for the payroll period contains the information required to be provided under 29 CFR 5.5 (a)(3)(ii), the appropriate information is being maintained under 29 CFR 5.5(a)(3)(i), and that such information is correct and complete;

(2) That each laborer or mechanic (including each helper, apprentice, and trainee) employed on the contract during the payroll period has been paid the full weekly wages earned, without rebate, either directly or indirectly, and that no deductions have been made either directly or indirectly from the full wages earned, other than permissible deductions as set forth in 29 CFR Part 3;

(3) That each laborer or mechanic has been paid not less than the applicable wage rates and fringe benefits or cash equivalents for the classification of work performed, as specified in the applicable wage determination incorporated into the contract.

(c) The weekly submission of a properly executed certification set forth on the reverse side of Optional Form WH-347 shall satisfy the requirement for submission of the "Statement of Compliance" required by subparagraph A.3.(ii)(b).

(d) The falsification of any of the above certifications may subject the contractor or subcontractor to civil or criminal prosecution under Section 1001 of Title 18 and Section 231 of Title 31 of the United States Code.

(iii) The contractor or subcontractor shall make the records required under subparagraph A.3.(i) available for inspection, copying, or transcription by authorized representatives of HUD or its designee or the Department of Labor, and shall permit such representatives to interview employees during working hours on the job. If the contractor or subcontractor fails to submit the required records or to make them available, HUD or its designee may, after written notice to the contractor, sponsor, applicant or owner, take such action as may be necessary to cause the suspension of any further payment, advance, or guarantee of funds. Furthermore, failure to submit the required records upon request or to make such records available may be grounds for debarment action pursuant to 29 CFR 5.12.

4. Apprentices and Trainees.

(i) Apprentices. Apprentices will be permitted to work at less than the predetermined rate for the work they performed when they are employed pursuant to and individually registered in a bona fide apprenticeship program registered with the U.S. Department of Labor, Employment and Training Administration, Office of Apprenticeship Training, Employer and Labor Services, or with a State Apprenticeship Agency recognized by the Office, or if a person is employed in his or her first 90 days of probationary employment as an apprentice in such an apprenticeship program, who is not individually registered in the program, but who has been certified by the Office of Apprenticeship Training, Employer and Labor Services or a State Apprenticeship Agency (where appropriate) to be eligible for probationary employment as an apprentice. The allowable ratio of apprentices to journeymen on the job site in any craft classification shall not be greater than the ratio permitted to the contractor as to the entire work force under the registered program. Any worker listed on a payroll at an apprentice wage rate, who is not registered or otherwise employed as stated above, shall be paid not less than the applicable wage rate on the wage determination for the classification of work actually performed. In addition, any apprentice performing work on the job site in excess of the ratio permitted under the registered program shall be paid not less than the applicable wage rate on the wage determination for the work actually performed. Where a contractor is performing construction on a project in a locality other than that in which its program is registered, the ratios and wage rates (expressed in percentages of the journeyman's hourly rate) specified in the contractor's or subcontractor's registered program shall be observed. Every apprentice must be paid at not less than the rate specified in the registered program for the apprentice's level of progress, expressed as a percentage of the journeymen hourly rate specified in the applicable wage determination. Apprentices shall be paid fringe benefits in accordance with the provisions of the apprenticeship program. If the apprenticeship program does not specify fringe benefits, apprentices must be paid the full amount of fringe benefits listed on the wage determination for the applicable classification. If the Administrator determines that a different practice prevails for the applicable apprentice classification, fringes shall be paid in accordance with that determination. In the event the Office of Apprenticeship Training, Employer and Labor Services, or a State Apprenticeship Agency recognized by the Office, withdraws approval of an apprenticeship program, the contractor will no longer be permitted to utilize apprentices at less than the applicable predetermined rate for the work performed until an acceptable program is approved.

(ii) Trainees. Except as provided in 29 CFR 5.16, trainees will not be permitted to work at less than the predetermined rate for the work performed unless they are employed pursuant ',to and individually registered in a program which has received prior approval, evidenced by formal certification by the U.S. Department of Labor, Employment and Training Administration. The ratio of trainees to journeymen on the job site shall not be greater than permitted under the plan approved by the Employment and Training Administration. Every trainee must be paid at not less than the rate specified in the approved program for the trainee's level of progress, expressed as a percentage of the journeyman hourly rate specified in the applicable wage determination. Trainees shall be paid fringe benefits in accordance with the provisions of the trainee program. If the trainee program does not mention fringe benefits, trainees shall be paid the full amount of fringe benefits listed on the wage determination unless the Administrator of the Wage and Hour Division determines that there is an apprenticeship program associated with the corresponding journeyman wage rate on the wage determination which provides for less than full fringe benefits for apprentices. Any employee listed on the payroll at a trainee rate who is not registered and participating in a training plan approved by

the Employment and Training Administration shall be paid not less than the applicable wage rate on the wage determination for the work actually performed. In addition, any trainee performing work on the job site in excess of the ratio permitted under the registered program shall be paid not less than the applicable wage rate on the wage determination for the work actually performed. In the event the Employment and Training Administration withdraws approval of a training program, the contractor will no longer be permitted to utilize trainees at less than the applicable predetermined rate for the work performed until an acceptable program is approved.

(iii) Equal employment opportunity. The utilization of apprentices, trainees and journeymen under 29 CFR Part 5 shall be in conformity with the equal employment opportunity requirements of Executive Order 11246, as amended, and 29 CFR Part 30.

5. Compliance with Copeland Act requirements. The contractor shall comply with the requirements of 29 CFR Part 3 which are incorporated by reference in this contract

6. Subcontracts. The contractor or subcontractor will insert in any subcontracts the clauses contained in subparagraphs 1 through 11 in this paragraph A and such other clauses as HUD or its designee may by appropriate instructions require, and a copy of the applicable prevailing wage decision, and also a clause requiring the subcontractors to include these clauses in any lower tier subcontracts. The prime contractor shall be responsible for the compliance by any subcontractor or lower tier subcontractor with all the contract clauses in this paragraph.

7. Contract termination; debarment. A breach of the contract clauses in 29 CFR 5.5 may be grounds for termination of the contract and for debarment as a contractor and a subcontractor as provided in 29 CFR 5.12.

8. Compliance with Davis-Bacon and Related Act Requirements. All rulings and interpretations of the Davis-Bacon and Related Acts contained in 29 CFR Parts 1, 3, and 5 are herein incorporated by reference in this contract

9. Disputes concerning labor standards. Disputes arising out of the labor standards provisions of this contract shall not be subject to the general disputes clause of this contract. Such disputes shall be resolved in accordance with the procedures of the Department of Labor set forth in 29 CFR Parts 5, 6, and 7. Disputes within the meaning of this clause include disputes between the contractor (or any of its subcontractors) and HUD or its designee, the U.S. Department of Labor, or the employees or their representatives.

10. (i) Certification of Eligibility. By entering into this contract the contractor certifies that neither it (nor he or she) nor any person or firm who has an interest in the contractor's firm is a person or firm ineligible to be awarded Government contracts by virtue of Section 3(a) of the Davis-Bacon Act or 29 CFR 5.12(a)(1) or to be awarded HUD contracts or participate in HUD programs pursuant to 24 CFR Part 24.

(ii) No part of this contract shall be subcontracted to any person or firm ineligible for award of a Government contract by virtue of Section 3(a) of the Davis-Bacon Act or 29 CFR 5.12(a)(1) or to be awarded HUD contracts or participate in HUD programs pursuant to 24 CFR Part 24.

(iii) The penalty for making false statements is prescribed in the U.S. Criminal Code, 18 U.S.C. 1001. Additionally, U.S. Criminal Code, Section 1 01 0, Title 18, U.S.C., "Federal Housing Administration transactions", provides in part: "Whoever, for the purpose of . . . influencing in any way the action of such Administration..... makes, utters or publishes any statement knowing the same to be false..... shall be fined not more than $5,000 or imprisoned not more than two years, or both."

11. Complaints, Proceedings, or Testimony by Employees. No laborer or mechanic to whom the wage, salary, or other labor standards provisions of this Contract are applicable shall be discharged or in any other manner discriminated against by the Contractor or any subcontractor because such employee has filed any complaint or instituted or caused to be instituted any proceeding or has testified or is about to testify in any proceeding under or relating to the labor standards applicable under this Contract to his employer.

B. Contract Work Hours and Safety Standards Act. The provisions of this paragraph B are applicable where the amount of the prime contract exceeds $100,000. As used in this paragraph, the terms "laborers" and "mechanics" include watchmen and guards.

(1) Overtime requirements. No contractor or subcontractor contracting for any part of the contract work which may require or involve the employment of laborers or mechanics shall require or permit any such laborer or mechanic in any workweek in which the individual is employed on such work to work in excess of 40 hours in such workweek unless such laborer or mechanic receives compensation at a rate not less than one and one-half times the basic rate of pay for all hours worked in excess of 40 hours in such workweek.

(2) Violation; liability for unpaid wages; liquidated damages. In the event of any violation of the clause set forth in subparagraph (1) of this paragraph, the contractor and any subcontractor responsible therefor shall be liable for the unpaid wages. In addition, such contractor and subcontractor shall be liable to the United States (in the case of work done under contract for the District of Columbia or a territory, to such District or to such territory), for liquidated damages. Such liquidated damages shall be computed with respect to each individual laborer or mechanic, including watchmen and guards, employed in violation of the clause set forth in subparagraph (1) of this paragraph, in the sum of $10 for each calendar day on which such individual was required or permitted to work in excess of the standard workweek of 40 hours without payment of the overtime wages required by the clause set forth in sub paragraph (1) of this paragraph.

(3) Withholding for unpaid wages and liquidated damages. HUD or its designee shall upon its own action or upon written request of an authorized representative of the Department of Labor withhold or cause to be withheld, from any moneys payable on account of work performed by the contractor or subcontractor under any such contract or any other Federal contract with the same prime contract, or any other Federally-assisted contract subject to the Contract Work Hours and Safety Standards Act which is held by the same prime contractor such sums as may be determined to be necessary to satisfy any liabilities of such contractor or subcontractor for unpaid wages and liquidated damages as provided in the clause set forth in subparagraph (2) of this paragraph.

(4) Subcontracts. The contractor or subcontractor shall insert in any subcontracts the clauses set forth in subparagraph (1) through (4) of this paragraph and also a clause requiring the subcontractors to include these clauses in any lower tier subcontracts. The prime contractor shall be responsible for compliance by any subcontractor or lower tier subcontractor with the clauses set forth in subparagraphs (1) through (4) of this paragraph.

C. Health and Safety. The provisions of this paragraph C are applicable where the amount of the prime contract exceeds $100,000.

(1) No laborer or mechanic shall be required to work in surroundings or under working conditions which are unsanitary, hazardous, or dangerous to his health and safety as determined under construction safety and health standards promulgated by the Secretary of Labor by regulation.

(2) The Contractor shall comply with all regulations issued by the Secretary of Labor pursuant to Title 29 Part 1926 and failure to comply may result in imposition of sanctions pursuant to the Contract Work Hours and Safety Standards Act, (Public Law 91-54, 83 Stat 96). 40 USC 3701 et seq.

(3) The contractor shall include the provisions of this paragraph in every subcontract so that such provisions will be binding on each subcontractor. The contractor shall take such action with respect to any subcontractor as the Secretary of Housing and Urban Development or the Secretary of Labor shall direct as a means of enforcing such provisions.

MBE/WBE Contact/Solicitation Statement

The Subrecipient and Prime Contractor are encouraged to solicit a minimum of 5 quotes/bids from minority/female owned businesses for all CDBG/HOME funded projects. Please refer to the MBE/WBE directory as needed.

_____
Project Name Subrecipient or Company Name

_____
Contact Person Telephone Number

Please list the minority- and/or woman-owned businesses and contractors from which you solicited quotes or bids in regard to this contract.

Company Name & Telephone #	MBE (×)	WBE (×)	Type of Work and/or Material to be Supplied	Dollar Amount of Quote

_____
Authorized Signature Print Name

_____
Title Date

THE DELAWARE COUNTY

DIRECTORY OF

MINORITY- & WOMAN-OWNED

AND SECTION 3

CONTRACTORS AND BUSINESSES

Prepared by the County of Delaware

OHCD Office of Housing and Community Development

600 N. Jackson Street, Rm. 101, Media, PA 19063 (610) 891-5425

Revised, August 2019

INTRODUCTION

This directory is published as an information listing only. It has been produced in response to HUD requirements to facilitate the use of minority and woman-owned and Section 3 contractors and businesses. Delaware County does not endorse the products and services offered nor does it vouch for the capacity, workmanship, financial stability, or minority status of the businesses listed in this directory. Neither the County of Delaware, its agents or anyone distributing the directory make any warranty regarding the contents of this directory and will not be liable or responsible for any loss, damages, or injury to persons or property in any manner arising out of or incident to the use of this directory, including all consequential damages. All listings and advertisements have been accepted for publication on the presumption that the information is true. This directory is also a working document that is neither exhaustive nor all-inclusive and will be updated on a periodic schedule. To be included in the next addition to this directory, please contact the Delaware County Office of Housing and Community Development at (610) 891-4312, 600 N. Jackson Street, Room 101, Media, PA 19063.

This directory has been updated using the original resource directory and the PA Department of General Services, MBE/WBE website:

http://www.dgs.internet.state.pa.us/SBPI/AlphaResults.aspx

http://www.dgs.internet.state.pa.us/SmallDiverseBusinessSearch/

https://portalapps.hud.gov/Sec3BusReg/BRegistry/SearchBusiness

Note: *** designates the MBE/WBE business is also registered as a Section 3 Business.

TABLE OF CONTENTS

A&E SERVICES

MBE/WBE:

ANN ROTHMANN DBA
1224 Baltimore Pike, Suite 205
Chadds Ford, PA 19317
(610) 945-1839
Ann Rothmann
arothmann@aol.com
arpe1991@gmail.com

APEX TECHNIOLOGY GROUP LLC
1224 Baltimore Pike, Suite 205
Chadds Ford, PA 19317
(610) 558-0555
Ali Shahid
ali@atgmail.net

CUETOKEARNEY DESIGN LLC
110 Park Avenue, Suite 1
Swathmore, PA 19081
(610) 544-1722
Claudia Cueto
claudia@cuetokearney.com
cuetok@comcast.net

J&M PRESERVATION STUDIO LLC
105 Rutgers Avenue, Suite 244
Swathmore, PA 19081
(215) 769-1133
Jessica Senker
info@jmpreservation.com

KOH ENGINEERS, LLC ***
325 Chestnut Street, Suite 800
Philadelphia, PA 19106
Duane A. Quamina
kohengineers@gmail.com

THERESA PEARCE SHEPHARD DBA
335 W. State Street
Media, PA 19063
(484) 442-8137
Theresa Shephard
theresa@shephardrestoration.com
info@shephardrestoration.com

TREC GROUP INC
900 Old Marple Road
Springfield, PA 19064
(610) 328-6465
Barbara Tulskie
BARB@trecgroup.com

CONCRETE, CURBS & CURBING, MASONRY, SEWERS

MBE/WBE:

ALBERT G CIPOLLONI, JR & SONS, INC
719 Highland Avenue
Morton, PA 19070
(610) 543-6144
Carol Cipolloni
agcip@live.com

COCCO CONTRACTING CORP
201 Saville Avenue
Eddystone PA, 19022
(610) 874-3400
Lois E. Cocco
Coccocontracting@aol.com

COMPACTION GROUTING SERVICES INC
375 Parkmount Road
Media, PA 19063
(610) 558-8999
Kathrine L Miluski
kmiluski@cgsinc.net; kaylmer@cgsinc.net

CONNELLY CONSTRUCTION CORP
1126 Upper State Road
P.O. Box 587
Montgomerryville, PA 18926
(215) 362-6283
Rita Connelly
estimating.dept@connellycorp.com

GORECON INC
PO Box 1778
Doylestown, PA 18901
(267) 880-0890
Brina Sweet
brinasweet@goreconinc.com

MARA RESTORATION INC
150 Roesch Avenue
Oreland, PA 19075
(215) 887-9900
Patty McNamara
pmcnamara@mararestoration.com

OLD PHILADELPHIA ASSOCIATES INC
315 S. Bolmar Street
West Chester, PA 19380
(610) 436-8022
Christina Patrone
cpatrone@oldphila.com

QUINN CONSTRUCTION INC
1017 4th Avenue, Suite 100
Essington, PA 19029
(610) 586-1332
Elizabeth Quinn
equinn@quinnconstruction.com

CONSTRUCTION/GENERAL CONSTRUCTION

MBE/WBE:

AKM CONSTRUCTION SERVICES INC
350 S. Governor Printz Boulevard
Lester, PA 19029
(610) 362-0210
Kimberly Moore
akmconstservices@aol.com
moorek-akm@comcast.net

AHJ CONSTRUCTION CO
1208 Main Street
Darby, PA 19023
(215) 900-3508
Henry Robinson
info@ahjconstructionco.com;
hrobinson@ahjconstructionco.com

CHOATES G CONTRACTING LLC ***
225 Lincoln Highway
Philadelphia, PA 19111
(267) 864-7817
Darrel Choates, Jr.
darellchoates@gmail.com

HP TOTAL CONSTRUCTION ***
30 South 15th Street
Philadelphia, PA 19102
(215) 828-1944
Michael Bowman
Bowmanmichael215@gmail.com

LYON CONTRACTING SERVICES, LLC ***
702 N 3rd Street, Suite 209
Philadelphia, PA 19148
(267) 419-7800
Daniel Labrador
lyoncontracting@comcast.net

NESMITH & COMPANY INC
2440 Tasker Street
Philadelphia, PA 19145
(215) 755-4570
Karen Burgoyne
k.burgoyne@nesmith-electric.com;
admin@nesmithcompany.com

PERRYMAN BUILDING & CONSTRUCTION
100 N. 20th Street, Suite 305
Philadelphia, PA 19103
(267) 538-0700
Angelo Perryman
angelop@perrymanbc.com

QUANTUM BUILDERS
295 E Swedesford Road, Suite 282
Wayne, PA 19087
(610) 453-8662
Victor Milbourne
victor@militaryconstruction.net;

SECTION 3:

ATTRACTIVE PROPERTIES
843 Tyson Avenue
Abington, PA 19001
(267) 625-7107
Alan Simbo
alan@remodelphilly.com

NEW AGE DEVELOPMENT GROUP INC
125 East Elm, Suite 300
Conshohocken, PA 19428
(215) 676-1326
Dexter Lanigan
dl@newagedevelopment.com

CW3 INC
P.O. Box 794
Glenside, PA 19038
(215) 469-1302
Clifford Washington
cw3inc@gmail.com

ADKINS MANAGEMENT INC
8109 Vermeer Place
Philadelphia, PA 19153
(267) 249-9843
Sheila Adkins
adkinsmus@aol.com

METRO SERVICE GROUP INC
1 International Plaza, Suite 550
Philadelphia, PA 19113
(844) 520-8331
Melissa Tate
mtate@metroservicegroup.com

THE Q GROUP BUILDERS INC
138 Railroad Drive
Warminster, PA 18974
(215) 942-6700
Angelo Quisito
angelo@theqgroup.biz

DEMOLITION CONTRACTORS

MBE/WBE:

TAMCO CONSTRUCTION INC
539 E Dark Hollow Road
Pipersville, PA 18947
(215) 416-3646
Tammy Johnson
tamcoconstruction@gmail.com

ELECTRICAL CONTRACTORS

MBE/WBE:

JUST IT'S ELECTRIC, LLC
P.O. Box 881
Bala Cynwyd, PA 19004
(215) 473-5878
Erik Truxon
etruxon@justitselectric.com;
info@justitselectric.com

MJK ELECTRICAL CORPORATION
5957 Addison Street
Philadelphia, PA 19143
(215) 471-4110
Michael J. Jones
mike@mjkecorp.com

SECTION 3:

BILAL BUSINESS WORKS, LLC
441 West Champlost Street, Apt 2
Philadelphia, PA 19120
(215) 815-3455
Lloyd Bilal
lloydzbilal@gmail.com

ENVIROMENTAL CONTRACTORS/CONSULTANTS

MBE/WBE:

ANCHOR CONSULTANTS LLC
1224 BALTIMORE PIKE, Suite 205
Chadds Ford, PA 19317
(610) 945-1839
Seema Nadeem
MARKETING@ANCHOR-CONSULTANTS.COM

FRERRICK CONSTRUCTION CO INC
811 Ivy Hill Road
Philadelphia, PA 19150
(215) 233-1600
Janice Ferrick
Janice.Ferrick@comcast.net

KEATING ENVIROMENTAL
835 Spring Drive, Suite 200
Exton, PA 19341
(484) 876-2200
Keith Choper
info@kempartners.com

WESTCHESTER ENVIRONMENTAL LLC
307 N Walnut Street
West Chester, PA 19380
(610) 431-7545
Matthew Abraham
mabraham@westchesterenvironmental.com

SECTION 3:

ENERGY COORDINATING AGENCY OF PHILADELPHIA
106 West Clearfield Street
Philadelphia, PA 19133
(215) 609-1000
Steve Luxton
stevel@ecasavesenergy.org

EXCAVATION

MBE/WBE:

FLOYD G HERSH INC
5275 McLean Station Road
Green Lane, PA 18054
(215) 679-2833
Michele Peart
michelep@fghershinc.com;
mikep@fghershinc.com

LANDSCAPING/HORTICULTURISTS

MBE/WBE:

CAST CONSTRUCTION INC
11 Graystone Drive
Chadds Ford, PA 19317
(610) 459-5080
Diane Schiavino
castconstruction@comcast.net

RAM-T CORPORATION
1121 Downingtown Pike
West Chester, PA 19380
(610) 269-4495
Cathy DiLuigi
estimating@ramtcorporation.com
dturner@ramtcorporation.com

RECREATION RESOURCE USA LLC
425 McFarlan Road, Suite 100
Kennett Square, PA 19348
(610) 444-4402
Kevin Umbreit
info@recreation-resource.com

PAINTING CONTRACTORS

MBE/WBE:

GRACIE PAINTING SERVICES, INC
1222 East Columbia Avenue
Philadelphia, PA 19125
(215) 345-0956
Maude Martin
jvgpaintng@aol.com

SECTION 3:

EXCELLENT PAINTING USA, LLC
3548 Woodhaven Rd
Philadelphia, PA 19154
(267) 592-7593
craigexcellentpaintingusa@gmail.com

PLUMBING/MECHANICAL CONTRACTORS

MBE/WBE:

CROMEDY CONSTRUCTION CORPORATION
5702 Newtown Avenue
Philadelphia, PA 19120 USA
(215) 437-7606
Billy Cromey
bcromedy@cromedyconstruction.com

JOHN KINKAID HEATING & AIR
1366 Fitzwatertown Road
Roslyn, PA 19001
(215) 657-1262
Melissa Ryan
John.Kinkaid.HVAC@Gmail.com

ROOFING CONTRACTORS

MBE/WBE:

MUNN ROOFING CORP
3213 Unionville Pike
Hatfield, PA 19440
(215) 997-2258
Chad Munn
info@munnroofingcorp.com
Tonya@munnroofingcorp.com

SECTION 3:

CLARK ROOFING CO
6727 Lindbergh Blvd
Philadelphia, PA 19142
(215) 235-2000

STRUCTURAL STEEL/IRON/METAL CONTRACTORS

MBE/WBE:

E & K CONSTRUCTION SERVICES
3070 Bristol Pike, Build 1 Suite 102C
Bensalem, PA 19020
(215) 633-7200
Sheri Etter-Levins
eandkconstructionservices@verizon.net;
sheri_eandk@verizon.net

L B CONSTRUCTION ENTERPRISES INC
905 Bethlehem Pike, Number 232
Spring House, PA 19477
(215) 421-3978
LaMar Childs
lamar@lbconstructionenterprises.com;
mandy@lbconstructionenterprises.com

STRUCTURAL STEEL/IRON/METAL CONTRACTORS

MBE/WBE:

PBA CONSTRUCTION INC
4999 Grays Avenue
Philadelphia, PA 19143
(215) 729-1107
Patricia Ciervo
pba1@snip.net

QUINCO CONTRACTING & MAINTENANCE
842 Arrowhead Lane, PO Box 147
Harleysville, PA 19438
(215) 513-1554
Debra Quinn
dquinn@quincocontracting.com
qcm@quincocontracting.com

WINDOWS/DOORS/FLOORING/INSULATION

MBE/WBE:

ABSTRACT OVERHEAD DOOR COMPANY, INC ***
1911 Pennsylvania Avenue
Croydon, PA 19021
(215) 781-1500
Mark Gallagher
AbstractDoor@gmail.com

GRABOYES COMMERCIAL WINDOW CO
4050 S. 26th Street, Suite 160
Philadelphia, PA 19112
(215) 625-8810
Ellis G. Guiles
ellis@graboyes.com
laura@graboyes.com

QUALITY FLOORING WORKROOM, INC
6176 Newtown Avenue
Fairless Hills, PA 19103
(215) 949-1356
Jonathan Arnold
JONARNOLD@QUALITYFLOORING.CO

SMITH FLOORING, INC ***
903 Townsend Street
Chester, PA 19013
(610) 497-9758
Angelique Hunter
ahunter@smithflooringinc.com

SUN LITE CORPORATION
3525 Lancaster Avenue
Philadelphia, PA 19104
(215) 222-4402
Joan E Schiff
joanschiff@sunlitecorp.com
admin@sunlitecorp.com

SECTION 3:

PHILLY OVERHEAD DOORS, INC
2542 Ann Street
Philadelphia, PA 19134
(215) 291-0519
Monica Shaw
philly.19134@verizon.net

SHARON HILL INSULATION
240 Cherry Street
Sharon Hill, PA 19079
(610) 476-8477
Ahmad Rahim
sharonhillinsul@yahoo.com

CERTIFICATION OF NON-SEGREGATED FACILITIES

The Bidder certified that he does not maintain or provide for his employees any segregated facilities at any of his establishments and that he does not permit his employees to perform their services at any location under his control where segregated facilities are maintained. The Bidder certifies further that he will not maintain or provide for his employees any segregated facilities at any of his establishments, and that he will not permit his employees to perform their services at any location under his control where segregated facilities are maintained. The Bidder agrees that a breach of his certification will be a violation of the Equal Opportunity Clause in any contract resulting from acceptance of this Bid. As used in this certification, the term "segregated facilities" means any waiting rooms, work areas, restrooms and washrooms, restaurants and other eating areas, timeclocks, locker rooms and other storage areas, transportation and facilities provided for employees which are segregated on the basis of race, color, religion or national origin, because of habit, local custom.

NOTE: The penalty for making false statements in offers is prescribed in 18 U.S.C. Paragraph 1001.

DATE: _____

NAME OF BIDDER: _____

BY: _____

TITLE: _____

OFFICIAL ADDRESS (INCLUDING ZIP CODE)

PHONE NO.: _____

VERIFICATION OF CONTRACTOR ELIGIBILITY AND

TERMINATION OF INELIGIBLE CONTRACTOR

I hereby certify that I / we am / are eligible for award of a Federally assisted or insured Contract.

In the event I / we am / are found ineligible after an award of Contract, said Contract shall be terminated and the matter will be referred to the Department of Labor for its action.

_____ _____

Signature Date

_____

Name of Firm

_____ _____

Subcontractor Date

_____

Name of Firm

BIDDER'S QUALIFICATIONS

All questions must be answered and the date given must be clear and comprehensive. This statement must be notarized. If necessary, questions may be answered on separate attached sheets. The Bidder may submit additional information if he so desires.

1. Name of Bidder:
2. Permanent main office address:
3. When Organized:
4. If a corporation, where incorporated:
5. How many years have you been engaged in the contracting business under your present firm or trade name?
6. Contracts on hand: Schedule these showing amount of each contract and the appropriate anticipated dates of completion.
7. General character of work performed by your company:
8. Have you ever failed to complete any work awarded to you? If so, where and why.
9. Have you ever defaulted on a contract? If so, where and why.
10. List the more important projects recently completed by your company, stating the approximate cost for each and the month and year completed.
11. List your major equipment available for this contract:
12. List experience in construction work similar in importance to this project:
13. List background and experience of the principal members of your organization, including the officers:
14. List credit available: $
15. List bank references:
16. Will you, upon request, fill out a detailed financial statement and furnish any other information which may be required by the Owner?
17. The undersigned hereby authorizes and requests any person, firm or corporation to furnish any information requested by the Owner in verification of the recitals comprising this Statement of Bidder's Qualifications.

Bidder: _____

By: _____

Title: _____

Dated this _____ day of _____, 20_____.

State of _____ §

County of _____:

_____ being duly sworn deposes and says that he is _____ of _____ and that the answers to the foregoing questions and all statements therein contained are true and correct.

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

_____ Notary Public

My commission expires: _____

COMMONWEALTH OF PENNSYLVANIA

PUBLIC WORKS EMPLOYMENT VERIFICATION FORM

Date _____

Business or Organization Name (Employer)_____

Address _____

City _____ State_____ Zip Code _____

☐ Contractor ☐ Subcontractor (check one)

Contracting Public Body _____

Contract/Project No _____

Project Description _____

Project Location _____

As a contractor/subcontractor for the above referenced public works contract, I hereby affirm that as of the above date, our company is in compliance with the Public Works Employment Verification Act ('the Act') through utilization of the federal E-Verify Program (EVP) operated by the United States Department of Homeland Security. To the best of my/our knowledge, all employees hired post January 1, 2013 are authorized to work in the United States.

It is also agreed to that all public works contractors/subcontractors will utilize the federal EVP to verify the employment eligibility of each new hire within five (5) business days of the employee start date throughout the duration of the public works contract. Documentation confirming the use of the federal EVP upon each new hire shall be maintained in the event of an investigation or audit.

I, _____, authorized representative of the company above, attest that the information contained in this verification form is true and correct and understand that the submission of false or misleading information in connection with the above verification shall be subject to sanctions provided by law.

_____

Authorized Representative Signature

PDE MASTER STANDARD TERMS AND CONDITIONS

1. **Scope of Agreement.** The Grantee will adhere to all Federal and State regulations and guidelines relating to the program funded under this agreement which constitute the conditions upon which these program funds are allocated. The Request for Proposals (RFP) and/or Program Guidelines issued by the Commonwealth of Pennsylvania (hereinafter referred to as "Commonwealth") are hereby incorporated by reference and made a part of this agreement, and all the terms, conditions and provisions of the RFP and/or Program Guidelines (unless specifically modified by this agreement) will apply to this agreement the same as if they were expressly rewritten and included here at length.

2. **Grant Construction**. The provisions of this agreement shall be construed in accordance with the provisions of the laws of the Commonwealth.

3. **Independent Capacity of Grantee**. The parties hereto agree that the Grantee, and any agents and employees of the Grantee, in the performance of this agreement, shall act in an independent capacity and not as officers, employees or agents of the Commonwealth.

4. **Assignability.** This grant may not be assigned by the Grantee either in whole or in part.

5. **Subcontracts.** Subcontracting by the Grantee shall be prohibited unless permitted by individual program guidelines or regulations.

6. **Commonwealth Held Harmless**. The Grantee agrees to indemnify and hold harmless the Commonwealth from damages to property or injuries (including death) to any person and to indemnify and hold harmless the Commonwealth for any other losses, damages or expenses, incurred in connection with the work performed by the Grantee.

7. **Copyright Indemnity**. The Grantee shall defend any suit or proceeding brought against the Commonwealth on account of any alleged infringement of any copyright arising out of the performance of this grant, including all work, services, materials, reports, studies and computer programs provided by the Grantee. This is upon the condition that the Commonwealth shall provide prompt notification in writing of such suit or proceeding, full right, authorization and opportunity to conduct the defense thereof, and full information and all reasonable cooperation for the defense of same. As principles of governmental or public law are involved, the Commonwealth may participate in the defense of any such action. The Grantee shall pay all damages and costs awarded therein against the Commonwealth. If information and assistance are furnished by the Commonwealth at the Grantee's written request, it shall be only that within the Grantee's written authorization. If any of the materials, reports, studies or computer programs provided by the Grantee are in such suit or proceeding held to constitute infringement and the use or publication thereof is enjoined, the Grantee shall, at his own expense and at his option, either procure the right to publish or continue use of such infringing materials, reports, studies or computer programs, replace them with non-infringing items, or modify them so that they are no longer infringing. The obligations of the Grantee under this paragraph continue without time limit.

8. **Nondiscrimination/Sexual Harassment Clause**. The Grantee agrees:

1. In the hiring of any employee(s) for the manufacture of supplies, performance of work, or any other activity required under the grant agreement or any subgrant agreement, contract, or subcontract, the Grantee, a subgrantee, a contractor, a subcontractor, or any person acting on behalf of the Grantee shall not discriminate by reason of race, gender, creed, color, sexual orientation, gender identity or expression, or in violation of the *Pennsylvania Human Relations Act* (PHRA) and applicable federal laws, against any citizen of this Commonwealth who is qualified and available to perform the work to which the employment relates.

2. The Grantee, any subgrantee, contractor or any subcontractor or any person on their behalf shall not in any manner discriminate by reason of race, gender, creed, color, sexual orientation, gender identity or expression, or in violation of the PHRA and applicable federal laws, against or intimidate any of its employees.

3. Neither the Grantee nor any subgrantee nor any contractor nor any subcontractor nor any person on their behalf shall in any manner discriminate by reason of race, gender, creed, color, sexual orientation, gender identity or expression, or in violation of the PHRA and applicable federal laws, in the provision of services under the grant agreement, subgrant agreement, contract or subcontract.

4. Neither the Grantee nor any subgrantee nor any contractor nor any subcontractor nor any person on their behalf shall in any manner discriminate against employees by reason of participation in or decision to refrain from participating in labor activities protected under the *Public Employee Relations Act, Pennsylvania Labor Relations Act or National Labor Relations Act,* as applicable and to the extent determined by entities charged with such Acts' enforcement, and shall comply with any provision of law establishing organizations as employees' exclusive representatives.

5. The Grantee, any subgrantee, contractor or any subcontractor shall establish and maintain a written nondiscrimination and sexual harassment policy and shall inform their employees in writing of the policy. The policy must contain a provision that sexual harassment will not be tolerated and employees who practice it will be disciplined. Posting this Nondiscrimination/Sexual Harassment Clause conspicuously in easily-accessible and well-lighted places customarily frequented by employees and at or near where the grant services are performed, shall satisfy this requirement for employees with an established work site.

6. The Grantee, any subgrantee, contractor or any subcontractor shall not discriminate by reason of race, gender, creed, color, sexual orientation, gender identity or expression, or in violation of the PHRA and applicable federal laws, against any subgrantee, contractor, subcontractor or supplier who is qualified to perform the work to which the grant relates.

7. The Grantee, and each subgrantee, contractor and subcontractor represents that it is presently in compliance with and will maintain compliance with all applicable federal, state, and local laws and regulations relating to nondiscrimination and sexual harassment. The Grantee and each subgrantee, contractor and subcontractor further represents that it has filed a Standard Form 100 Employer Information Report ("EEO-1") with the U.S. Equal Employment Opportunity Commission ("EEOC") and shall file an annual EEO-1 report with the EEOC as required for employers' subject to *Title VII* of the *Civil Rights Act of 1964*, as amended, that have 100 or more employees and employers that have federal government contracts or first-tier subcontracts and have 50 or more employees. The Grantee, any subgrantee, any contractor or any subcontractor shall, upon request and within the time periods requested by the Commonwealth, furnish all necessary employment documents and records, including EEO-1 reports, and permit access to their books, records, and accounts by the granting agency and the Bureau of Diversity, Inclusion and Small Business Opportunities for the purpose of ascertaining compliance with the provisions of this Nondiscrimination/Sexual Harassment Clause.

8. The Grantee, any subgrantee, contractor or any subcontractor shall include the provisions of this Nondiscrimination/Sexual Harassment Clause in every subgrant agreement, contract or subcontract so that those provisions applicable to subgrantees, contractors or subcontractors will be binding upon each subgrantee, contractor or subcontractor.

9. The Granter's and each subgrantee's, contractor's and subcontractor's obligations pursuant to these provisions are ongoing from and after the effective date of the grant agreement through the termination date thereof. Accordingly, the Grantee and each subgrantee, contractor and subcontractor shall have an obligation to inform the Commonwealth if, at any time during the term of the grant agreement, it becomes aware of any actions or occurrences that would result in violation of these provisions.

10. The Commonwealth may cancel or terminate the grant agreement and all money due or to become due under the grant agreement may be forfeited for a violation of the terms and conditions of this Nondiscrimination/Sexual Harassment Clause. In addition, the granting agency may proceed with debarment or suspension and may place the Grantee, subgrantee, contractor, or subcontractor in the Contractor Responsibility File.

9. **Equal Opportunity for the Handicapped**.

   a. The Grantee agrees to abide by Sections 503 and 504 of the Rehabilitation Act of 1973, as amended (Public Law 93-112, 29 U.S.C. §§793 and 794, as amended) and implementing federal regulations. The Grantee assures that any benefits, services, or employment, available through the Grantee to the public by way of this grant's funds, shall not be denied handicapped persons who are otherwise qualified or eligible for the benefits, services, or employment available as a result of this grant.

   b. The Grantee will include the provisions of paragraph 9(a) above in every subgrant under this grant so that such provision binds each subgrantee.

10. **Covenant Against Contingent Fees**. The Grantee warrants that no person or selling agency has been employed or retained to solicit or secure this grant upon an agreement or understanding for a commission, percentage, brokerage, or contingent fee, excepting bona fide employes or bona fide established commercial or selling agencies maintained by the Grantee for the purpose of securing business. For breach or violation of this warranty, the Commonwealth shall have the right to annul this grant without liability or in its discretion to deduct from the grant price or consideration, or otherwise recover, the full amount of such commission, percentage, brokerage, or contingent fee.

11. **Sensitive Information**. The Grantee shall not publish or otherwise disclose, except to the Commonwealth and except matters of public record, any information or data obtained hereunder from private individuals, organizations, or public agencies, in a publication whereby the information or data furnished by or about any particular person or establishment can be identified, except with the consent of such person or establishment. While this grant is in effect any documentation provided by the Grantee, if marked as proprietary information, shall be held by the Commonwealth to the best of its ability as confidential and protected from unauthorized disclosure. The Commonwealth shall have the right to reproduce, including a proprietary notice, or copy any portion of such documentation for its own use. All such copies will be treated as the property of the Grantee.

12. **Publication Rights**. All property rights, including publication rights, in the interim, draft and final reports and other documentation produced by the Grantee in connection with the work provided for under this grant, shall rest with the Commonwealth. The Grantee shall not publish any of the results of the work without the written permission of the Department of Education.

13. **Termination**. The Commonwealth has the right to terminate this grant for any of the following reasons:

   a. **TERMINATION FOR CONVENIENCE:** The Commonwealth may terminate this grant for its convenience if the Commonwealth determines termination to be in its best interest. The Grantee shall be paid for work satisfactorily completed prior to the effective date of the termination, but in no event shall the Grantee be entitled to recover loss of profits.

   b. **NONAPPROPRIATION:** The Commonwealth's obligations are contingent upon appropriation of funds for the grant purpose and the availability of sufficient funds to pay Grantee's full allocation. The Commonwealth shall have the right to terminate this grant because of the nonavailability of sufficient funds (state and/or federal) for the Commonwealth to pay for the services to be rendered under this grant, including but not limited to the reservation of funds.

   c. **TERMINATION FOR CAUSE:** The Commonwealth reserves the right to terminate this grant upon written notice for Grantee's nonperformance or inadequate performance.

14. **Disputes**. All questions or disputes arising between the parties hereto respecting any matter pertaining to this Agreement or any part thereof or any breach of contract arising thereunder shall be referred to the Pennsylvania Secretary of Education (under procedures which can be found at 1 Pa. Code Chapters 31, 33, and 35). Settlement of disputes under this provision must be prior to subsequent payments to Grantee. The foregoing provision notwithstanding, any dispute between the parties regarding matters governed by 34 C.F.R. 76.783 shall be resolved in accordance with the procedures in 34 C.F.R. 76.401(d).

15. **Record Retention**.

a. The Grantee will create and maintain program and accounting records required by the Commonwealth and agrees that a program review may be conducted at any reasonable time by Federal and State personnel and by any other persons duly authorized by the Federal grantor agency or the Commonwealth. Review of program and accounting records will be conducted in accordance with applicable Federal and State policies and regulations.

b. The Grantee will maintain all statistical records of the program, as required by the Commonwealth, and will produce program narrative and statistical data at times prescribed, and on forms provided, by the Commonwealth.

c. All required records will be retained in accordance with the statute and regulations governing the individual grant program.

d. Regardless of any other applicable requirement, all records pertinent to this Agreement, including financial, statistical, property and participant, and supporting documentation shall be retained for a period of at least **six (6) years** from the date of submission of the final closeout report for this Agreement or until all audits are complete and findings on all claims have been completely resolved.

e. The Grantee shall make any grant application, program evaluation, periodic program plan, or report relating to any program operated under this Agreement available for public inspection upon request.

16. **Insurance**. The Grantee shall provide public liability, property damage and worker's compensation insurance, insuring as they may appear, the interest of all parties to this Agreement against any and all claims which may arise out of Grantee's operations under the terms of this Agreement. It is agreed that in the event any carrier of such insurance exercises cancellation, notice will be made immediately to the Commonwealth of such cancellation. The Grantee shall accept full responsibility for the payment of required premiums for worker's compensation, employment security, and social security, as well as all income tax deductions and any other taxes or payroll deductions required by law for its employees who are performing services specified by the Agreement.

17. **Patents and Copyrights**. If, in the course of performance of services pursuant to this agreement, the Grantee produces patentable items, patent rights processes or inventions, said items, rights, processes, inventions or discoveries become the property of the Commonwealth.

If, in the course of the performance of services pursuant to this agreement, the Grantee produces copyrightable material, the copyright rests with the Commonwealth. The Grantee shall provide public notice of the Commonwealth's copyright ownership by placing the following designation on all copies of the material: (1) the symbol c or the word "Copyright" or the abbreviation "Copr."; (2) the year of first publication; and (3) the name of the owner of the copyright. For example: "Copyright 1995 Commonwealth of Pennsylvania." The notice is to be affixed to all copies in such a manner and location as to give reasonable notice of the claim of the copyright.

The Commonwealth shall have unrestricted authority to reproduce, distribute and use any submitted report, data, or material, and any software or modifications, and any associated documentation that is designed or developed and delivered to the Commonwealth under this Agreement.

18. **Grantee Integrity Provisions.** It is essential that those who seek to contract with the Commonwealth of Pennsylvania ("Commonwealth") observe high standards of honesty and integrity. They must conduct themselves in a manner that fosters public confidence in the integrity of the Commonwealth contracting and procurement process.

1. DEFINITIONS. For purposes of these Contractor Integrity Provisions, the following terms shall have the meanings found in this Section:

a. "Affiliate" means two or more entities where (a) a parent entity owns more than fifty percent of the voting stock of each of the entities; or (b) a common shareholder or group of shareholders owns more than fifty percent of the voting stock of each of the entities; or (c) the entities have a common proprietor or general partner.

b. "Consent" means written permission signed by a duly authorized officer or employee of the Commonwealth, provided that where the material facts have been disclosed, in writing, by prequalification, bid, proposal, or contractual terms, the Commonwealth shall be deemed to have consented by virtue of the execution of this contract.

c. "Contractor" means the individual or entity, that has entered into this contract with the Commonwealth.

d. "Contractor Related Parties" means any affiliates of the Contractor and the Contractor's executive officers, Pennsylvania officers and directors, or owners of 5 percent or more interest in the Contractor.

e. "Financial Interest" means either:

(1) Ownership of more than a five percent interest in any business; or

2) Holding a position as an officer, director, trustee, partner, employee, or holding any position of management.

f. "Gratuity" means tendering, giving, or providing anything of more than nominal monetary value including, but not limited to, cash, travel, entertainment, gifts, meals, lodging, loans, subscriptions, advances, deposits of money, services, employment, or contracts of any kind. The exceptions set forth in the Governor's Code of Conduct. Executive Order 1980-18, the 4 Pa. Code §7.153(b), shall apply.

g. "Non-bid Basis" means a contract awarded or executed by the Commonwealth with Contractor without seeking bids or proposals from any other potential bidder or offeror.

2. In furtherance of this policy, Contractor agrees to the following:

a. Contractor shall maintain the highest standards of honesty and integrity during the performance of this contract and shall take no action in violation of state or federal laws or regulations or any other applicable laws or regulations, or other requirements applicable to Contractor or that govern contracting or procurement with the Commonwealth.

b. Contractor shall establish and implement a written business integrity policy, which includes, at a minimum, the requirements of these provisions as they relate to the Contractor activity with the Commonwealth and Commonwealth employees and which is made known to all Contractor employees. Posting these Contractor Integrity Provisions conspicuously in easily-accessible and well-lighted places customarily frequented by employees and at or near where the contract services are performed shall satisfy this requirement.

c. Contractor, its affiliates, agents, employees and anyone in privity with Contractor shall not accept, agree to give, offer, confer, or agree to confer or promise to confer, directly or indirectly, any gratuity or pecuniary benefit to any person, or to influence or attempt to influence any person in violation of any federal or state law, regulation, executive order of the Governor of Pennsylvania, statement of policy, management directive or any other published standard of the Commonwealth in connection with performance of work under this contract, except as provided in this contract.

d. Contractor shall not have a financial interest in any other contractor, subcontractor, or supplier providing services, labor, or material under this contract, unless the financial interest is disclosed to the Commonwealth in writing and the Commonwealth consents to Contractor's financial interest prior to Commonwealth execution of the contract. Contractor shall disclose the financial interest to the Commonwealth at the time of bid or proposal submission, or if no bids or proposals are solicited, no later than Contractor's submission of the contract signed by Contractor.

e. Contractor certifies to the best of its knowledge and belief that within the last five (5) years Contractor or Contractor Related Parties have not:

(1) been indicted or convicted of a crime involving moral turpitude or business honesty or integrity in any jurisdiction;

(2) been suspended, debarred or otherwise disqualified from entering into any contract with any governmental agency;

(3) had any business license or professional license suspended or revoked;

(4) had any sanction or finding of fact imposed as a result of a judicial or administrative proceeding related to fraud, extortion, bribery, bid rigging, embezzlement, misrepresentation or anti-trust; and

(5) been, and is not currently, the subject of a criminal investigation by any federal, state or local prosecuting or investigative agency and/or civil anti-trust investigation by any federal, state or local prosecuting or investigative agency.

If Contractor cannot so certify to the above, then it must submit along with its bid, proposal or contract a written explanation of why such certification cannot be made and the Commonwealth will determine whether a contract may be entered into with the Contractor. The Contractor's obligation pursuant to this certification is ongoing from and after the effective date of the contract through the termination date thereof. Accordingly, the Contractor shall have an obligation to immediately notify the Commonwealth in writing if at any time during the term of the contract if becomes aware of any event which would cause the Contractor's certification or explanation to change. Contractor acknowledges that the Commonwealth may, in its sole discretion, terminate the contract for cause if it learns that any of the certifications made herein are currently false due to intervening factual circumstances or were false or should have been known to be false when entering into the contract.

f. Contractor shall comply with the requirements of the Lobbying Disclosure Act (65 Pa.C.S. §13A01 et seq.) regardless of the method of award. If this contract was awarded on a Non-bid Basis, Contractor must also comply with the requirements of the Section 1641 of the Pennsylvania Election Code (25 P.S. §3260a).

g. When Contractor has reason to believe that any breach of ethical standards as set forth in law, the Governor's Code of Conduct, or these Contractor Integrity Provisions has occurred or may occur, including but not limited to contact by a Commonwealth officer or employee which, if acted upon, would violate such ethical standards, Contractor shall immediately notify the Commonwealth contracting officer or the Office of the State Inspector General in writing.

h. Contractor, by submission of its bid or proposal and/or execution of this contract and by the submission of any bills, invoices or requests for payment pursuant to the contract, certifies and represents that it has not violated any of these Contractor Integrity Provisions in connection with the submission of the bid or proposal, during any contract negotiations or during the term of the contract, to include any extensions thereof. Contractor shall immediately notify the Commonwealth in writing of any actions for occurrences that would result in a violation of these Contractor Integrity Provisions. Contractor agrees to reimburse the Commonwealth for the reasonable costs of investigation incurred by the Office of the State Inspector General for investigations of the Contractor's compliance with the terms of this or any other agreement between the Contractor and the Commonwealth that results in the suspension or debarment of the Contractor. Contractor shall not be responsible for investigative costs for investigations that do not result in the Contractor's suspension or debarment.

i. Contractor shall cooperate with the Office of the State Inspector General in its investigation of any alleged Commonwealth agency or employee breach of ethical standards and any alleged Contractor non-compliance with these Contractor Integrity Provisions. Contractor agrees to make identified Contractor employees available for interviews at reasonable times and places. Contractor, upon the inquiry or request of an Inspector General, shall provide, or if appropriate, make promptly available for inspection or copying, any information of any type or form deemed relevant by the Office of the State Inspector General to Contractor's integrity and compliance with these provisions. Such information may include, but shall not be limited to, Contractor's business or financial records, documents or files of any type or form that refer to or concern this contract. Contractor shall incorporate this paragraph in any agreement, contract or subcontract it enters into in the course of the performance of this contract/agreement solely for the purpose of obtaining subcontractor compliance with this provision. The incorporation of this provision in a subcontract shall not create privity of contract between the Commonwealth and any such subcontractor, and no third party beneficiaries shall be created thereby.

j. For violation of any of these Contractor Integrity Provisions, the Commonwealth may terminate this and any other contract with Contractor, claim liquidated damages in an amount equal to the value of anything received in breach of these Provisions, claim damages for all additional costs and expenses incurred in obtaining another contractor to complete performance under this contract, and debar and suspend Contractor from doing business with the Commonwealth. These rights and remedies are cumulative, and the use or non-use of any one shall not preclude the use of all or any other. These rights and remedies are in addition to those the Commonwealth may have under law, statute, regulation, or otherwise.

19. The Commonwealth will not be obligated to pay for services or goods provided without a fully executed agreement.

20. **Offset Provision**. The Grantee agrees that the Commonwealth may set off the amount of any state tax liability or other obligation of the Grantee or its subsidiaries to the Commonwealth against any payments due the Grantee under any contract with the Commonwealth.

21. **Contractor Responsibility Provisions**.

For the purpose of these provisions, the term contractor is defined as any person, including, but not limited to, a bidder, offeror, loan recipient, grantee or lessor, who has furnished or performed or seeks to furnish or perform, goods, supplies, services, leased space, construction or other activity, under a contract, grant, lease, purchase order or reimbursement agreement with the Commonwealth of Pennsylvania (Commonwealth). The term contractor includes a permittee, licensee, or any agency, political subdivision, instrumentality, public authority, or other public entity in the Commonwealth.

1. The Contractor certifies, in writing, for itself and its subcontractors required to be disclosed or approved by the Commonwealth, that as of the date of its execution of this Bid/Contract, that neither the Contractor, nor any such subcontractors, are under suspension or debarment by the Commonwealth or any governmental entity, instrumentality, or authority and, if the Contractor cannot so certify, then it agrees to submit, along with its Bid/Contract, a written explanation of why such certification cannot be made.

2. The Contractor also certifies, in writing, that as of the date of its execution of this Bid/Contract it has no tax liabilities or other Commonwealth obligations, or has filed a timely administrative or judicial appeal if such liabilities or obligations exist, or is subject to a duly approved deferred payment plan if such liabilities exist.

3. The Contractor's obligations pursuant to these provisions are ongoing from and after the effective date of the Contract through the termination date thereof. Accordingly, the Contractor shall have an obligation to inform the Commonwealth if, at any time during the term of the Contract, it becomes delinquent in the payment of taxes, or other Commonwealth obligations, or if it or, to the best knowledge of the Contractor, any of its subcontractors are suspended or debarred by the Commonwealth, the federal government, or any other state or governmental entity. Such notification shall be made within 15 days of the date of suspension or debarment.

4. The failure of the Contractor to notify the Commonwealth of its suspension or debarment by the Commonwealth, any other state, or the federal government shall constitute an event of default of the Contract with the Commonwealth.

5. The Contractor agrees to reimburse the Commonwealth for the reasonable costs of investigation incurred by the Office of State Inspector General for investigations of the Contractor's compliance with the terms of this or any other agreement between the Contractor and the Commonwealth that results in the suspension or debarment of the contractor. Such costs shall include, but shall not be limited to, salaries of investigators, including overtime; travel and lodging expenses; and expert witness and documentary fees. The Contractor shall not be responsible for investigative costs for investigations that do not result in the Contractor's suspension or debarment.

6. The contractor may obtain a current list of suspended and debarred Commonwealth contractors by either searching the Internet at **http://www.dgs.state.pa.us/** or contacting the:

Department of General Services
Office of Chief Counsel
603 North Office Building
Harrisburg, PA 17125
Telephone No: (717) 783-6472
FAX No: (717) 787-9138

22. **Provisions concerning the Americans with Disabilities Act.** During the terms of this agreement, the Grantee agrees as follows:

a. Pursuant to federal regulations promulgated under the authority of THE AMERICANS WITH DISABILITIES ACT, 28 C.F.R. §35.101 et seq., the Grantee understands and agrees that no individual with an disability shall, on the basis of the disability, be excluded from participation in this agreement or from activities provided for under this agreement. As a condition of accepting and executing this agreement, the Grantee agrees to comply with the "General Prohibitions Against Discrimination," 28 C.F.R. §35.130, and all other regulations promulgated under Title II of The Americans With Disabilities Act which are applicable to the benefits, services, programs, and activities provided by the Commonwealth of Pennsylvania through grants with outside Grantees.

b. The Grantee shall be responsible for and agrees to indemnify and hold harmless the Commonwealth of Pennsylvania from all losses, damages, expenses, claims, demands, suits, and actions brought by any party against the Commonwealth of Pennsylvania as a result of the Grantee's failure to comply with the provisions of paragraph a., above.

23. **Integration Clause**. This agreement and attachments hereto constitute the entire agreement between the parties. No agent, representative, employee or officer of either the Commonwealth or the Grantee has authority to make, or has made, any statement, agreement or representation, oral or written, in connection with this agreement, which in any way can be deemed to modify, add to or detract from, or otherwise change or alter its terms and conditions. No negotiations between the parties, nor any custom or usage, shall be permitted to modify or contradict any of the terms and conditions of this agreement. Except as set forth in this agreement, no modifications, alterations, or changes to this agreement or any of its terms shall be valid or binding unless accomplished by a written amendment signed by both parties. All such amendments or modifications will be made using the appropriate Commonwealth form.

24. Donation of Excess Prepared Food Clause. The Grantee agrees to make a good faith effort to donate to a nonprofit organization for ultimate free distribution to needy individuals any apparently wholesome food or grocery products apparently fit for human consumption which are not consumed at the Commonwealth function. A good faith effort includes, but is not limited to, contacting one or more of the entities appearing on the referral listing maintained by the Department of Agriculture. Grantee is hereby put on notice that liability will not attach if the Grantee complies with 42 PA. C.S. §8338.

25. Automated Clearing House Payment

a. The Commonwealth will make payments to the recipient through ACH. Within 10 days of the grant award, the recipient must submit or must have already submitted its ACH and electronic addenda information, if desired, to the commonwealth's Payable Service Center, Vendor Data Management Unit at 717-214-0140 (FAX) or by mail to the Office of Comptroller Operations, Bureau of Payable Services, Payable Service Center, Vendor Data Management Unit, 555 Walnut Street – 9th Floor, Harrisburg, PA 17101.

b. The recipient must submit a unique invoice number with each invoice submitted. The unique invoice number will be listed on the Commonwealth's ACH remittance advice to enable the recipient to properly apply the state agency's payment to the respective invoice or program.

c. It is the responsibility of the recipient to ensure that the ACH information contained in the Commonwealth's Central Vendor Master File is accurate and complete. Failure to maintain accurate and complete information may result in delays in payments.

26. **Right to Know Law**

a. Grantee or Subgrantee understands that this agreement and records related to or arising out of the Grant Agreement are subject to requests made pursuant to the Pennsylvania Right-to-Know Law, 65 P.S. §§ 67.101-3104, ("RTKL"). For the purpose of these provisions, the term "the Commonwealth" shall refer to the granting Commonwealth agency.

b. If the Commonwealth needs the Grantee's or Subgrantee's assistance in any matter arising out of the RTKL related to this agreement, it shall notify the Grantee or Subgrantee using the legal contact information provided in the Grant Agreement. The Grantee or Subgrantee, at any time, may designate a different contact for such purpose upon reasonable prior written notice to the Commonwealth.

c. Upon written notification from the Commonwealth that it requires Grantee's or Subgrantee's assistance in responding to a request under the RTKL for information related to this agreement that may be in Grantee's or Subgrantee's possession, constituting, or alleged to constitute, a public record in accordance with the RTKL ("Requested Information"), Grantee or Subgrantee shall:

(1) Provide the Commonwealth, within ten (10) calendar days after receipt of written notification, access to, and copies of, any document or information in Grantee's or Subgrantee's possession arising out of this agreement that the Commonwealth reasonably believes is Requested Information and may be a public record under the RTKL; and

(2) Provide such other assistance as the Commonwealth may reasonably request, in order to comply with the RTKL with respect to this agreement.

d. If Grantee or Subgrantee considers the Requested Information to include a request for a Trade Secret or Confidential Proprietary Information, as those terms are defined by the RTKL, or other information that Grantee or Subgrantee considers exempt from production under the RTKL, Grantee or Subgrantee must notify the Commonwealth and provide, within seven (7) calendar days of receiving the written notification, a written statement signed by a representative of Grantee or Subgrantee explaining why the requested material is exempt from public disclosure under the RTKL.

e. The Commonwealth will rely upon the written statement from Grantee or Subgrantee in denying a RTKL request for the Requested Information unless the Commonwealth determines that the Requested Information is clearly not protected from disclosure under the RTKL. Should the Commonwealth determine that the Requested Information is clearly not exempt from disclosure, Grantee or Subgrantee shall provide the Requested Information within five (5) business days of receipt of written notification of the Commonwealth's determination.

f. If Grantee or Subgrantee fails to provide the Requested Information within the time period required by these provisions, Grantee or Subgrantee shall indemnify and hold the Commonwealth harmless for any damages, penalties, costs, detriment or harm that the Commonwealth may incur as a result of Grantee's or Subgrantee's failure, including any statutory damages assessed against the Commonwealth.

g. The Commonwealth will reimburse Grantee or Subgrantee for any costs associated with complying with these provisions only to the extent allowed under the fee schedule established by the office of Open Records or as otherwise provided by the RTKL if the fee schedule is inapplicable.

h. Grantee or Subgrantee may file a legal challenge to any Commonwealth decision to release a record to the public with the Office of Open Records, or in the Pennsylvania Courts, however, Grantee or Subgrantee shall indemnify the Commonwealth for any legal expenses incurred by the Commonwealth as a result of such a challenge and shall hold the Commonwealth harmless for any damages, penalties, costs, detriment or harm that the Commonwealth may incur as a result of Grantee's or Subgrantee's failure, including any statutory damages assessed against the Commonwealth, regardless of the outcome of such legal challenge. As between the parties, Grantee or Subgrantee agrees to waive all rights or remedies that may be available to it as a result of the Commonwealth's disclosure of Requested Information pursuant to the RTKL.

i. The Grantee's or Subgrantee's duties relating to the RTKL are continuing duties that survive the expiration of this agreement and shall continue as long as the Grantee or Subgrantee has Requested Information in its possession.

27. AUDIT REQUIREMENTS.

The Department of Education shall have the right to audit or investigate the provision of services and the expenditure of funds under this agreement and/or to ensure the Grantee's compliance with any provision of state or federal laws. Grantee will fully cooperate with any such audit or investigation, including without limitation by providing representatives of the Department with full and complete access to the facility and records of the Grantee and to interview any employees/students of the Grantee in connection with such audit or investigation.

The following applies to federal grant awards: Grantee must comply with all applicable federal and state grant requirements including The Single Audit Act Amendments of 1996; 2 CFR Part 200 as amended; and any other applicable law or regulation, and any amendment to such other applicable law or regulation that may be enacted or promulgated by the federal government.

If the Grantee is a local government or non-profit organization that expends $750,000 or more in federal awards during its fiscal year, Grantee is required to provide the appropriate single or program specific audit in accordance with the provisions outlined in 2 CFR Part 200.501.

If Grantee expends total federal awards of less than the threshold established by 2 CFR 200.501, it is exempt from federal audit requirements for that year, but records must be available for review or audit by appropriate officials (or designees) of the federal agency, pass-through entity, and Government Accountability Office (GAO).

If Grantee is a for-profit entity, it is not subject to the auditing and reporting requirements of 2 CFR Part 200, Subpart F-Audit Requirements (Subpart F). However, the pass-through commonwealth agency is responsible for establishing requirements, as necessary, to ensure compliance by for-profit subrecipients. The contract with the for-profit subrecipient should describe applicable compliance requirements and the for-profit subrecipient's compliance responsibility. Methods to ensure compliance for federal awards made to for-profit subrecipients may include pre-award audits, monitoring during the contract and post-award audits. The post-award audits may be in the form of a financial audit in accordance with Government Auditing Standards, a single audit report or program-specific audit report in accordance with Subpart F. However, these post-award audits must be submitted directly to the affected commonwealth agency that provided the funding. Only single audit reports for local governmental and non-profit subrecipients are electronically submitted to the Federal Audit Clearinghouse.

In instances where a federal program-specific audit guide is available, the audit report package for a program-specific audit may be different and should be prepared in accordance with the appropriate audit guide, Government Auditing Standards, and Subpart F.

In addition to the requirements of Subpart F, commonwealth agencies may require that the single audit reporting packages include additional components in the SEFA, or supplemental schedules, as identified through the respective grant agreement.

Grantee must submit an electronic copy of the audit report package to the Federal Audit Clearinghouse, which shall include the elements outlined in Subpart F.

The subrecipients must send a copy of the confirmation from the Federal Audit Clearinghouse to the resource account RA-BOASinqleAudit@pa.gov.

Grantee is responsible for obtaining the necessary audit and securing the services of a certified public accountant or independent governmental auditor.

The commonwealth reserves the right for federal and state agencies or their authorized representatives to perform additional audits of a financial or performance nature, if deemed necessary by commonwealth or federal agencies. Any such additional audit work will rely on work already performed by the Grantee's auditor and the costs for any additional work performed by the federal or state agencies will be borne by those agencies at no additional expense to the Grantee.

Audit documentation and audit reports must be retained by the Grantee's auditor for a minimum of five years from the date of issuance of the audit report, unless Grantee's auditor is notified in writing by the commonwealth, the cognizant federal agency for audit, or the oversight federal agency for audit to extend the retention period. Audit documentation will be made available upon request to authorized representatives of the commonwealth, the cognizant federal agency for audit, the oversight federal agency for audit, the federal funding agency, or the GAO.

28. **PRO-CHILDREN ACT OF 1994.**

If this grant provides payments of federal funds to the Grantee, pursuant to the Pro-Children Act of 1994, 20 U.S.C. §6081 et. seq., the Grantee assures that:

a. The Grantee prohibits smoking within any indoor facility owned or leased or granted for and utilized by the Grantee for the routine or regular kindergarten, elementary, or secondary education or library services to children; and

b. The Grantee prohibits smoking within any indoor facility (or portion thereof) owned or leased or granted for by the Grantee for the provision by the Grantee of regular or routine health care or day care or early childhood development (Head Start) services to children or for the use of the employees of the Grantee who provide such services, except that this subsection shall not apply to:
    (i) any portion of such facility that is used for inpatient hospital treatment of individuals dependent on, or addicted to, drugs or alcohol; and

    (ii.) any private residence.

29. **FEDERAL ASSURANCE CLAUSE.**

If this grant provides payments of federal funds to the Grantee, the following clause will apply: Grantee's activities under this grant shall be carried out on a nondiscriminatory basis in accordance with 34 CFR Parts 100, 104 and 106 and 45 CFR Part 90 (relating to nondiscrimination on the basis of race, color, national origin, sex, handicap or age), the Civil Rights Act of 1870, as amended (42 U.S.C. §§1981 et seq.) and the Federal Age Discrimination Act of 1975, as amended (42 U.S.C. §§6101-6107), and shall be carried out in accordance with the Fair Labor Standards Act (29 U.S.C. §§201-219), Uniform Relocation Assistance and Real Property Acquisition Act of 1970 (42 U.S.C. §4601 et. seq.), Equal Pay Act (29 U.S.C. §206), 34 CFR Parts 76, 80, 82, 98 and 99, and Office of Management and Budget Circulars A-87, A-102, A-110, A-128 and A-133, as applicable. Grantee certifies that it is acting in compliance with the provisions of 34 CFR Part 85 (relating to debarment and suspension), 20 U.S.C. §3224(a) (relating to drug and alcohol abuse prevention programs), and 31 U.S.C. §1352 (relating to lobbying). The above required certification shall be in such manner as required by applicable law. If Grantee is a school district, intermediate unit, area vocational-technical school, or other local educational agency or a state or public agency, it further assures that its employees and officials, whose principal employment is in connection with an activity funded with federal grant money, shall not engage in any political activity barred by the Hatch Act, 5 U.S.C. §§1501 et seq**.**

30. **GUN FREE SCHOOLS.**

As required by the Gun Free Schools Act, 20 U.S.C. §7151, the Grantee assures that, as a condition of receiving funds under this contract, it is complying with 24 P.S. §13-1317.2.

31. **LOBBYING CERTIFICATION.**

The following applies if this grant provides payment over $100,000 of federal funds to the Grantee: The Grantee certifies, to the best of its knowledge and belief, that:

a. No federal appropriated funds have been paid or will be paid, by or on behalf of the Grantee to any person for influencing or attempting to influence an officer or employee of any agency, a member of Congress, an officer or employee of Congress, or an employee of a member of Congress in connection with the awarding of any federal grant, the making of any federal grant, the making of any federal loan, the entering into of any cooperative agreement, and the extension, continuation, renewal, amendment, or modification of any federal grant, grant, loan, or cooperative agreement.

b. If any funds other than federal appropriated funds have been paid or will be paid to any person for influencing or attempting to influence an officer or employee of any agency, a member of Congress, an officer or employee of Congress, or an employee of a member of Congress in connection with this federal grant, loan, or cooperative agreement, the Grantee shall complete and submit Standard Form-LLL, "Disclosure of Lobbying Activities," in accordance with its instructions.

c. The Grantee shall require that the language of this certification be included in the award documents for all subawards at all tiers (including subgrants, and grants under grants, loans, and cooperative agreements) and that all subrecipients shall certify and disclose accordingly.

This certification is a material representation of fact upon which reliance was placed when this transaction was made or entered into. Submission of this certification is a prerequisite for making or entering into this transaction imposed under 31 U.S.C. §1352. Any person who fails to file the required certification shall be subject to a civil penalty of not less than $10,000 and not more than $100,000 for such failure.

32. **FEDERAL FUNDING ACCOUNTABILITY AND TRANSPARENCY ACT PROVISIONS**

A. Registration and Identification Information

Grantee must maintain current registration in the Central Grantee Registration (www.ccr.gov) at all times during which they have active federal awards funded pursuant to this agreement. A Dun and Bradstreet Data Universal Numbering System (DUNS) Number (www.dnb.com) is one of the requirements for registration in the Central Grantee Registration.

Grantee must provide its assigned DUNS number, and DUNS + 4 number if applicable, to the Commonwealth along with Grantee's return of the signed grant agreement. The Commonwealth will not process this grant until such time that Grantee provides this information.

B. Primary Location

Grantee must provide to the Commonwealth the primary location of performance under the award, including the city, State, and zip+4. If performance is to occur in multiple locations, then Grantee must list the location where the most amount of the grant award is to be expended pursuant to this grant agreement.

Grantee must provide this information to the Commonwealth along with Grantee's return of the signed grant agreement. The Commonwealth will not process this grant until such time that Grantee provides this information.

C. Compensation of Officers

Grantee must provide to the Commonwealth the names and total compensation of the five most highly compensated officers of the entity **if**—

(i) the entity in the preceding fiscal year received—

(I) 80 percent or more of its annual gross revenues in Federal awards; and
(II) $25,000,000 or more in annual gross revenues from Federal awards: and

(ii) the public does not have access to information about the compensation of the senior executives of the entity through periodic reports filed under section 13(a) or 15(d) of the Securities Exchanges Act of 1934 (15 U.S.C. 78m(a), 78o(d)) or section 6104 of the Internal Revenue Code of 1986.

If the Grantee does not meet the conditions listed above, then it must specifically affirm to the Commonwealth that the requirements of this clause are inapplicable to the Grantee.

Grantee must provide information responding to this question along with Grantee's return of the signed grant agreement. The Commonwealth will not process this grant until such time that Grantee provides such information responding to this question.

33. **TRANSPORTATION, LODGING AND SUBSISTENCE**. Transportation, lodging and subsistence expenses incurred under this Agreement shall be reimbursed at state rates as per Management Directive 230.10

34. **SIGNATURES.** This Agreement may be executed in multiple counterparts, each of which shall be deemed an original and all of which shall together constitute one and the same instrument. Execution by the Commonwealth shall not be complete unless the Agreement bears all the signature approvals of duly authorized representatives of each and every Commonwealth office designated on the signature page. This Agreement, agreements ancillary to this Agreement, and related documents to be entered into in connection with this Agreement will be considered duly executed and delivered by any party affixing its electronic signature to an electronic file of the contract via the Department's e-grants system, or when the signature of a party is delivered by facsimile transmission or delivered by scanned image (e.g. .pdf or .tiff file extension name) as an attachment to electronic mail (email).

35. **ADDITIONAL TERMS AND CONDITIONS**.

A. The Grantee shall be liable for all disallowed costs, as determined during program audits or reviews, or as otherwise determined. The Grantee shall be liable for any payments made to, or for, any participants determined ineligible during program audits or reviews, or as otherwise determined.

B. The Grantee shall administer grant equipment, materials and supplies purchased with the funds provided by this Grant Agreement and use the funds provided hereunder for the purposes stated in the Agreement and in accordance with the applicable Federal and state laws and regulations and the most current program guidelines issued by Commonwealth. Without limitation of the foregoing, Grantee shall comply with all federal regulations concerning the use of funds or property purchased with federal funds, including 34 C.F.R. §§74.31through 74.37 (concerning the management and disposition of property charged to a project supported by a Federal award).

C. The Grantee and the Commonwealth recognize that in actual economic practice, overcharges by the Grantee's suppliers resulting from violations of state and Federal antitrust laws are in fact borne by the Commonwealth. As part of the consideration for the award of this agreement, and intending to be legally bound, the Grantee assigns to the Commonwealth all right, title and interest in and to any claims the Grantee now has or may hereafter acquire under state or Federal antitrust laws relating to the goods or services which are the subject of this agreement.

D. Environmental Protection: In carrying out this Agreement, the Grantee shall minimize pollution and shall strictly comply with all applicable environmental laws and regulations. (Clean Streams Law, Act of June 22, 1937, P.L. 1987, as amended; the Solid Waste Management Act, Act of July 7, 1980, P.L. 380, as amended; and the Dam Safety and Encroachments Act of November 26, 1978, P.L. 1375, as amended) (This clause does not apply to any project that does not have an environmental component).

E. In addition to any other notice required hereunder, the Grantee shall notify the Department's Division of Procurements and Grants in the event of Grantee debarment or suspension by any agency or department of the federal government or by any other state.

SECTION 011200 - MULTIPLE CONTRACT SUMMARY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes a summary of each contract, including responsibilities for coordination and temporary facilities and controls.

B. Specific requirements for Work of each contract are also indicated in individual Specification Sections and on Drawings.

C. Related Requirements:
   1. Section 013100 "Project Management and Coordination" for general coordination requirements.

1.3 DEFINITIONS

A. Permanent Enclosure: As determined by Architect, the condition at which roofing is insulated and weathertight; exterior walls are insulated and weathertight; and openings are closed with permanent construction or substantial temporary closures equivalent in weather protection to permanent construction.

1.4 GENERAL REQUIREMENTS OF CONTRACTS

A. Extent of Contract: Unless the Agreement contains a more specific description of the Work of each Contract, requirements indicated on Drawings and in Specification Sections determine which contract includes a specific element of Project.

   1. Unless otherwise indicated, the work described in this Section for each contract shall be complete systems and assemblies, including products, components, accessories, and installation required by the Contract Documents.
   2. Blocking, backing panels, sleeves, and metal fabrication supports for the work of each contract shall be the work of the General Construction Contract
   3. Furnishing of access panels for the work of each contract shall be the work of each contract for its own work. Installation of access panels shall be the work of the General Construction Contract
   4. Equipment pads for the work of each contract shall be the work of the General Construction Contract

5. Roof-mounted equipment curbs for the work of each contract shall be the work of the General Construction Contract
6. Painting for the work of each contract shall be the work of the General Construction Contract
7. Cutting and Patching: Provided under each contract for its own work
8. Through-penetration firestopping for the work of each contract shall be provided by each contract for its own work.
9. Contractors' Startup Construction Schedule: Within five working days after startup horizontal bar-chart-type construction schedules submittal has been received from Project coordinator, submit a matching startup horizontal bar-chart schedule showing construction operations sequenced and coordinated with overall construction.

B. Substitutions: Each contractor shall cooperate with other contractors involved to coordinate approved substitutions with remainder of the work.

C. Temporary Facilities and Controls: In addition to specific responsibilities for temporary facilities and controls indicated in this Section and in Section 015000 "Temporary Facilities and Controls," each contractor is responsible for the following:

1. Installation, operation, maintenance, and removal of each temporary facility necessary for its own normal construction activity, and costs and use charges associated with each facility, except as otherwise provided for in this Section.

D. Close-out Procedures: Each Prime Contractor shall be responsible for:

a. Preparation and submission of Project Record Documents (as-builts, record specifications, record shop drawings, etc.) for work completed.
b. Preparation and submission of operation and maintenance manuals.
c. Scheduling and conducting Owner’s training, and submitting record of training for materials and systems as specified.
d. Assembly and submission of extra materials and attic stock to Owner.
e. Preparation and submission of warranties, emergency contact information, and service contact information.

1.5 GENERAL CONSTRUCTION CONTRACT

A. Work of the General Construction Contract includes, but not limited to, the following:

1. Provide photographic documentation.
2. Provide quality-assurance and quality-control services
3. Window Replacement.
4. Select Exterior Door Replacement
5. Millwork
6. Ceiling replacement
7. General waste disposal facilities.
8. Barricades, warning signs, and lights.
9. Environmental protection.

1.6 MECHANICAL CONTRACT

A. Work of the MECHANICAL Contract includes, but is not limited to, the following:
   1. HVAC systems and equipment.
   2. HVAC instrumentation and controls.
   3. HVAC testing, adjusting, and balancing.
   4. Mechanical connections to equipment furnished by the General Construction Contract Electrical Contract.
   5. Removal of existing gas piping and service,
   6. New gas service, new gas piping to HVAC equipment

1.7 ELECTRICAL CONTRACT

A. Work of the Electrical Contract includes, but is not limited to, the following:
   1. Electrical service replacement.
   2. New distribution panel
   3. Removal of ceiling mounted devices, lighting etc,
   4. New Lighting and lighting controls
   5. Fire alarm system
   6. Emergency lighting and exit signage
   7. Electrical connections to equipment furnished by the HVAC Contract.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 011200

SECTION 012200 - UNIT PRICES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

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

B. Related Requirements:
   1. Section 012600 "Contract Modification Procedures" for procedures for submitting and handling Change Orders.
   2. Section 014000 "Quality Requirements" for field testing by an independent testing agency.

1.3 DEFINITIONS

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

1.4 PROCEDURES

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

B. Measurement and Payment: See individual Specification Sections for work that requires establishment of unit prices. Methods of measurement and payment for unit prices are specified in those Sections.

C. List of Unit Prices: A schedule of unit prices is included in Part 3. Specification Sections referenced in the Part 3 "Schedule of Unit Prices" Article contain requirements for materials described under each unit price.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

END OF SECTION 012200

SECTION 012300 - ALTERNATES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes administrative and procedural requirements for alternates.

1.3 DEFINITIONS

A. Alternate: An amount proposed by bidders and stated on the Bid Form for certain work defined in the bidding requirements that may be added to or deducted from the base bid amount if the Owner decides to accept a corresponding change either in the amount of construction to be completed or in the products, materials, equipment, systems, or installation methods described in the Contract Documents.

1. Alternates described in this Section are part of the Work only if enumerated in the Agreement.
2. The cost or credit for each alternate is the net addition to or deduction from the Contract Sum to incorporate alternates into the Work. No other adjustments are made to the Contract Sum.

1.4 PROCEDURES

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

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

B. Execute accepted alternates under the same conditions as other Work of the Contract.

C. Schedule: A Part 3 "Schedule of Alternates" Article is included at the end of this Section. Specification Sections referenced in schedule contain requirements for materials necessary to achieve the work described under each alternate.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

END OF SECTION 012300

SECTION 012500 - SUBSTITUTION PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes administrative and procedural requirements for substitutions.

B. Related Requirements:
   1. Section 016000 "Product Requirements" for requirements for submitting comparable product submittals for products by listed manufacturers.

1.3 DEFINITIONS

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

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

1.4 ACTION SUBMITTALS

A. Substitution Requests: Submit documentation identifying 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 form acceptable to Architect.
   2. Documentation: Show compliance with requirements for substitutions and the following, as applicable:

      a. Statement indicating why specified product or fabrication or installation method cannot be provided, if applicable.
      b. Coordination of information, including a list of changes or revisions needed to other parts of the Work and to construction performed by Owner and separate contractors that will be necessary to accommodate proposed substitution.

c. Product Data, including drawings and descriptions of products and fabrication and installation procedures.
d. Samples, where applicable or requested.
e. Certificates and qualification data, where applicable or requested.
f. Material test reports from a qualified testing agency, indicating and interpreting test results for compliance with requirements indicated.
g. Cost information, including a proposal of change, if any, in the Contract Sum.
h. Contractor's certification that proposed substitution complies with requirements in the Contract Documents, except as indicated in substitution request, is compatible with related materials and is appropriate for applications indicated.

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

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

1.5 QUALITY ASSURANCE

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

1.6 PROCEDURES

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

1.7 SUBSTITUTIONS

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

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

a. Requested substitution is consistent with the Contract Documents and will produce indicated results.
b. Requested substitution will not adversely affect Contractor's construction schedule.

c. Requested substitution has received necessary approvals of authorities having jurisdiction.
d. Requested substitution is compatible with other portions of the Work.
e. Requested substitution has been coordinated with other portions of the Work.
f. Requested substitution provides specified warranty.
g. If requested substitution involves more than one contractor, requested substitution has been coordinated with other portions of the Work, is uniform and consistent, is compatible with other products, and is acceptable to all contractors involved.

B. Substitutions for Convenience: Architect will consider requests for substitution if received within **60** days after the Notice to Proceed Requests received after that time may be considered or rejected at discretion of Architect.

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

a. Requested substitution offers Owner a substantial advantage in cost, time, energy conservation, or other considerations, after deducting additional responsibilities Owner must assume. Owner's additional responsibilities may include compensation to Architect for redesign and evaluation services, increased cost of other construction by Owner, and similar considerations.
b. Requested substitution does not require extensive revisions to the Contract Documents.
c. Requested substitution is consistent with the Contract Documents and will produce indicated results.
d. Substitution request is fully documented and properly submitted.
e. Requested substitution is compatible with other portions of the Work.
f. Requested substitution has been coordinated with other portions of the Work.
g. Requested substitution provides specified warranty.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 012500

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 012500 "Substitution Procedures" for administrative procedures for handling requests for substitutions made after the Contract award.
2. Section 013100 "Project Management and Coordination" for requirements for forms for contract modifications provided as part of web-based Project management software.

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.

1.4 PROPOSAL REQUESTS

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

1. Work Change Proposal Requests issued by Architect are not instructions either to stop work in progress or to execute the proposed change.
2. Within 10 days, when not otherwise specified after receipt of Proposal Request, submit a quotation estimating cost adjustments to the Contract Sum and the Contract Time necessary to execute the change.

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

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

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

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.
7. Proposal Request Form: Use form acceptable to Architect

1.5 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**

1.6 CONSTRUCTION CHANGE DIRECTIVE

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

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

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

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

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 012600

SECTION 012900 - PAYMENT PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 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 012600 "Contract Modification Procedures" for administrative procedures for handling changes to the Contract.
   2. 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. Submit the schedule of values to Architect at earliest possible date, but no later than 10 days before the date scheduled for submittal of initial Applications for Payment.
   1. Use Project Manual table of contents as a guide to establish line items for the schedule of values. Provide at least one line item for each Specification Section.
   2. Identification: Include the following Project identification on the schedule of values:
   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 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.
5. Overhead Costs, Proportional Distribution: Include total cost and proportionate share of general overhead and profit for each line item.
6. 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 following the initial Application for Payment shall be consistent with previous applications and payments, as certified by Architect, and paid for by Owner.

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

C. Payment Application Times: Submit Application for Payment to Architect by the 15 of the month. The period covered by each Application for Payment is one month, ending on the last day of the month.

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

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

1. Other Application for Payment forms proposed by the Contractor may be acceptable to Architect and Owner. Submit forms for approval with initial submittal of schedule of values.

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

1. Entries shall match data on the schedule of values and Contractor's construction schedule. Use updated schedules if revisions were made.
2. Include amounts for work completed following previous Application for Payment, whether or not payment has been received. Include only amounts for work completed at time of Application for Payment.

3. Include amounts of Change Orders and Construction Change Directives issued before last day of construction period covered by application.
4. Indicate separate amounts for work being carried out under Owner-requested project acceleration.

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 1 signed and notarized original copies of each Application for Payment to **Engineer** electronically. 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. Initial Application for Payment: Administrative actions and submittals that must precede or coincide with submittal of first Application for Payment include the following:

1. List of subcontractors.
2. Schedule of values.
3. Contractor's construction schedule (preliminary if not final).
4. Products list (preliminary if not final).
5. Sustainable design action plans, including preliminary project materials cost data.
6. Schedule of unit prices.
7. Submittal schedule (preliminary if not final).
8. List of Contractor's staff assignments.
9. List of Contractor's principal consultants.
10. Copies of building permits.
11. Copies of authorizations and licenses from authorities having jurisdiction for performance of the Work.
12. Initial progress report.
13. Report of preconstruction conference.
14. Certificates of insurance and insurance policies.
15. Performance and payment bonds.

16. Data needed to acquire Owner's insurance.

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

1. Include documentation supporting claim that the Work is substantially complete and a statement showing an accounting of changes to the Contract Sum.

a. Complete administrative actions, submittals, and Work preceding this application, as described in Section 017700 "Closeout Procedures."

2. This application shall reflect Certificate(s) of Substantial Completion issued previously for Owner occupancy of designated portions of the Work.

J. Final Payment Application: After completing Project closeout requirements, submit final Application for Payment with releases and supporting documentation not previously submitted and accepted, including, but not limited, to the following:

1. Evidence of completion of Project closeout requirements.
2. Certification of completion of final punch list items.
3. Insurance certificates for products and completed operations where required and proof that taxes, fees, and similar obligations were paid.
4. Updated final statement, accounting for final changes to the Contract Sum.
5. AIA Document G706.
6. AIA Document G706A.
7. AIA Document G707.
8. Evidence that claims have been settled.
9. 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.
10. Proof that taxes, fees, and similar obligations are paid.
11. Waivers and releases.

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

1. General coordination procedures.
2. RFIs.
3. Digital project management procedures.
4. Project meetings.

B. Related Requirements:

1. Section 011200 "Summary" for a description of the work
2. Section 013200 "Construction Progress Documentation"
3. Section 017300 "Execution"
4. Section 017700 "Closeout Procedures" for coordinating closeout of the Contract.

1.3 DEFINITIONS

A. BIM: Building Information Modeling.

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

1.4 INFORMATIONAL SUBMITTALS

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

1. Name, address, telephone number, and email address of entity performing subcontract or supplying products.
2. Number and title of related Specification Section(s) covered by subcontract.
3. Drawing number and detail references, as appropriate, covered by subcontract.

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

1. Post copies of list in Project meeting room, in temporary field office, in web-based Project software directory, **and** in prominent location in built facility. Always keep list current.

1.5 GENERAL COORDINATION PROCEDURES

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

1. Schedule construction operations in sequence required to obtain the best results, where installation of one part of the Work depends on installation of other components, before or after its own installation.
2. Coordinate installation of different components to ensure maximum performance and accessibility for required maintenance, service, and repair.
3. Make adequate provisions to accommodate items scheduled for later installation.

B. Administrative Procedures: Coordinate scheduling and timing of required administrative procedures with other construction activities and scheduled 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.

1.6 REQUEST FOR INFORMATION (RFI)

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

1. Engineer will return without response those RFIs submitted to Architect by other entities controlled by Contractor.
2. Coordinate and submit RFIs in a prompt manner to avoid delays in Contractor's work or work of subcontractors.

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

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

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

C. RFI Forms: Software-generated form with substantially the same content as indicated above, acceptable to Architect.

1. Attachments shall be electronic files in PDF format.

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

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

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

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

3. Architect's action on RFIs that may result in a change to the Contract Time or the Contract Sum may be eligible for Contractor to submit Change Proposal according to Section 012600 "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** days of receipt of the RFI response.

E. RFI Log: Prepare, maintain, and submit a tabular log of RFIs organized by the RFI number.

1. Project name.
2. Name and address of Contractor.
3. Name and address of Architect
4. RFI number, including RFIs that were returned without action or withdrawn.
5. RFI description.
6. Date the RFI was submitted.
7. Date Architect's response was received.
8. Identification of related Minor Change in the Work, Construction Change Directive, and Proposal Request, as appropriate.

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

1.7 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 a minimum of **seven** days prior to meeting.
2. Agenda: Prepare the meeting agenda. Distribute the agenda to all invited attendees.
3. Minutes: Entity responsible for conducting meeting will record significant discussions and agreements achieved. Distribute the meeting minutes to everyone concerned, including Owner, Architect, within **three** days of the meeting.

B. Preconstruction Conference: Schedule and conduct a preconstruction conference before starting construction, at a time convenient to Owner and Architect, but no later than 15 days after execution of the Agreement.
1. Agenda: Discuss items of significance that could affect progress, including the following:

    a. Responsibilities and personnel assignments.
    b. Tentative construction schedule.
    c. Phasing.
    d. Critical work sequencing and long lead items.
    e. Designation of key personnel and their duties.
    f. Lines of communications.
    g. Procedures for processing field decisions and Change Orders.

h. Procedures for RFIs.
i. Procedures for testing and inspecting.
j. Procedures for processing Applications for Payment.
k. Distribution of the Contract Documents.
l. Submittal procedures.
m. Project closeout requirements and sustainable design certification procedures.
n. Construction waste management.
o. Construction operations and sustainable design requirements and restrictions.
p. Preparation of Record Documents.
q. Use of the premises
r. Work restrictions.
s. Working hours.
t. Owner's occupancy requirements.
u. Responsibility for temporary facilities and controls.
v. Procedures for moisture and mold control.
w. Procedures for disruptions and shutdowns.
x. Construction waste management and recycling.
y. Parking availability.
z. Office, work, and storage areas.
aa. Equipment deliveries and priorities.
bb. First aid.
cc. Security.
dd. Progress cleaning.

C. Preinstallation Conferences: Conduct a preinstallation conference at Project site before each construction activity when required by other Sections and when required for coordination with other construction.

1. Record significant conference discussions, agreements, and disagreements, including required corrective measures and actions.
2. Reporting: Distribute minutes of the meeting to each party present and to other parties requiring information.

D. Project Closeout Conference: **Schedule and conduct** a project closeout conference, at a time convenient to Owner and Architect, but no later than **90** 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. Submittal of written warranties.
d. Requirements for delivery of material samples, attic stock, and spare parts.
e. Preparation of Contractor's punch list.
f. Procedures for processing Applications for Payment at Substantial Completion and for final payment.
g. Submittal procedures.
h. Coordination of separate contracts.
i. Owner's partial occupancy requirements.
j. Installation of Owner's furniture, fixtures, and equipment.
k. Responsibility for removing temporary facilities and controls.

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

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

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

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

1) Review schedule for next period.

b. Review present and future needs of each entity present, including the following:
1) Status of submittals.
2) Deliveries.
3) Access.
4) Site use.
5) Temporary facilities and controls.
6) Progress cleaning.
7) Quality and work standards.
8) Status of correction of deficient items.
9) Field observations.
10) Status of RFIs.
11) Status of Proposal Requests.
12) Pending changes.
13) Status of Change Orders.
14) Pending claims and disputes.
15) Documentation of information for payment requests.

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

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

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 013100

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. Section includes administrative and procedural requirements for the following:

1. Preconstruction photographs.
2. Concealed Work photographs.
3. Periodic construction photographs.
4. Final Completion construction photographs.

B. Related Requirements:

1. Section 017700 "Closeout Procedures" for submitting photographic documentation as Project Record Documents at Project closeout.

1.3 INFORMATIONAL SUBMITTALS

A. Key Plan: Submit key plan of Project site and building with notation of vantage points marked for location and direction of each photograph. Indicate elevation or story of construction. Include same information as corresponding photographic documentation.

B. Digital Photographs: Submit image files within 5 days of taking photographs.

1. Submit photos by uploading to project management site. Include copy of key plan indicating each photograph's location and direction.
2. Identification: Provide the following information with each image description in web-based project management site:

a. Name of Project.
b. Name and contact information for photographer.
c. Name of Engineer
d. Name of Contractor.
e. Date photograph was taken.
f. Description of location, vantage point, and direction.
g. Unique sequential identifier keyed to accompanying key plan.

1.4 CONSTRUCTION PHOTOGRAPHS

A. General: Take photographs with maximum depth of field and in focus.

1. Maintain key plan with each set of construction photographs that identifies each photographic location.

B. Preconstruction Photographs: Before commencement of the Work, take photographs of Project area, including existing items to remain during construction, from different vantage points, as directed by Engineer.

C. Concealed Work Photographs: Before proceeding with installing work that will conceal other work, take photographs sufficient in number, with annotated descriptions, to record nature and location of concealed Work.

D. Periodic Construction Photographs: Take 10 photographs weekly. Select vantage points to show status of construction and progress since last photographs were taken.

E. Final Completion Construction Photographs: Take 40 photographs after date of Substantial Completion for submission as Project Record Documents.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 013233

SECTION 013300 - SUBMITTAL PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Submittal schedule requirements.
2. Administrative and procedural requirements for submittals.

B. Related Requirements:
1. Section 013100 "Project Management and Coordination"
2. Section 013200 "Construction Progress Documentation"
3. Section 013233 "Photographic Documentation"
4. Section 014000 "Quality Requirements"
5. Section 017700 "Closeout Procedures"
6. Section 017839 "Project Record Documents"

1.2 DEFINITIONS

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

B. Informational Submittals: Written and graphic information and physical samples that do not require Engineer'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."

1.3 SUBMITTAL SCHEDULE

A. Submittal Schedule: Submit, as an action submittal, a list of submittals, arranged in chronological order by dates required by construction schedule. Include time required for review, ordering, manufacturing, fabrication, and delivery when establishing dates. Include additional time required for making corrections or revisions to submittals noted by Engineer and additional time for handling and reviewing submittals required by those corrections.

1. Coordinate submittal schedule with list of subcontracts, the schedule of values, and Contractor's construction schedule.

2. Format: Arrange the following information in a tabular format:

a. Scheduled date for first submittal.
b. Specification Section number and title.

c. Submittal Category: Action; informational.
d. Name of subcontractor.
e. Description of the Work covered.
f. Scheduled date for Engineer's final release or approval.

1.4 SUBMITTAL FORMATS

A. Submittal Information: Include the following information in each submittal:

1. Project name.
2. Date.
3. Name of Engineer.
4. Unique submittal number, including revision identifier. Include Specification Section number with sequential alphanumeric identifier and alphanumeric suffix for resubmittals.
5. Category and type of submittal.
6. Submittal purpose and description.
7. Number and title of Specification Section, with paragraph number and generic name for each of multiple items.
8. Drawing number and detail references, as appropriate.
9. Indication of full or partial submittal.
10. Location(s) where product is to be installed, as appropriate.
11. Other necessary identification.
12. Remarks.
13. Signature of transmitter.

B. Options: Identify options requiring selection by Engineer.

C. Deviations and Additional Information: On each submittal, clearly indicate deviations from requirements in the Contract Documents, including minor variations and limitations; include relevant additional information and revisions, other than those requested by Engineer on previous submittals. Indicate by highlighting on each submittal or noting on attached separate sheet.

D. Electronic Submittals: Prepare submittals as PDF package, incorporating complete information into each PDF file. Name PDF file with submittal number.

E. Submittals Utilizing Web-Based Project Software: Prepare submittals as PDF files or other format indicated by Project management software.

1.5 SUBMITTAL PROCEDURES

A. Prepare and submit submittals required by individual Specification Sections. Types of submittals are indicated in individual Specification Sections.

1. Email: Prepare submittals as PDF package and transmit to Engineer by sending via email. Include PDF transmittal form. Include information in email subject line as requested by Engineer.

a. Engineer will return annotated file. Annotate and retain one copy of file as a digital Project Record Document file.

2. Web-Based Project Management Software: Prepare submittals in PDF form, and upload to web-based Project management software website. Enter required data in web-based software site to fully identify submittal.

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

1. Coordinate each submittal with fabrication, purchasing, testing, delivery, other submittals, and related activities that require sequential activity.
2. Submit all submittal items required for each Specification Section concurrently unless partial submittals for portions of the Work are indicated on approved submittal schedule.
3. Submit action submittals and informational submittals required by the same Specification Section as separate packages under separate transmittals.
4. Coordinate transmittal of submittals for related parts of the Work specified in different Sections, so processing will not be delayed because of need to review submittals concurrently for coordination.

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

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

1. Initial Review: Allow 15 days for initial review of each submittal. Allow additional time if coordination with subsequent submittals is required. Engineer will advise Contractor when a submittal being processed must be delayed for coordination.
2. Intermediate Review: If intermediate submittal is necessary, process it in same manner as initial submittal.
3. Resubmittal Review: Allow 15 days for review of each resubmittal.
4. Sequential Review: Where sequential review of submittals by Engineer's consultants, Owner, or other parties is indicated, allow 21 days for initial review of each submittal.

D. 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 with approval notation from Engineer's action stamp.

E. 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.

F. Use for Construction: Retain complete copies of submittals on Project site. Use only final action submittals that are marked with approval notation from Engineer's and Construction Manager's action stamp.

1.6 SUBMITTAL REQUIREMENTS

A. 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 published data are unsuitable 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 catalog cuts.
    b. Manufacturer's product specifications.
    c. Standard color charts.
    d. Statement of compliance with specified referenced standards.
    e. Testing by recognized testing agency.
    f. Application of testing agency labels and seals.
    g. Notation of coordination requirements.
    h. Availability and delivery time information.

4. For equipment, include the following in addition to the above, as applicable:

    a. Wiring diagrams that show factory-installed wiring.
    b. Printed performance curves.
    c. Operational range diagrams.
    d. Clearances required to other construction, if not indicated on accompanying Shop Drawings.

5. Submit Product Data before Shop Drawings, and before or concurrently with Samples.

B. Shop Drawings: Prepare Project-specific information, drawn accurately to scale. Do not base Shop Drawings on reproductions of the Contract Documents or standard printed data**.**

1. Preparation: Fully illustrate requirements in the Contract Documents. Include the following information, as applicable:

    a. Identification of products.
    b. Schedules.
    c. Compliance with specified standards.
    d. Notation of coordination requirements.
    e. Notation of dimensions established by field measurement.
    f. Relationship and attachment to adjoining construction clearly indicated.
    g. Seal and signature of professional engineer if specified.

C. Samples: Submit Samples for review of type, color, pattern, and texture for a check of these characteristics with other materials.

1. Transmit Samples that contain multiple, related components, such as accessories together in one submittal package.
2. Identification: Permanently attach label on unexposed side of Samples that includes the following:

    a. Project name and submittal number.
    b. Generic description of Sample.
    c. Product name and name of manufacturer.
    d. Sample source.
    e. Number and title of applicable Specification Section.
    f. Specification paragraph number and generic name of each item.
3. Web-Based Project Management Software: Prepare submittals in PDF form, and upload to web-based Project software website. Enter required data in web-based software site to fully identify submittal.
4. 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.

5. Samples for Initial Selection: Submit manufacturer's color charts consisting of units or sections of units, showing the full range of colors, textures, and patterns available.

    a. Number of Samples: Submit **one** full set(s) of available choices where color, pattern, texture, or similar characteristics are required to be selected from manufacturer's product line. Engineer, will return submittal with options selected.

6. Samples for Verification: Submit full-size units or Samples of size indicated, prepared from same material to be used for the Work, cured and finished in manner specified, and physically identical with material or product proposed for use, and that show full range of color and texture variations expected. Samples include, but are not limited to, the following: partial sections of manufactured or fabricated components; small cuts or containers of materials; complete units of repetitively used materials; swatches showing color, texture, and pattern; color range sets; and components used for independent testing and inspection.

    a. Number of Samples: Submit **three** sets of Samples. Engineer will retain **two** Sample sets; remainder will be returned.

        1) Submit a single Sample where assembly details, workmanship, fabrication techniques, connections, operation, and other similar characteristics are to be demonstrated.
        2) If variation in color, pattern, texture, or other characteristic is inherent in material or product represented by a Sample, submit at least **three** sets of paired units that show approximate limits of variations.

D. Product Schedule: As required in individual Specification Sections, prepare a written summary indicating types of products required for the Work and their intended location. Include the following information in tabular form:

1. Type of product. Include unique identifier for each product indicated in the Contract Documents or assigned by Contractor if none is indicated.
2. Manufacturer and product name, and model number if applicable.
3. Number and name of room or space.
4. Location within room or space.

E. Qualification Data: Prepare written information that demonstrates capabilities and experience of firm or person. Include lists of completed projects with project names and addresses, contact information of Engineers and owners, and other information specified.

F. Design Data: Prepare and submit written and graphic information indicating compliance with indicated performance and design criteria in individual Specification Sections. Include list of assumptions and summary of loads. Include load diagrams if applicable. Provide name and version of software, if any, used for calculations. Number each page of submittal.

G. Certificates:

1. Certificates and Certifications Submittals: Submit a 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. Provide a notarized signature where indicated.
2. Installer Certificates: Submit 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.
3. Manufacturer Certificates: Submit written statements on manufacturer's letterhead, certifying that manufacturer complies with requirements in the Contract Documents. Include evidence of manufacturing experience where required.
4. Product Certificates: Submit written statements on manufacturer's letterhead, certifying that product complies with requirements in the Contract Documents.

H. Test and Research Reports:

1. Compatibility Test Reports: Submit 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 substrate preparation and primers required.
2. Field Test Reports: Submit written reports 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.
3. Material Test Reports: Submit 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.
4. Preconstruction Test Reports: Submit 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.

5. Product Test Reports: Submit written reports indicating that 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.

1.7 CONTRACTOR'S REVIEW

A. Action Submittals and Informational Submittals: 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 Engineer.

B. Contractor's Approval: Indicate Contractor's approval for each submittal with a uniform approval stamp, and indication in web-based Project management software. Include 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.

1. Engineer will not review submittals received from Contractor that do not have Contractor's review and approval.

1.8 ENGINEER'S REVIEW

A. Action Submittals: Engineer will review each submittal, indicate corrections or revisions required.

1. PDF Submittals: Engineer will indicate, via markup on each submittal, the appropriate action.
    1) APPROVED: The work involved may proceed, and no further submission is required.
    2) APPROVED AS NOTED: The work involved may proceed incorporating comments. Annotations do not authorize changes to Contract Sum.
    3) REVISE AND RESUBMIT: The work involved may not proceed. Submittal must be corrected and resubmitted.
    4) REJECTED: The submittal is not in accordance with the Contract Documents, and a completely new submittal is required

2. Submittals by Web-Based Project Management Software: Engineer will indicate, on Project management software website, the appropriate action.

    a. Actions taken by indication on Project management software website have the following meanings:
        1) APPROVED: The work involved may proceed, and no further submission is required.
        2) APPROVED AS NOTED: The work involved may proceed incorporating comments. Annotations do not authorize changes to Contract Sum.
        3) REVISE AND RESUBMIT: The work involved may not proceed. Submittal must be corrected and resubmitted.

4) REJECTED: The submittal is not in accordance with the Contract Documents, and a completely new submittal is required

B. Informational Submittals: Engineer will review each submittal and will not return it, or will return it if it does not comply with requirements. Engineer will forward each submittal to appropriate party.

C. Partial submittals prepared for a portion of the Work will be reviewed when use of partial submittals has received prior approval from Engineer.

D. Incomplete submittals are unacceptable, will be considered nonresponsive, and will be returned for resubmittal without review.

E. Submittals not required by the Contract Documents will be returned by Engineer without action.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 013300

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 Engineer, Owner or authorities having jurisdiction are not limited by provisions of this Section.

1.3 DEFINITIONS

A. Experienced: When used with an entity or individual, "experienced," unless otherwise further described, means having successfully completed a minimum of **five** previous projects similar in nature, size, and extent to this Project; being familiar with special requirements indicated; and having complied with requirements of authorities having jurisdiction.

B. Field Quality-Control Tests and Inspections: Tests and inspections that are performed on-site for installation of the Work and for completed Work.

C. 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, assembly, and similar operations.

1. Use of trade-specific terminology in referring to a Work result does not require that certain construction activities specified apply exclusively to specific trade(s).

D. Preconstruction Testing: Tests and inspections performed specifically for Project before products and materials are incorporated into the Work, to verify performance or compliance with specified criteria. Unless otherwise indicated, copies of reports of tests or inspections performed for other than the Project do not meet this definition.

E. Product Tests: Tests and inspections that are performed by a nationally recognized testing laboratory (NRTL) according to 29 CFR 1910.7, by a testing agency accredited according to NIST's National Voluntary Laboratory Accreditation Program (NVLAP), or by a testing agency qualified to conduct product testing and acceptable to authorities having jurisdiction, to establish product performance and compliance with specified requirements.

F. Source Quality-Control Tests and Inspections: Tests and inspections that are performed at the source (e.g., plant, mill, factory, or shop).

G. Testing Agency: An entity engaged to perform specific tests, inspections, or both. The term "testing laboratory" has the same meaning as the term "testing agency."

H. 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.

I. 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. Contractor's quality-control services do not include contract administration activities performed by Architect.

1.4 INFORMATIONAL SUBMITTALS

A. Contractor's Quality-Control Plan: For quality-assurance and quality-control activities and responsibilities.

B. Qualification Data: For Contractor's quality-control personnel.

C. Contractor's Statement of Responsibility: When required by authorities having jurisdiction, submit copy of written statement of responsibility submitted to authorities having jurisdiction before starting work on the following systems:

1. Seismic-force-resisting system, designated seismic system, or component listed in the Statement of Special Inspections.
2. Primary wind-force-resisting system or a wind-resisting component listed in the Statement of Special Inspections.

D. Testing Agency Qualifications: For testing agencies specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include proof of qualifications in the form of a recent report on the inspection of the testing agency by a recognized authority.

E. Reports: Prepare and submit certified written reports and documents as specified.

F. Permits, Licenses, and Certificates: For Owner's record, submit copies of permits, licenses, certifications, inspection reports, releases, jurisdictional settlements, notices, receipts for fee payments, judgments, correspondence, records, and similar documents established for compliance with standards and regulations bearing on performance of the Work.

1.5 REPORTS AND DOCUMENTS

A. Manufacturer's Technical Representative's Field Reports: Prepare written information documenting manufacturer's technical representative's tests and inspections specified in other Sections. Include the following:

1. Name, address, telephone number, and email address of technical representative making report.
2. Statement on condition of substrates and their acceptability for installation of product.
3. Statement that products at Project site comply with requirements.
4. Summary of installation procedures being followed, whether they comply with requirements and, if not, what corrective action was taken.
5. Results of operational and other tests and a statement of whether observed performance complies with requirements.
6. Statement of whether conditions, products, and installation will affect warranty.
7. Other required items indicated in individual Specification Sections.

1.6 QUALITY ASSURANCE

A. Qualifications paragraphs in this article establish the minimum qualification levels required; individual Specification Sections specify additional requirements.

B. Manufacturer Qualifications: A firm experienced in manufacturing products or systems similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units. As applicable, procure products from manufacturers able to meet qualification requirements, warranty requirements, and technical or factory-authorized service representative requirements.

C. Fabricator Qualifications: A firm experienced in producing products similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.

D. Installer Qualifications: A firm or individual experienced in installing, erecting, applying, 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.

1.7 QUALITY CONTROL

A. Contractor Responsibilities: Tests and inspections not explicitly assigned to Owner are Contractor's responsibility. Perform additional quality-control activities, whether specified or not, to verify and document that the Work complies with requirements.

1. Unless otherwise indicated, provide quality-control services specified and those required by authorities having jurisdiction. Perform quality-control services required of Contractor by authorities having jurisdiction, whether specified or not.
2. Engage a qualified testing agency to perform quality-control services.

3. Notify testing agencies at least **24** hours in advance of time when Work that requires testing or inspection will be performed.
4. Where quality-control services are indicated as Contractor's responsibility, submit a certified written report, in duplicate, of each quality-control service.
5. Testing and inspection requested by Contractor and not required by the Contract Documents are Contractor's responsibility.
6. Submit additional copies of each written report directly to authorities having jurisdiction, when they so direct.

B. Coordination: Coordinate sequence of activities to accommodate required quality-assurance and quality-control services with a minimum of delay and to avoid necessity of removing and replacing construction to accommodate testing and inspection.

1. Schedule times for tests, inspections, obtaining samples, and similar activities.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 014000

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 QUALITY ASSURANCE

A. Electric Service: Comply with NECA, NEMA, and UL standards and regulations for temporary electric service. Install service to comply with NFPA 70.

B. Tests and Inspections: Arrange for authorities having jurisdiction to test and inspect each temporary utility before use. Obtain required certifications and permits.

1.4 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. Polyethylene Sheet: Reinforced, fire-resistive sheet, 10-mil minimum thickness, with flame-spread rating of 15 or less in accordance with ASTM E84 and passing NFPA 701 Test Method 2.

B. Dust-Control Adhesive-Surface Walk-Off Mats: Provide mats, minimum 36 by 60 inches

PART 3 - EXECUTION

3.1 TEMPORARY FACILITIES, GENERAL

A. Locate facilities where they will serve Project adequately and result in minimum interference with performance of the Work. Relocate and modify facilities as required by progress of the Work.

B. General: Install temporary service or connect to existing service.

C. Temporary Signs: Provide other signs as indicated and as required to inform public and individuals seeking entrance to Project Area. Provide temporary, directional signs for construction personnel and visitors.

D. Waste Disposal Facilities: Provide waste-collection containers in sizes adequate to handle waste from construction operations. Comply with requirements of authorities having jurisdiction. Comply with progress cleaning requirements in Section 017300 "Execution."

E. 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.

3.2 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.

1. Where access to adjacent properties is required in order to affect protection of existing facilities, obtain written permission from adjacent property owner to access property for that purpose.

B. Environmental Protection: Provide protection, operate temporary facilities, and conduct construction as required to 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 Section 011000 "Summary."

C. Security Enclosure and Lockup: Install temporary enclosure around partially completed areas of construction. Provide lockable entrances to prevent unauthorized entrance, vandalism, theft, and similar violations of security. Lock entrances at end of each workday.

D. Barricades, Warning Signs, and Lights: Comply with requirements of authorities having jurisdiction for erecting structurally adequate barricades, including warning signs and lighting.

1. Provide overhead decking, protective enclosure walls, handrails, barricades, warning signs, exit signs, lights, safe and well-drained walkways, and similar provisions for protection and safe passage.
2. Paint and maintain appearance of walkway for duration of the Work.

E. Temporary Enclosures: Construct dustproof partitions with gypsum wallboard, with joints taped on occupied side, and fire-retardant-treated plywood on construction operations side.
1. Construct dustproof partitions with two layers of 6-mil polyethylene sheet on each side. Cover floor with two layers of 6-mil polyethylene sheet, extending sheets 18 inches up the sidewalls. Overlap and tape full length of joints. Cover floor with fire-retardant-treated plywood.
2. Provide walk-off mats at each entrance through temporary partition.

F. Controlled Construction Period: After completing and sealing of the building enclosure but

3.3 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. 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. At Substantial Completion, repair, renovate, and clean permanent facilities used during construction period. Comply with final cleaning requirements specified in Section 017700 "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. Section includes administrative and procedural requirements for selection of products for use in Project; product delivery, storage, and handling; manufacturers' standard warranties on products; special warranties; and comparable products.

B. Related Requirements:

1. Section 011000 "Summary" for Contractor requirements related to Owner-furnished products.
2. Section 012500 "Substitution Procedures" for requests for substitutions.
3. Section 01770 "Closeout Procedures" for submitting warranties.

1.3 DEFINITIONS

A. Products: Items obtained for incorporating into the Work, whether purchased for Project or taken from previously purchased stock. The term "product" includes the terms "material," "equipment," "system," and terms of similar intent.

1. Named Products: Items identified by manufacturer's product name, including make or model number or other designation shown or listed in manufacturer's published product literature that is current as of date of the Contract Documents.
2. New Products: Items that have not previously been incorporated into another project or facility. Salvaged items or items reused from other projects are not considered new products. Items that are manufactured or fabricated to include recycled content materials are considered new products, unless indicated otherwise.
3. Comparable Product: Product by named manufacturer that is demonstrated and approved through the comparable product submittal process described in Part 2 "Comparable Products" Article, to have the indicated qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics that equal or exceed those of specified product.

B. Basis-of-Design Product Specification: A specification in which a single manufacturer's product is named and accompanied by the words "basis-of-design product," including make or model number or other designation. Published attributes and characteristics of basis-of-design product establish salient characteristics of products.

1. Evaluation of Comparable Products: In addition to the basis-of-design product description, product attributes and characteristics may be listed to establish the significant qualities related to type, function, in-service performance and physical properties, weight, dimension, durability, visual characteristics, and other special features and requirements for purposes of evaluating comparable products of additional manufacturers named in the specification.

C. Subject to Compliance with Requirements: Where the phrase "Subject to compliance with requirements" introduces a product selection procedure in an individual Specification Section, provide products qualified under the specified product procedure. In the event that a named product or product by a named manufacturer does not meet the other requirements of the specifications, select another named product or product from another named manufacturer that does meet the requirements of the specifications; submit a comparable product request or substitution request, if applicable.

D. Comparable Product Request Submittal: An action submittal requesting consideration of a comparable product, including the following information:

1. Identification of basis-of-design product or fabrication or installation method to be replaced, including Specification Section number and title and Drawing numbers and titles.
2. Data indicating compliance with the requirements specified in Part 2 "Comparable Products" Article.

E. Basis-of-Design Product Specification Submittal: An action submittal complying with requirements in Section 013300 "Submittal Procedures."

F. Substitution: Refer to Section 012500 "Substitution Procedures" for definition and limitations on substitutions.

1.4 QUALITY ASSURANCE

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

a. Contractors are responsible for providing products and construction methods compatible with products and construction methods of other contractors.
b. If a dispute arises between the multiple contractors over concurrently selectable but incompatible products, Engineer will determine which products shall be used.

B. Identification of Products: Except for required labels and operating data, do not attach or imprint manufacturer or product names or trademarks on exposed surfaces of products or equipment that will be exposed to view in occupied spaces or on the exterior.

1. Labels: Locate required product labels and stamps on a concealed surface, or, where required for observation following installation, on a visually accessible surface that is not conspicuous.

2. Equipment Nameplates: Provide a permanent nameplate on each item of service- or power-operated equipment. Locate on a visually accessible but inconspicuous surface. Include information essential for operation, including the following:

    a. Name of product and manufacturer.
    b. Model and serial number.
    c. Capacity.
    d. Speed.
    e. Ratings.

3. See individual identification Sections in Divisions -23, and 26 for additional equipment identification requirements.

1.5 COORDINATION

A. Modify or adjust affected work as necessary to integrate work of approved comparable products and approved substitutions.

1.6 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, and handle products, using means and methods that will prevent damage, deterioration, and loss, including theft and vandalism. Comply with manufacturer's written instructions.

B. Delivery and Handling:

1. Schedule delivery to minimize long-term storage at Project site and to prevent overcrowding of construction spaces.
2. Coordinate delivery with installation time to ensure minimum holding time for items that are flammable, hazardous, easily damaged, or sensitive to deterioration, theft, and other losses.
3. Deliver products to Project site in an undamaged condition in manufacturer's original sealed container or other packaging system, complete with labels and instructions for handling, storing, unpacking, protecting, and installing.
4. Inspect products on delivery to determine compliance with the Contract Documents and that products are undamaged and properly protected.

C. Storage:

1. Provide a secure location and enclosure at Project site for storage of materials and equipment.
2. Store products to allow for inspection and measurement of quantity or counting of units.
3. Store materials in a manner that will not endanger Project structure.
4. Store products that are subject to damage by the elements under cover in a weathertight enclosure above ground, with ventilation adequate to prevent condensation and with adequate protection from wind.
5. Protect foam plastic from exposure to sunlight, except to extent necessary for period of installation and concealment.

6. Comply with product manufacturer's written instructions for temperature, humidity, ventilation, and weather-protection requirements for storage.
7. Protect stored products from damage and liquids from freezing.

1.7 PRODUCT WARRANTIES

A. Warranties specified in other Sections shall be in addition to, and run concurrent with, other warranties required by the Contract Documents. Manufacturer's disclaimers and limitations on product warranties do not relieve Contractor of obligations under requirements of the Contract Documents.

1. Manufacturer's Warranty: Written standard warranty form furnished by individual manufacturer for a particular product and issued in the name of the Owner or endorsed by manufacturer to Owner.
2. Special Warranty: Written warranty required by the Contract Documents to provide specific rights for Owner and issued in the name of the Owner or endorsed by manufacturer to Owner.

B. Special Warranties: Prepare a written document that contains appropriate terms and identification, ready for execution.

1. Manufacturer's Standard Form: Modified to include Project-specific information and properly executed.
2. Specified Form: When specified forms are included in the Project Manual, prepare a written document, using indicated form properly executed.
3. See other Sections for specific content requirements and particular requirements for submitting special warranties.

C. Submittal Time: Comply with requirements in Section 017700 "Closeout Procedures."

PART 2 - PRODUCTS

2.1 PRODUCT SELECTION PROCEDURES

A. General Product Requirements: Provide products that comply with the Contract Documents, are undamaged and, unless otherwise indicated, are new at time of installation.

1. Provide products complete with accessories, trim, finish, fasteners, and other items needed for a complete installation and indicated use and effect.
2. Owner reserves the right to limit selection to products with warranties meeting requirements of the Contract Documents.
3. Where products are accompanied by the term "as selected," Engineer will make selection.
4. Descriptive, performance, and reference standard requirements in the Specifications establish salient characteristics of products.
5. Or Equal: For products specified by name and accompanied by the term "or equal," "or approved equal," or "or approved," comply with requirements in "Comparable Products" Article to obtain approval for use of an unnamed product.

a. Submit additional documentation required by Engineer in order to establish equivalency of proposed products. Unless otherwise indicated, evaluation of "or equal" product status is by the Engineer, whose determination is final.

B. Product Selection Procedures:

1. Limited List of Products: Where Specifications include a list of names of both manufacturers and products, provide one of the products listed that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered unless otherwise indicated.

a. Limited list of products may be indicated by the phrase "Subject to compliance with requirements, provide one of the following."

2. Limited List of Manufacturers: Where Specifications include a list of manufacturers' names, provide a product by one of the manufacturers listed that complies with requirements. Comparable products or substitutions for Contractor's convenience **will** be considered

a. Limited list of manufacturers is indicated by the phrase "Subject to compliance with requirements, provide products by one of the following."

3. Basis-of-Design Product: Where Specifications name a product, or refer to a product indicated on Drawings, and include a list of manufacturers, provide the specified or indicated product or a comparable product by one of the other named manufacturers. Drawings and Specifications may additionally indicate sizes, profiles, dimensions, and other characteristics that are based on the product named. Comply with requirements in "Comparable Products" Article for consideration of an unnamed product by one of the other named manufacturers.

a. For approval of products by unnamed manufacturers, comply with requirements in Section 012500 "Substitution Procedures" for substitutions for convenience.

C. Visual Matching Specification: Where Specifications require the phrase "match Engineer's sample," provide a product that complies with requirements and matches Engineer's sample. Engineer's decision will be final on whether a proposed product matches.

1. If no product available within specified category matches and complies with other specified requirements, comply with requirements in Section 012500 "Substitution Procedures" for proposal of product.

D. Visual Selection Specification: Where Specifications include the phrase "as selected by Engineer from manufacturer's full range" or a similar phrase, select a product that complies with requirements. Engineer will select color, gloss, pattern, density, or texture from manufacturer's product line that includes both standard and premium items.

E. Sustainable Product Selection: Where Specifications require product to meet sustainable product characteristics, select products complying with indicated requirements. Comply with requirements in Division 01 sustainability requirements Section and individual Specification Sections.

1. Select products for which sustainable design documentation submittals are available from manufacturer.

2.2 COMPARABLE PRODUCTS

A. Conditions for Consideration of Comparable Products: Engineer will consider Contractor's request for comparable product when the following conditions are satisfied. If the following conditions are not satisfied, Engineer may return requests without action, except to record noncompliance with the following requirements:

1. Evidence that proposed product does not require revisions to the Contract Documents, is consistent with the Contract Documents, will produce the indicated results, and is compatible with other portions of the Work.
2. Detailed comparison of significant qualities of proposed product with those of the named basis-of-design product. Significant product qualities include attributes, such as type, function, in-service performance and physical properties, weight, dimension, durability, visual characteristics, and other specific features and requirements.
3. Evidence that proposed product provides specified warranty.
4. List of similar installations for completed projects, with project names and addresses and names and addresses of Engineers and owners, if requested.
5. Samples, if requested.

B. Engineer's Action on Comparable Products Submittal: If necessary, Engineer will request additional information or documentation for evaluation, as specified in Section 013300 "Submittal Procedures."

1. Form of Approval of Submittal: As specified in Section 013300 "Submittal Procedures."
2. Use product specified if Engineer does not issue a decision on use of a comparable product request within time allocated.

C. Submittal Requirements, Two-Step Process: Approval by the Engineer of Contractor's request for use of comparable product is not intended to satisfy other submittal requirements. Comply with specified submittal requirements.

PART 3 - EXECUTION (Not Used)

END OF SECTION 016000

SECTION 017300 - EXECUTION

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes general administrative and procedural requirements governing execution of the Work, including, but not limited to, the following:
   1. Installation of the Work.
   2. Cutting and patching.
   3. Coordination of Owner-installed products.
   4. Progress cleaning.
   5. Starting and adjusting.
   6. Protection of installed construction.
   7. Correction of the Work.

B. Related Requirements:
   1. 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.

1.2 DEFINITIONS

A. Cutting: Removal of in-place construction necessary to permit installation or performance of subsequent work.

B. Patching: Fitting and repair work required to restore construction to original conditions after installation of subsequent work.

1.3 QUALITY ASSURANCE

A. Professional Engineer Qualifications: Refer to Section 014000 "Quality Requirements."

B. Cutting and Patching: Comply with requirements for and limitations on cutting and patching of construction elements.
   1. 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.

C. Manufacturer's Installation Instructions: Obtain and maintain on-site manufacturer's written recommendations and instructions for installation of specified products and equipment.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Comply with requirements specified in other Sections.

1. For projects requiring compliance with sustainable design and construction practices and procedures, use products for patching that comply with sustainable design requirements.

B. In-Place Materials: Use materials for patching identical to in-place materials. For exposed surfaces, use materials that visually match in-place adjacent surfaces to the fullest extent possible.

1. If identical materials are unavailable or cannot be used, use materials that, when installed, will provide a match acceptable to Architect for the visual and functional performance of in-place materials. Use materials that are not considered hazardous.

C. 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 EXAMINATION

A. Examination and Acceptance of Conditions: Before proceeding with each component of the Work, 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. Examine roughing-in for mechanical and electrical systems to verify actual locations of connections before equipment and fixture installation.
2. Examine walls, floors, and roofs for suitable conditions where products and systems are to be installed.
3. Verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.

B. 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 that is necessary to adjust, move, or relocate existing utility structures, utility poles, lines, services, or other utility appurtenances located in or affected by construction. Coordinate with authorities having jurisdiction.

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

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

3.3 INSTALLATION

A. Comply with manufacturer's written instructions and recommendations for installing products in applications indicated.

B. Install products at the time and under conditions that will ensure satisfactory results as judged by Architect. Maintain conditions required for product performance until Substantial Completion.

C. 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 of type expected for Project.

D. Tools and Equipment: Select tools or equipment that minimize production of excessive noise levels.

E. Templates: Obtain and distribute to the parties involved templates for Work specified to be factory prepared and field installed. Check Shop Drawings of other portions of the Work to confirm that adequate provisions are made for locating and installing products to comply with indicated requirements.

F. Attachment: Provide blocking and attachment plates and anchors and fasteners of adequate size and number to securely anchor each component in place, accurately located and aligned with other portions of the Work. Where size and type of attachments are not indicated, verify size and type required for load conditions with manufacturer.

G. Joints: Make joints of uniform width. Where joint locations in exposed Work are not indicated, arrange joints for the best visual effect, as judged by Architect. Fit exposed connections together to form hairline joints.

3.4 CUTTING AND PATCHING

A. General: Employ skilled workers to perform cutting and patching. Proceed with cutting and patching at the earliest feasible time, and complete without delay.

B. Existing Warranties: Remove, replace, patch, and repair materials and surfaces cut or damaged during installation or cutting and patching operations, by methods and with materials so as not to void existing warranties.

C. Temporary Support: Provide temporary support of Work to be cut.

D. Protection: Protect in-place construction during cutting and patching to prevent damage. Provide protection from adverse weather conditions for portions of Project that might be exposed during cutting and patching operations.

E. Existing Utility Services and Mechanical/Electrical Systems: Where existing services/systems are required to be removed, relocated, or abandoned, bypass such services/systems before cutting to **minimize** interruption to occupied areas.

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 neatly to minimum 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.

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 practicable, as judged by Architect. Provide materials and comply with installation requirements specified in other Sections, where applicable.

1. Inspection: Where feasible, test and inspect patched areas after completion to demonstrate physical integrity of installation.
2. Exposed Finishes: Restore exposed finishes of patched areas and extend finish restoration into retained adjoining construction in a manner that will eliminate evidence of patching and refinishing.

    a. Clean piping, conduit, and similar features before applying paint or other finishing materials.
    b. Restore damaged pipe covering to its original condition.

3. Floors and Walls: Where walls or partitions that are removed extend one finished area into another, patch and repair floor and wall surfaces in the new space. Provide an even surface of uniform finish, color, texture, and appearance. Remove in-place floor and wall coverings and replace with new materials, if necessary, to achieve uniform color and appearance.

    a. Where patching occurs in a painted surface, prepare substrate and apply primer and intermediate paint coats appropriate for substrate over the patch, and apply final paint coat over entire unbroken surface containing the patch, corner to corner of wall and edge to edge of ceiling. Provide additional coats until patch blends with adjacent surfaces.

4. Ceilings: Patch, repair, or rehang in-place ceilings as necessary to provide an even-plane surface of uniform appearance.

5. Exterior Building Enclosure: Patch components in a manner that restores enclosure to a weathertight condition and ensures thermal and moisture integrity of building enclosure.

H. Cleaning: Clean areas and spaces where cutting and patching are performed. Remove paint, mortar, oils, putty, and similar materials from adjacent finished surfaces.

3.5 PROGRESS CLEANING

A. Clean Project site and work areas daily, including common areas. Enforce requirements strictly. Dispose of materials lawfully.

1. Comply with requirements in NFPA 241 for removal of combustible waste materials and debris.
2. Containerize hazardous and unsanitary waste materials separately from other waste. Mark containers appropriately and dispose of legally, according to regulations.

B. 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.

C. 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.

D. Concealed Spaces: Remove debris from concealed spaces before enclosing the space.

E. Exposed Surfaces: Clean exposed surfaces and protect as necessary to ensure freedom from damage and deterioration at time of Substantial Completion.

F. 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.

G. 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.

H. Limiting Exposures: Supervise construction operations to ensure 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 CORRECTION OF THE WORK

A. Repair or remove and replace damaged, defective, or nonconforming Work. Restore damaged substrates and finishes.

1. Repairing includes replacing defective parts, refinishing damaged surfaces, touching up with matching materials, and properly adjusting operating equipment.

B. Repair Work previously completed and subsequently damaged during construction period. Repair to like-new condition.

C. Restore permanent facilities used during construction to their specified condition.

D. Remove and replace damaged surfaces that are exposed to view if surfaces cannot be repaired without visible evidence of repair.

E. Repair components that do not operate properly. Remove and replace operating components that cannot be repaired.

F. Remove and replace chipped, scratched, and broken glass or reflective surfaces.

END OF SECTION 017300

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. Section includes administrative and procedural requirements for Contract closeout, including, but not limited to, the following:

1. Substantial Completion procedures.
2. Final completion procedures.
3. Warranties.
4. Final cleaning.

B. Related Requirements:

1. Section 012900 "Payment Procedures" for requirements for Applications for Payment for Substantial Completion and Final Completion.
2. Section 013233 "Photographic Documentation" for submitting Final Completion construction photographic documentation.
3. Section 017839 "Project Record Documents" for submitting Record Drawings, Record Specifications, and Record Product Data.

1.3 DEFINITIONS

A. List of Incomplete Items: Contractor-prepared list of items to be completed or corrected, prepared for the Engineer's use prior to Engineer's inspection, to determine if the Work is substantially complete.

1.4 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.

1.5 CLOSEOUT SUBMITTALS

A. Certificates of Release: From authorities having jurisdiction.

B. Certificate of Insurance: For continuing coverage.

C. Field Report: For pest-control inspection.

1.6 SUBSTANTIAL COMPLETION PROCEDURES

A. Contractor's List of Incomplete Items: Prepare and submit a list of items to be completed and corrected (Contractor's "punch list"), indicating the value of each item on the list and reasons why the Work is incomplete.

B. Submittals Prior to Substantial Completion: Complete the following a minimum of **10** days prior to requesting inspection for determining date of Substantial Completion. List items below that are incomplete at time of request.

1. Certificates of Release: Obtain and submit releases from authorities having jurisdiction, permitting Owner unrestricted use of the Work and access to services and utilities. Include occupancy permits, operating certificates, and similar releases.
2. Submit closeout submittals specified in individual Sections, including specific warranties, workmanship bonds, maintenance service agreements, final certifications, and similar documents.
3. Submit maintenance material submittals specified in individual Sections, including tools, spare parts, extra materials, and similar items, and deliver to location designated by **Engineer**. Label with manufacturer's name and model number.

C. Procedures Prior to Substantial Completion: Complete the following a minimum of **10** days prior to requesting inspection for determining date of Substantial Completion. List items below that are incomplete at time of request.

1. Advise Owner of pending insurance changeover requirements.
2. Make final changeover of permanent locks and deliver keys to Owner. Advise Owner's personnel of changeover in security provisions.
3. Complete startup and testing of systems and equipment.
4. Perform preventive maintenance on equipment used prior to Substantial Completion.
5. Instruct Owner's personnel in operation, adjustment, and maintenance of products, equipment, and systems. Submit demonstration and training video recordings specified in Section 017900 "Demonstration and Training."
6. Advise Owner of changeover in utility services.
7. Participate with Owner in conducting inspection and walkthrough with local emergency responders.
8. Terminate and remove temporary facilities from Project site, along with mockups, construction tools, and similar elements.
9. Complete final cleaning requirements.
10. Touch up paint and otherwise repair and restore marred exposed finishes to eliminate visual defects.

D. Inspection: Submit a written request for inspection to determine Substantial Completion a minimum of **10** days prior to date the Work will be completed and ready for final inspection and tests. On receipt of request, Engineer will either proceed with inspection or notify Contractor of unfulfilled requirements. Engineer 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 Engineer, that must be completed or corrected before certificate will be issued.

1. Request reinspection when the Work identified in previous inspections as incomplete is completed or corrected.
2. Results of completed inspection will form the basis of requirements for Final Completion.

1.7 FINAL COMPLETION PROCEDURES

A. Submittals Prior to Final Completion: Before requesting final inspection for determining Final Completion, complete the following:

1. Submit a final Application for Payment in accordance with Section 012900 "Payment Procedures."
2. Certified List of Incomplete Items: Submit certified copy of Engineer's Substantial Completion inspection list of items to be completed or corrected (punch list), endorsed and dated by Engineer. Certified copy of the list shall state that each item has been completed or otherwise resolved for acceptance.
3. Certificate of Insurance: Submit evidence of final, continuing insurance coverage complying with insurance requirements.
4. Submit pest-control final inspection report.
5. Submit Final Completion photographic documentation.

B. Inspection: Submit a written request for final inspection to determine acceptance a minimum of 10 days prior to date the Work will be completed and ready for final inspection and tests. On receipt of request, Engineer, will either proceed with inspection or notify Contractor of unfulfilled requirements. Engineer 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. Request reinspection when the Work identified in previous inspections as incomplete is completed or corrected.

1.8 LIST OF INCOMPLETE ITEMS

A. Organization of List: Include name and identification of each space and area affected by construction operations for incomplete items and items needing correction including, if necessary, areas disturbed by Contractor that are outside the limits of construction.

1. Organize list of spaces in sequential order, listed by room or space number.
2. Organize items applying to each space by major element, including categories for ceilings, 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 Engineer,
    d. Name of Contractor.
    e. Page number.

4. Submit list of incomplete items in the following format:

    a. MS Excel Electronic File: Engineer, will return annotated file.
    b. Web-Based Project Software Upload: Utilize software feature for creating and updating list of incomplete items (punch list).

1.9 SUBMITTAL OF PROJECT WARRANTIES

A. Time of Submittal: Submit written warranties on request of Engineer for designated portions of the Work where warranties are indicated to commence on dates other than date of Substantial Completion, or when delay in submittal of warranties might limit Owner's rights under warranty.

B. Organize warranty documents into an orderly sequence based on the table of contents of Project Manual.

C. Warranty Electronic File: Provide warranties and bonds in PDF format. Assemble complete warranty and bond submittal package into a single electronic PDF file with bookmarks enabling navigation to each item. Provide bookmarked table of contents at beginning of document.

    1. Submit on digital media acceptable to Engineer, by uploading to web-based project software site.

D. Warranties in Paper Form:

    1. Bind warranties and bonds in heavy-duty, three-ring, vinyl-covered, loose-leaf binders, thickness as necessary to accommodate contents, and sized to receive 8-1/2-by-11-inch 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.

E. 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: Perform final cleaning. Conduct cleaning and waste-removal operations to comply with local laws and ordinances and Federal and local environmental and antipollution regulations.

B. Cleaning: Employ experienced workers or professional cleaners for final cleaning. Clean each surface or unit to condition expected in an average commercial building cleaning and maintenance program. Comply with manufacturer's written instructions.

a. Clean Project site of rubbish, waste material, litter, and other foreign substances.
b. Remove tools, construction equipment, machinery, and surplus material from Project site.
c. Remove snow and ice to provide safe access to building.
d. Clean flooring, removing debris, dirt, and staining; clean according to manufacturer's recommendations.
e. Vacuum carpet and similar soft surfaces, removing debris and excess nap; clean according to manufacturer's recommendations if visible soil or stains remain.
f. Clean transparent materials, including mirrors and glass in doors and windows. Remove glazing compounds and other noticeable, vision-obscuring materials. Polish mirrors and glass, taking care not to scratch surfaces.
g. Remove labels that are not permanent.
h. Wipe surfaces of mechanical and electrical equipment**,** elevator equipment**,** and similar equipment. Remove excess lubrication, paint and mortar droppings, and other foreign substances.
i. Clean plumbing fixtures to a sanitary condition, free of stains, including stains resulting from water exposure.
j. Replace disposable air filters and clean permanent air filters. Clean exposed surfaces of diffusers, registers, and grills.
k. Clean ducts, blowers, and coils, if units were operated without filters during construction or that display contamination with particulate matter on inspection.

l. Clean luminaires, lamps, globes, and reflectors to function with full efficiency.
m. Clean strainers.
n. Leave Project clean and ready for occupancy.

C. Construction Waste Disposal: Comply with waste-disposal requirements in Section 015000 "Temporary Facilities and Controls." Section 017419 "Construction Waste Management and Disposal.

3.2 REPAIR OF THE WORK

A. Complete repair and restoration operations required by Section 017300 "Execution" before requesting inspection for determination of Substantial Completion.

END OF SECTION 017700

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, product maintenance manuals.

B. Related Requirements:

1. Section 011200 "Multiple Contract Summary" for coordinating operation and maintenance manuals covering the Work of multiple contracts.
2. Section 013300 "Submittal Procedures" for submitting copies of submittals for operation and maintenance manuals.
3. Section 019113 "General Commissioning Requirements" for verification and compilation of data into 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. Engineer 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 operation and maintenance manuals in the following format:

1. Submit on digital media acceptable to Engineer, by uploading to web-based project software site. Enable reviewer comments on draft submittals.
2. .

C. Initial Manual Submittal: Submit draft copy of each manual at least **30**days before commencing demonstration and training. Engineer 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 1**5** days before commencing demonstration and training. Engineer will return copy with comments.

1. Correct or revise each manual to comply with Engineer's comments. Submit copies of each corrected manual within **15** days of receipt of Engineer'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.

1.6 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. 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.

C. 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.

D. 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.

E. Repair Materials and Sources: Include lists of materials and local sources of materials and related services.

F. 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. Section includes administrative and procedural requirements for Project Record Documents, including the following:

1. Record Drawings.
2. Record specifications.
3. Record Product Data.
4. Miscellaneous record submittals.

B. Related Requirements:
1. Section 017700 "Closeout Procedures" for general closeout procedures.
2. Section 017823 "Operation and Maintenance Data" for operation and maintenance manual requirements.

1.3 CLOSEOUT SUBMITTALS

A. Record Drawings: Comply with the following:
1. : Submit copies of Record Drawings as follows:

a. Initial Submittal:
1) Submit PDF electronic files of scanned record prints
2) Submit Record Digital Data Files
3) Architect will indicate whether general scope of changes, additional information recorded, and quality of drafting are acceptable.

b. Final Submittal:
1) Submit PDF electronic files of scanned Record Prints
2) Print each drawing, whether changes and additional information were recorded.

B. Record Specifications: Submit **annotated PDF electronic files** of Project's Specifications, including addenda and Contract modifications.

C. Record Product Data: Submit **annotated PDF electronic files and directories** of each submittal.

1. Where record Product Data are required as part of operation and maintenance manuals, submit duplicate marked-up Product Data as a component of manual.

D. Miscellaneous Record Submittals: See other Specification Sections for miscellaneous record-keeping requirements and submittals in connection with various construction activities. Submit **annotated PDF electronic files and directories** of each submittal.

E. Reports: Submit written report **weekly** indicating items incorporated into Project Record Documents concurrent with progress of the Work, including revisions, concealed conditions, field changes, product selections, and other notations incorporated.

1.4 RECORD SPECIFICATIONS

A. Preparation: Mark Specifications to indicate the actual product installation, where installation varies from that indicated in Specifications, addenda, and Contract modifications.

1. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.

B. Format: Submit record specifications as **annotated PDF electronic file**

1.5 RECORD PRODUCT DATA

A. Recording: Maintain one copy of each submittal during the construction period for Project Record Document purposes. Post changes and revisions to Project Record Documents as they occur; do not wait until end of Project.

B. 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

C. Format: Submit Record Product Data as **annotated PDF electronic file**.

1. Include Record Product Data directory organized by Specification Section number and title, electronically linked to each item of Record Product Data.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 017839

DIVISION 02 – SITE CONSTRUCTION

SECTION 02 41 19 – SELECTIVE DEMOLITION

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
1. Demolition and removal of selected portions of building or structure.
2. Salvage of existing items to be reused or recycled.

1.2 DEFINITIONS

A. Remove: Detach items from existing construction and legally dispose of them off-site unless indicated to be removed and salvaged or removed and reinstalled.

B. Remove and Salvage: Carefully detach from existing construction, in a manner to prevent damage, and deliver to Owner.

C. Remove and Reinstall: Detach items from existing construction, prepare for reuse, and reinstall where indicated.

D. Existing to Remain: Existing items of construction that are not to be permanently removed and that are not otherwise indicated to be removed, removed and salvaged, or removed and reinstalled.

1.3 PREINSTALLATION MEETINGS

A. Predemolition Conference: Conduct conference at Project site.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For refrigerant recovery technician, if applicable.

B. Predemolition Photographs or Video: Submit before Work begins.

C. Statement of Refrigerant Recovery: Signed by refrigerant recovery technician.

1.5 CLOSEOUT SUBMITTALS

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

1.6 QUALITY ASSURANCE

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

1.7 FIELD CONDITIONS

A. Owner will occupy portions of building immediately adjacent to selective demolition area. Conduct selective demolition so Owner's operations will not be disrupted.

B. Conditions existing at time of inspection for bidding purpose will be maintained by Owner as far as practical.

C. Notify Architect of discrepancies between existing conditions and Drawings before proceeding with selective demolition.

D. Hazardous Materials: It is not expected that hazardous materials will be encountered in the Work.

1. Hazardous materials will be removed by Owner before start of the Work.
2. If suspected hazardous materials are encountered, do not disturb; immediately notify Architect and Owner. Hazardous materials will be removed by Owner under a separate contract.

E. Storage or sale of removed items or materials on-site is not permitted.

F. Utility Service: Maintain existing utilities indicated to remain in service and protect them against damage during selective demolition operations.

1. Maintain fire-protection facilities in service during selective demolition operations.

1.8 WARRANTY

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

PART 2 - PRODUCTS

2.1 PEFORMANCE REQUIREMENTS

A. Regulatory Requirements: Comply with governing EPA notification regulations before beginning selective demolition. Comply with hauling and disposal regulations of authorities having jurisdiction.

B. Standards: Comply with ANSI/ASSE A10.6 and NFPA 241.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that utilities have been disconnected and capped before starting selective demolition operations.

B. Survey existing conditions and correlate with requirements indicated to determine extent of selective demolition required.

C. When unanticipated mechanical, electrical, or structural elements that conflict with intended function or design are encountered, investigate and measure the nature and extent of conflict. Promptly submit a written report to Architect.

3.2 UTILITY SERVICES AND MECHANICAL/ELECTRICAL SYSTEMS

A. Existing Services/Systems to Remain: Maintain services/systems indicated to remain and protect them against damage.

1. Comply with requirements for existing services/systems interruptions specified in Division 01 Section "Summary."

B. Existing Services/Systems to Be Removed, Relocated, or Abandoned: Locate, identify, disconnect, and seal or cap off indicated utility services and mechanical/electrical systems serving areas to be selectively demolished.

1. Owner will arrange to shut off indicated services/systems when requested by Contractor.
2. Arrange to shut off indicated utilities with utility companies.
3. If services/systems are required to be removed, relocated, or abandoned, provide temporary services/systems that bypass area of selective demolition and that maintain continuity of services/systems to other parts of building.
4. Disconnect, demolish, and remove fire-suppression systems, plumbing, and HVAC systems, equipment, and components indicated to be removed.

    a. Piping to Be Removed: Remove portion of piping indicated to be removed and cap or plug remaining piping with same or compatible piping material.
    b. Piping to Be Abandoned in Place: Drain piping and cap or plug piping with same or compatible piping material.
    c. Equipment to Be Removed: Disconnect and cap services and remove equipment.
    d. Equipment to Be Removed and Reinstalled: Disconnect and cap services and remove, clean, and store equipment; when appropriate, reinstall, reconnect, and make equipment operational.
    e. Equipment to Be Removed and Salvaged: Disconnect and cap services and remove equipment and deliver to Owner.
    f. Ducts to Be Removed: Remove portion of ducts indicated to be removed and plug remaining ducts with same or compatible ductwork material.
    g. Ducts to Be Abandoned in Place: Cap or plug ducts with same or compatible ductwork material.

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

3.3 PREPARATION

A. Site Access and Temporary Controls: Conduct selective demolition and debris-removal operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.

1. Comply with requirements for access and protection specified in Division 01 Section "Temporary Facilities and Controls."

B. Temporary Facilities: Provide temporary barricades and other protection required to prevent injury to people and damage to adjacent buildings and facilities to remain.

C. Temporary Shoring: Provide and maintain shoring, bracing, and structural supports as required to preserve stability and prevent movement, settlement, or collapse of construction and finishes to remain, and to prevent unexpected or uncontrolled movement or collapse of construction being demolished.

3.4 SELECTIVE DEMOLITION, GENERAL

A. General: Demolish and remove existing construction only to the extent required by new construction and as indicated. Use methods required to complete the Work within limitations of governing regulations and as follows:

1. Neatly cut openings and holes plumb, square, and true to dimensions required. Use cutting methods least likely to damage construction to remain or adjoining construction. Use hand tools or small power tools designed for sawing or grinding, not hammering and chopping, to minimize disturbance of adjacent surfaces. Temporarily cover openings to remain.
2. Cut or drill from the exposed or finished side into concealed surfaces to avoid marring existing finished surfaces.
3. Do not use cutting torches until work area is cleared of flammable materials. At concealed spaces, such as duct and pipe interiors, verify condition and contents of hidden space before starting flame-cutting operations. Maintain fire watch and portable fire-suppression devices during flame-cutting operations.
4. Locate selective demolition equipment and remove debris and materials so as not to impose excessive loads on supporting walls, floors, or framing.
5. Dispose of demolished items and materials promptly. Comply with requirements in Division 01 Section "Construction Waste Management."

B. Removed and Reinstalled Items:

1. Clean and repair items to functional condition adequate for intended reuse.
2. Pack or crate items after cleaning and repairing. Identify contents of containers.
3. Protect items from damage during transport and storage.
4. Reinstall items in locations indicated. Comply with installation requirements for new materials and equipment. Provide connections, supports, and miscellaneous materials necessary to make item functional for use indicated.

C. Existing Items to Remain: Protect construction indicated to remain against damage and soiling during selective demolition. When permitted by Architect, items may be removed to a suitable, protected storage location during selective demolition and cleaned and reinstalled in their original locations after selective demolition operations are complete.

3.5 DISPOSAL OF DEMOLISHED MATERIALS

A. General: Except for items or materials indicated to be reused, salvaged, reinstalled, or otherwise indicated to remain Owner's property, remove demolished materials from Project site and legally dispose of them in an EPA-approved landfill.

1. Do not allow demolished materials to accumulate on-site.

2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.
3. Remove debris from elevated portions of building by chute, hoist, or other device that will convey debris to grade level in a controlled descent.
4. Comply with requirements specified in Division 01 Section "Construction Waste Management."

B. Burning: Do not burn demolished materials.

C. Disposal: Transport demolished materials off Owner's property and legally dispose of them.

3.6 CLEANING

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

END OF SECTION 02 41 19

DIVISION 04 – MASONRY

SECTION 04 20 00 – UNIT MASONRY

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Pre-Faced Concrete Masonry Units.
2. Mortar and grout.
3. Steel reinforcing bars.
4. Masonry joint reinforcement.
5. Ties and anchors.
6. Miscellaneous masonry accessories.
7. Cavity-wall insulation.

B. Related Sections:
1. Section 03 30 00 – Cast-in-Place
2. Section 05 12 00 – Structural Steel
3. Section 05 50 00 – Metal Fabrications
4. Section 07 62 00 – Sheet Metal Flashings and Trim

1.2 PERFORMANCE REQUIREMENTS

A. Provide structural unit masonry that develops indicated net-area compressive strengths at 28 days.

B. Determine net-area compressive strength of masonry from average net-area compressive strengths of masonry units and mortar types (unit-strength method) according to Tables 1 and 2 in ACI 530.1/ASCE 6/TMS 602.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Samples for Initial Selection:

1. Glazed CMU color to be determined.
2. Colored mortar.
3. Weep holes/vents.

C. 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 used in structural masonry, include data and calculations establishing average net-area compressive strength of units.

2. Cementitious materials. Include brand, type and name of manufacturer.
3. Preblended, dry mortar mixes. Include description of type and proportions of ingredients.
4. Grout mixes. Include description of type and proportions of ingredients.
5. Reinforcing bars.
6. Joint reinforcement.
7. Anchors, ties and metal accessories.

D. Mix Designs: For each type of mortar and grout. 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 for air content.
2. Include test reports, according to ASTM C 1019, for grout mixes required to comply with compressive strength requirement.

E. Statement of Compressive Strength of Masonry: For each combination of masonry unit 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 Tables 1 and 2 in ACI 530.1/ASCE 6/TMS 602.

F. Cold-Weather and Hot-Weather Procedures: Detailed description of methods, materials, and equipment to be used to comply with requirements.

1.4 QUALITY ASSURANCE

A. Testing Agency Qualifications: Qualified according to ASTM C 1093 for testing indicated.

B. 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.

C. 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 of producer for each aggregate.

D. Masonry Standard: Comply with ACI 530.1/ASCE 6/TMS 602 unless modified by requirements in the Contract Documents.

E. Mockup: Comply with requirements in Section 014000 – Quality Requirements for Mockups.

F. Comply with applicable requirements of the following standards and those others referenced in this Section, under the provisions of Section 014200 – References.

1. American Concrete Institute (ACI) and American Society of Civil Engineers (ASCE): ACI 530.1/ASCE 6 – Specifications for Masonry Structures.

1.5 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 designed for use with dispensing silos. Store preblended, dry mortar mix in delivery containers on elevated platforms, under cover, and 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.

1.6 PROJECT CONDITIONS

A. Protection of Masonry: During construction, cover tops of walls, projections, and sills with waterproof sheeting at end of each day's work. Cover partially completed masonry when construction is not in progress.

1. Extend cover a minimum of 24 inches (600mm) down both sides of walls and hold cover securely in place.

2. Where one wythe of multi-wythe masonry walls is completed in advance of other wythes, secure cover a minimum of 24 inches (600mm) down face next to unconstructed wythe and hold cover in place.

B. 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.

C. 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 rain-splashed mud and from mortar splatter by spreading coverings on ground and over wall surface.
2. Protect sills, ledges, and projections from mortar droppings.
3. Protect surfaces of window and door frames, as well as similar products with painted and integral finishes, from mortar droppings.
4. Turn scaffold boards near the wall on edge at the end of each day to prevent rain from splashing mortar and dirt onto completed masonry.

D. 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 ACI 530.1/ASCE 6/TMS 602. Use of an anti-freeze admixture is not an acceptable substitute for compliance with cold weather requirements.

E. 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.

F. Hot-Weather Requirements: Comply with hot-weather construction requirements contained in ACI 530.1/ASCE 6/TMS 602.

PART 2 - PRODUCTS

2.1 MASONRY UNITS, GENERAL

A. Defective Units: Referenced masonry unit standards may allow a certain percentage of units to contain chips, cracks, or other defects exceeding limits stated in the standard. Do not use units where such defects will be exposed in the completed Work.

B. Fire-Resistance Ratings: Where indicated, provide units that comply with requirements for fire-resistance ratings indicated as determined by testing according to ASTM E 119, by equivalent masonry thickness, or by other means, as acceptable to authorities having jurisdiction.

2.2 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 units for outside corners unless otherwise indicated.
3. CMUs: ASTM C

B. Pre-Faced Concrete Block: “Spectra-Glaze® II Units.”

1. Manufacturer: Licensed or authorized in writing by The Spectra Group through Spectra Industrial Licensing Corporation, Baltimore, Maryland.

2. Facing Components: Facing ingredients must be Spectra-Glaze® Compound made with Spectra-Glaze® polymers, supplied to approved manufacturers by Spectra Materials Corporation, a Spectra Sciences, LLC company, and other ingredients as required to meet or exceed Spectra-Glaze® Block product standards including ASTM C 744.Unit Compressive Strength: Provide units with minimum average net-area compressive strength of 2800 psi (19.3 MPa).

3. Pre-Faced Surfaces: Exterior use – smooth, satin finish, conforming to ASTM C 744, ASTM C 67, paragraph 8 (freeze-thaw) and Thermal Shock Test B100JL, 24P.

4. Exterior Use: For enhanced durability, use Spectra-Glaze® Plus units and water based epoxy grout or mortar enhanced with water based proofing systems using Crete, WRG. Crete, etc mortar with additives.
5. Colors: Select from Manufacturer’s established or custom colors. All Standard, Vari-tone®, or Special Colors™ Series must conform to ASTM C 744. Provide color and texture matching the range represented by Architect’s sample.
6. Concrete Block for Glazing: ASTM C 90 for hollow and solid load-bearing units; Type 1 exterior use require Block-Rite™ integral efflorescence control system.
7. Types: Plain, scored, engraved, embossed and/or sculptured faces; extent of each as shown.
8. Glazed Face Sizes & Joints: Modular 8”x16”, 4”x16”, 8”x8”, 12”x12”, 16”x16” including 1/4” exposed face joints; sizes as shown; long dimensions, horizontal or vertical as shown.

9. Concrete Block Sizes Before Glazing: Modular; 2”, 4”, 6”, 8”, 10”, 12” thickness as needed.
10. Surface Burning Characteristics of Facing: ASTM E 84; flame spread less than 25; fuel contribution 0; smoke density less than 50. Products of combustion considered non-toxic as determined by BRC 4690 (toxicity testing).
11. Through-The-Wall Units: Use pre-faced block thickness equal to nominal wall thickness where possible. Shapes: Provide shapes to suit the condition shown.
12. Jointing Tools: Use glass 5/8” for concave joints; clean, non-staining metal tools elsewhere. Replace worn tools promptly.
13. Related Products: Provide setting mortar, horizontal wire reinforcing, ties and anchors and other accessories needed to properly complete the work.
14. Cleaning Compound: Use masonry detergent cleaners such as Spectra® brand of cleaners, Vana-trol® or Deox® in strict accordance with each manufacturer’s directions. **Do not use any product containing unbuffered hydrochloric acid or other unbuffered acids**.
15. Wiping Rags: Select clean cotton waste or equivalent.

2.3 MORTAR AND GROUT MATERIALS

A. Portland Cement: ASTM C 150, 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.

B. Hydrate Lime: ASTM C 207, Type S.

C. Colored Cement Product: Packaged blend made from portland cement and hydrated lime and mortar pigments, all complying with specified requirements and containing no other ingredients.

1. Match existing color mortar to be:
   a. To Be Determined

2. Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
   a. Capital Materials Corporation; Riverton Portland Cement Lime Custom Color.
   b. Holcim (US) Inc.; Rainbow Mortamix Custom Color Cement/Lime
   c. Lafarge Cement Company; Lehigh Custom Color Portland/Lime Cement

3. Formulate blend as required to produce color match to existing.
4. Pigments shall not exceed 10 percent of portland cement by weight.

D. 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. For joints less than 1/4 inch (6mm) thick, use aggregate graded with 100 percent passing the No. 16 (1.18mm) sieve.
3. Colored-Mortar Aggregates: Natural sand or crushed stone of color necessary to produce required mortar color.

E. Aggregate for Grout: ASTM C 404.

F. 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. Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
   a. Euclid Chemical Company (The); Accelguard 80.
   b. Grace Construction Products, W.R. Grace & Co. – Conn.; Morset.
   c. Sonneborn Products, BASF Aktiengesellschaft; Trimix-NCA.

G. Water: Portable.

2.4 REINFORCEMENT

A. Uncoated Steel Reinforcing Bars: ASTM A 615/A 615M or ASTM A 996/A 996M, Grade 60 (Grade 420).

B. Masonry Joint Requirement, General: ASTM A 951/A 951M.

1. Interior and Exterior Walls: Hot-dip galvanized, carbon steel.
2. Wire Size for Side Rods: 0.148 inch (3.77 mm) diameter
3. Wire Size for Cross Rods: 0.148 inch (3.77 mm) diameter
4. Wire Size for Veneer Ties: 0.148 inch (3.77 mm) diameter
5. Spacing of Cross Rods, Tabs, and Cross Ties: Not more than 16 inches (407mm) o.c.
6. Provide in lengths of not less than 10 feet (3 m), with prefabricated corner and tee units.

C. Masonry Joint Reinforcement for Single-Wythe Masonry: Truss type with single pair of side rods.

D. Masonry Joint Reinforcement for Multi-Wythe Masonry: Adjustable (two-piece) type, either ladder or truss design, with one side rod at each face shell of backing wythe and with separate adjustable ties with pintle-and-eye connections having a maximum adjustment of 1 1/4 inches (32 mm). Size ties to extend at least halfway through facing wythe but with at least 5/8 inch (16 mm) cover on outsid face. Ties have hooks or clips to engage a continuous horizontal wire in the facing wythe.

2.5 TIES AND ANCHORS

A. Materials: Provide ties and anchors specified in this article that are made from Hot-Dip Galvanized, Carbon-Steel Wire: ASTM A 82/A 82M; with ASTM A 153/A 153M, Class B-2 coating.

B. Wire Ties, General: Unless otherwise indicated, size wire ties to extend at least halfway through veneer but with at least 5/8 inch (16 mm) cover on outside face. Outer ends of wires are bent 90 degrees and extend 2 inches (50 mm) parallel to face of veneer.

C. Individual Wire Ties: Rectangular units with closed ends and not less than 4 inches (100 mm) wide.

1. Z-shaped ties with ends bent 90 degrees to provide hooks not less than 2 inches (50 mm) long may be used for masonry constructed from solid units.
2. Where wythes do not align are of different materials, use adjustable ties with pintle-and-eye connections having a maximum adjustment of 1 1/4inches (32 mm).
3. Wire: Fabricate from 3/16 inch (4.76 mm) diameter, hot-dip galvanized steel wire.

D. Adjustable Anchors for Connecting to Structural Steel Framing: Provide anchors that allow vertical or horizontal adjustment but resist tension and compression forces perpendicular to plane of wall. Anchor all CMU to structural steel at 16" o.c. where the nearest face of the masonry is within 8" of the steel centerline. Use of an anti-freeze admixture is not an acceptable substitute for compliance with cold weather requirements.

See structural drawings for additional requirements.

1. Anchor Section for Welding to Steel Frame: Crimped 1/4 inch (6.35 mm) diameter, hot-dip galvanized steel wire.
2. Tie Section: Triangular-shaped wire tie, sized to extend within 1 inch (25mm) of masonry face, made from 1/4 inch (6.35 mm) diameter, hot-dip galvanized steel wire.

E. Partition Top anchors: 0.105 inch (2.66 mm) thick metal plate with 3/8 inch (9.5 mm) diameter metal rod 6 inches (152 mm) long welded to plate and with closed-end plastic tube fitted over rod that allows rod to move in and out of tube. Fabricate from steel, hot-dip galvanized after fabrication. See structural drawings for alternate means of bracing cmu walls.

F. Adjustable masonry veneer anchors: Provide two-piece assemblies that allow vertical or horizontal adjustment but resist tension and compression forces perpendicular to plane of wall. for attachment of masonry veneer to substrate.

1. Masonry-veneer to masonry, provide "Pintles and Eyes with 2X-hooks" by Hohmann & Barnard, Inc., or approved equal. Length determined by location and depth of substrate.

2. Masonry to metal stud, provide "X – Seal Anchor" by Hohmann & Barnard, Inc., or approved equal. Length determined by location and depth of substrate.

2.6 MISCELLANEOUS ANCHORS

A. Dovetail Slots in Concrete: Furnish dovetail slots with filler strips, of slot size indicated, fabricated from 0.034 inch (0.86 mm), galvanized steel sheet.

2.7 EMBEDDED FLASHING MATERIAL

A. Metal Flashing and Drip Edges: Fabricate from the following metal:

1. Stainless Steel: 0.016 inch (0.4 mm) thick.
2. Fabricate metal drip edges from sheet metal indicated above. Extend at least 3 inches (75 mm) into wall and 1/2 inch (13 mm) out from the wall, with a hemmed outer edge bend down 30 degrees.

2.8 MISCELLANEOUS MASONRY ACCESSORIES

A. Compressible Filler: Premolded filler strips complying with ASTM D 1056, Grade 2A1; compressible up to 35 percent; of width and thickness indicated; formulated from neoprene.

B. Preformed Control-Joint Gaskets: Made from styrene-butadiene-rubber compound, complying with ASTM D 2000, Designation M2AA-805 and designed to fit standard sash block and to maintain lateral stability in masonry wall; size and configuration as indicated.

C. Weep/Vent Products: Rectangular Plastic Weep/Vent Tubing: Clear butyrate, 3/8 by 1 1/2 by 3 1/2 inches (9 by 38 by 89 mm) long. Subject to compliance with requirements, provide one of the following:

1. Advanced Building Products Inc.; Mortar Maze weep vent.
2. Dayton Superior Corporation, Dur-O-Wal Division; Cell Vents.
3. Heckmann Building Products Inc.; No. 85 Cell Vent.
4. Hohmann & Barnard, Inc.; Quadro-Vent.

D. Cavity Drainage Material: Free-draining mesh, made from polymer strands that will not degrade within the wall cavity. Subject to compliance with requirements, provide one of the following:

1. Advanced Building Products Inc.; [Mortar Break][Mortar Break II].
2. Archovations, Inc.; CavClear Masonry Mat.
3. Dayton Superior Corporation, Dur-O-Wal Division; Polytite MortarStop.
4. Mortar Net USA, Ltd.; Mortar Net.

2.9 CAVITY-WALL INSULATION

A. Extruded-Polystyrene Board Insulation with Increased R-Value: ASTM C 578, Type IV, but with an aged thermal resistance (R-value) for 1 inch (25 mm) thickness of 5.6 deg F x h x sq. ft/Btu at 75 deg F (1.0 K x sq. m/W at 24 deg C) at 5 years; closed cell product with a carbon-black filler and extruded with an integral skin.

B. Adhesive: Type recommended by insulation board manufacturer for application indicated

2.10 MASONRY CLEANERS

1. Cleaning Compound: Use masonry detergent cleaners such as Spectra® brand of cleaners, Vana-trol® or Deox® in strict accordance with each manufacturer's directions. **Do not use any product containing unbuffered hydrochloric acid or other unbuffered acids**.

2.11 MORTAR AND GROUT MIXES

A. General: Do not use admixtures, including pigments, air-entraining agents, accelerators, retarders, water-repellent agents, antifreeze compounds or other admixtures, unless otherwise indicated.

1. Do not use calcium chloride in mortar or grout.
2. Use portland cement-lime masonry element.
3. Add cold-weather admixture (if used) at same rate for all mortar that will be exposed to view, regardless of weather conditions, to ensure that mortar color is consistent.

B. Preblended, Dry Mortar Mix: Furnish dry mortar ingredients in form of a preblended mix. Measure quantities by weight to ensure accurate proportions and thoroughly blend ingredients before delivering to Project Site.

C. Mortar for Unit Masonry: Comply with ASTM C 270 – Property Specification. Provided the following types of mortar for applications stated unless another type is indicated or needed to provide required compressive strength of masonry.

1. For masonry below grade or in contact with earth, use Type M.
2. For reinforced masonry, use Type S.
3. For exterior, above-grade, load-bearing, and non-load-bearing walls and parapet walls; for interior load-bearing walls; for interior non-load-bearing partitions and for other applications where another type is not indicated, use Type N.
4. For interior non-load-bearing partitions, Type O may be used instead of Type N.

D. Pigmented Mortar: Use colored cement product.

E. Grout for Unit Masonry: Comply with ASTM C 476.

1. Use grout of type indicated or, if not otherwise indicated, of type (fine or coarse) that will comply with Table 1.15.1 in ACI 530.1/ASCE 6/TMS 602 for dimensions of grout spaces and pour height.
2. Proportion grout in accordance with ASTM C 476, Table 1 or paragraph 4.2.2 for specified 28-day compressive strength indicated but not less than 2000 psi (14 MPa).
3. Provide grout with a slump of 8 to 11 inches (203 to 279 mm) as measured according to ASTM C 143/C 143M.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine conditions, with Installer present, for compliance with requirements for installation tolerances and other condition affecting performance of the Work.

1. Fro the record, prepare written report, endorsed by Installer, listing conditions detrimental to performance of work.
2. Verify that foundations arte within tolerances specified.
3. Verify that reinforcing dowels are properly placed.

B. Before installation, examine rough-in and built-in construction for piping systems to verify actual locations of piping connections.

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 the 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. Select and arrange units for exposed unit masonry to produce a uniform blend of colors and textures. Mix units from several pallets or cubes as they are placed.

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 story height.

B. Lines and Levels:

1. For bed joints and top surfaces of bearing walls do not vary from level by more that 1/4 inch in 10 feet (6 mm in 3 m) 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 3m), maximum.
3. Fro vertical lines and surfaces do not vary from plumb by more than 1/4 inch in 10 feet (6 mm in 3m), 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 3m), maximum.
5. For lines and surfaces do not vary from straight by more than 1/4 inch in 10 feet (6 mm in 3m), 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 3m), maximum.
7. For faces of adjacent exposed masonry units, do not vary from flush alignment by more than 1/16 inch (1.5 mm) except due to warpage of masonry units within tolerances specified for warpage of units.

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). Do not vary from adjacent bed-joint and head-joint thicknesses by more than 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 (15 mm) 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. Stacked Pattern for Exposed Masonry: Unless otherwise indicated, lay exposed masonry in stacked bond; 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. 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 racking 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.

I. Build non-load-bearing interior partitions full height of story to underside of solid floor or roof structure above unless otherwise indicated.

1. Install compressible filler in joint between top of partition and underside of structure above.
2. Fasten partition top anchors to structure above and build into top of partition. Grout cells of CMUs solidly around plastic tubes of anchors and push tubes down into grout to provide 1/2 inch (13 mm) clearance between end of anchor rod and end of tube. Space anchors 48 inches (1200 mm) o.c. unless otherwise indicated.
3. Wedge non-load-bearing partitions against structure above with small pieces of tile, slate, or metal. Fill joint with mortar after dead-load deflection of structure above approaches final position.
4. At fire-rated partitions, treat joint between top of partition and underside of structure above to comply with Division 07 Section “Fire-Resistive Joint Systems”.

3.5 MORTAR BEDDING AND JOINTING

A. Lay hollow brick and CMUs as follows:

1. With face shells fully bedded in mortar and with head joints of depth equal to bed joints.
2. With webs fully bedded in mortar in all courses of piers, columns and pilasters.
3. With webs fully bedded in mortar in grouted masonry, including starting course on footings.
4. With entire units, including areas under cells, fully bedded in mortar at starting course on footings where cells are not grouted.

B. Lay solid masonry units 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 CMU masonry wall to receive vapor permeable air barrier membrane or cavity wall insulation.

3.6 MASONRY JOINT REINFORCEMENT

A. General: Install entire length of longitudinal side rods in mortar with a minimum cover of 5/8 inch (16 mm) on exterior side of walls, 1/2 inch (13 mm) elsewhere. Lap reinforcement a minimum of 6 inches (150 mm).

1. Space reinforcement not more than 16 inches (406 mm) o.c.
2. Space reinforcement not more than 8 inches (203 mm) o.c. in foundation walls and parapet walls.
3. Provide reinforcement not more than 8 inches (203 mm) above and below wall openings and extending 12 inches (305 mm) beyond opening in addition to continuous reinforcement.

B. Interrupt joint reinforcement at control and expansion joints unless otherwise indicated.

C. Provided 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 returns, offsets, column fireproofing, pipe enclosures and other special conditions.

3.7 ANCHORING MASONRY TO STRUCTURTAL STEEL AND CONCRETE

A. Anchor masonry to structural steel and concrete where masonry abuts or faces structural steel or concrete to comply with the following:

1. Provide an open space not less than 2 inches (50 mm) wide between masonry and structural steel or concrete unless otherwise indicated. Keep open space free of mortar and other rigid materials.
2. Anchor masonry with anchors embedded in masonry joints and attached to structure.
3. Space anchors as indicated, but nor more than 24 inches (610 mm) o.c. vertically and 36 inches (915 mm) horizontally.

3.8 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 by using preformed control-joint gaskets, designed to fit standard sash block.

C. Form expansion joints in brick by forming open joint full depth of brick wythe and of width indicated, but not less than 3/8 inch (10 mm) for installation of sealant and backer rod specified in Section 079200 – Joint Sealants.

3.9 LINTELS

A. Install steel lintels where indicated.

B. Provide concrete lintels where shown and where openings of more than 12 inches (305 mm) for brick-size units and 24 inches (610 mm) for block-size units are shown without structural steel or other supporting lintels.

C. Provide minimum bearing of 8 inches (200 mm) at each jamb unless otherwise indicated.

3.10 FLASHING, WEEP HOLES, CAVITY DRAINAGE, AND VENTS

A. General: Install embedded flashing and weep holes in masonry at shelf angles, lintels, ledges, other obstructions to downward flow of water in wall and where indicated. Install vents at shelf angles, ledges, and other obstruction to upward flow of air in cavities and where indicated.

B. Install flashing as follow unless otherwise indicated:

1. Prepare masonry surfaces so they are smooth and free from projections that could puncture flashing. Where flashing is within mortar joint, place through-wall flashing on sloping bed of mortar and cover with mortar. Before covering with mortar seal penetrations in flashing with adhesive, sealant, or tape as recommended by flashing manufacturer.
2. At multiwythe masonry walls, including cavity walls, extend flashing through outer wythe, turned up a minimum of 4 inches (100 mm) and through inner wythe to within 1/2 inch (13 mm) of the interior face of wall in exposed masonry. Where interior face of wall is to receive furring or framing, carry flashing completely through inner wythe and turn flashing up approximately 2 inches (50 mm) on interior face.
3. At lintels and shelf angles, extend flashing a minimum of 6 inches (150 mm) into masonry at each end. At heads and sills, extend flashing 6 inches (150 mm) at ends and turn up not less than 2 inches (50 mm) to form end dams.
4. Install metal drip edges and sealant stops with ribbed sheet metal flashing by interlocking hemmed edges to form hooded seam. Seal seam with elastomeric sealant complying with requirements in Section 07920 – Joint Sealants for application indicated.
5. Install metal drip edges beneath flexible flashing of exterior face of wall. Stop flexible flashing 1/2 inch (13 mm) back from outside face of wall and adhere flexible flashing to top of metal drip edge.

C. Install weep holes in head joints in exterior wythes of first course of masonry immediately above imbedded flashing and as follows:

1. Use specified weep/vent products to from weep holes.
2. Space weep holes 24 inches (600 mm) o.c. unless otherwise indicated.

D. Place cavity drainage material in cavities to comply with configuration requirements for cavity drainage material in “Miscellaneous Masonry Accessories” Article.

3.11 REINFORCED UNIT MASONRY INSTALLATION

A. Placing Reinforcement: Comply with requirements in ACI 530.1/ASCE 6/TMS 602.

B. Grouting: Do not place grout until entire height of masonry to be grouted has attained enough strength to resist grout pressure.

1. Comply with requirements in ACI 530.1/ASCE 6/TMS 602 for cleanouts and for grout placement, including minimum grout space and maximum pour height.
2. Limit height of vertical grout pours to not more than 60 inches (1520 mm).

3.12 FIELD QUALITY CONTROL

A. Testing and Inspecting: Owner will engage special inspectors to perform tests and inspections and prepare reports. Allow inspectors access to scaffolding and work areas, as needed to perform tests and inspections. Retesting of materials that fail to comply with specified requirements shall be done at Contractor's expense.

B. Inspections: Level 1 special inspections according to the "International Building Code".

1. Begin masonry construction only after inspectors have verified proportions of site-prepared mortar.
2. Place grout only after inspectors have verified compliance of grout spaces and of grades, sizes, and locations of reinforcement.
3. Place grout only after inspectors have verified proportions of site-prepared grout.

C. Testing Prior to Construction: One set of tests.

D. Testing Frequency: One set of tests for each 5000 sq. ft. (464 sq. m)of wall area or portion thereof.

E. Concrete Masonry Unit Test: For each type of unit provided, according to ASTM C 140 for compressive strength.

F. Mortar Aggregate Ratio Test (Proportion Specification): For each mix provided, according to ASTM C 780.

G. Mortar Test (Property Specification): For each mix provided, according to ASTM C 780. Test mortar for mortar air content and compressive strength.

H. Grout Test (Compressive Strength): For each mix provided, according to ASTM C 1019.

I. Prism Test: For each type of construction provided, according to ASTM C 1314 at 7 days and at 28 days.

3.13 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 progressed 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 brick by bucket-and-brush hand-cleaning method described in BIA Technical Notes 20.
6. Clean masonry with a proprietary acidic cleaner applied according t manufacturer's written instructions.
7. Clean concrete masonry by cleaning method indicated in NCMA TEK 8-2A applicable to type of stain on exposed surfaces.
8. Clean stone trim to comply with stone supplier's written instructions.

3.14 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.

END OF SECTION 04 20 00

DIVISION 05 – METALS

SECTION 05 40 00 – COLD FORMED METAL FRAMING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the following:
1. Any partition indicated on plans with a thickness greater than 20 gauge**.**
2. Any interior partition greater than 10 feet in height.

B. Related Sections include the following:
1. Division 05 Section "Metal Fabrications" for masonry shelf angles and connections.
2. Division 07 Section “EIFS” for exterior sheathing.
3. Division 09 Section "Non-Structural Metal Framing" for interior non-load-bearing, metal-stud framing and ceiling-suspension assemblies.

1.3 PERFORMANCE REQUIREMENTS

A. Cold-Formed Steel Framing, General: Design according to AISI's "Standard for Cold-Formed Steel Framing - General Provisions."
1. Headers: Design according to AISI's "Standard for Cold-Formed Steel Framing - Header Design."
2. Design exterior non-load-bearing wall framing to accommodate horizontal deflection without regard for contribution of sheathing materials.

1.4 SUBMITTALS

A. Product Data: For each type of cold-formed metal framing product and accessory indicated.

1.5 QUALITY ASSURANCE

A. Product Tests: Mill certificates or data from a qualified independent testing agency, or in-house testing with calibrated test equipment indicating steel sheet complies with requirements, including base-metal thickness, yield strength, tensile strength, total elongation, chemical requirements, and metallic-coating thickness.

B. AISI Specifications and Standards: Comply with AISI's "North American Specification for the Design of Cold-Formed Steel Structural Members" and its "Standard for Cold-Formed Steel Framing - General Provisions."

1.6 DELIVERY, STORAGE, AND HANDLING

A. Protect cold-formed metal framing from corrosion, deformation, and other damage during delivery, storage, and handling.

B. Store cold-formed metal framing, protect with a waterproof covering, and ventilate to avoid condensation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering cold-formed metal framing that may be incorporated into the Work include, but are not limited to, the following:
1. AllSteel Products, Inc.
2. Dietrich Metal Framing; a Worthington Industries Company.
3. Formetal Co. Inc. (The).
4. Steel Construction Systems.
5. Super Stud Building Products, Inc.
6. United Metal Products, Inc.

2.2 MATERIALS

A. Steel Sheet for all galvanized studs, and accessories: ASTM A1003 or A653, as applicable, Structural Grade, metallic coated, of grade and coating weight as follows:
1. Yield Stress: 33 ksi for 18 ga. or lighter and 50 ksi or 33 ksi for 16 ga. or heavier.
2. Coating: G60 for metal studs and tracks, G90 for clips and accessories.

2.3 FRAMING ACCESSORIES

A. Fabricate steel-framing accessories from steel sheet, ASTM A 653, Structural Grade, Type H, metallic coated, of same grade and coating weight used for framing members.

2.4 ANCHORS, CLIPS, AND FASTENERS

A. Steel Shapes and Clips: ASTM A 36/A 36M, zinc coated by hot-dip process according to ASTM A 123/A 123M.

B. Anchor Bolts: ASTM F 1554, Grade 36, threaded carbon-steel headless, hooked bolts and carbon-steel nuts; and flat, hardened-steel washers; zinc coated by hot-dip process according to ASTM A 153/A 153M, Class C.

C. Expansion Anchors: Fabricated from corrosion-resistant materials, with capability to sustain, without failure, a load equal to 5 times design load, as determined by testing per ASTM E 488 conducted by a qualified independent testing agency.

D. Power-Actuated Anchors: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with capability to sustain, without failure, a load equal to 10 times design load, as determined by testing per ASTM E 1190 conducted by a qualified independent testing agency.

E. Mechanical Fasteners: ASTM C 1513, corrosion-resistant-coated, self-drilling, self-tapping steel drill screws.
1. Head Type: Low-profile head beneath sheathing, manufacturer's standard elsewhere.

F. Welding Electrodes: Comply with AWS standards.

2.5 MISCELLANEOUS MATERIALS

A. Galvanizing Repair Paint: SSPC-Paint 20 or DOD-P-21035.

B. Shims: Load bearing, high-density multimonomer plastic, nonleaching.

C. Sealer Gaskets: Closed-cell neoprene foam, 1/4 inch thick, selected from manufacturer's standard widths to match width of bottom track or rim track members.

2.6 FABRICATION

A. Fabricate cold-formed metal framing and accessories plumb, square, and true to line, and with connections securely fastened, according to referenced AISI's specifications and standards, manufacturer's written instructions, and requirements in this Section.

B. Reinforce, stiffen, and brace framing assemblies to withstand handling, delivery, and erection stresses. Lift fabricated assemblies to prevent damage or permanent distortion.

C. Fabrication Tolerances: Fabricate assemblies level, plumb, and true to line to a maximum allowable tolerance variation of 1/8 inch in 10 feet and as follows:

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine supporting substrates and abutting structural framing for compliance with requirements for installation tolerances and other conditions affecting performance.
   1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Install load bearing shims or grout between the underside of wall bottom track or rim track and the top of foundation wall or slab at stud or joist locations to ensure a uniform bearing surface on supporting concrete or masonry construction.

B. Install sealer gaskets to isolate the underside of wall bottom track or rim track and the top of foundation wall or slab at stud or joist locations.

3.3 INSTALLATION, GENERAL

A. Cold-formed metal framing may be shop or field fabricated for installation, or it may be field assembled.

B. Install cold-formed metal framing according to AISI's "Standard for Cold-Formed Steel Framing - General Provisions" and to manufacturer's written instructions unless more stringent requirements are indicated.

C. Install shop- or field-fabricated, cold-formed framing and securely anchor to supporting structure.
   1. Screw, bolt, or weld wall panels at horizontal and vertical junctures to produce flush, even, true-to-line joints with maximum variation in plane and true position between fabricated panels not exceeding 1/16 inch.

D. Install framing members in one-piece lengths unless splice connections are indicated for track or tension members.

E. Install temporary bracing and supports to secure framing and support loads comparable in intensity to those for which structure was designed. Maintain braces and supports in place, undisturbed, until entire integrated supporting structure has been completed and permanent connections to framing are secured.

F. Do not bridge building expansion and control joints with cold-formed metal framing. Independently frame both sides of joints.

G. Install insulation, specified in Division 07 Section "Thermal Insulation," in built-up exterior framing members, such as headers, sills, boxed joists, and multiple studs at openings, that are inaccessible on completion of framing work.

H. Fasten hole reinforcing plate over web penetrations that exceed size of manufacturer's standard punched openings.

I. Erection Tolerances: Install cold-formed metal framing level, plumb, and true to line to a maximum allowable tolerance variation of 1/8 inch in 10 feet and as follows:
   1. Space individual framing members no more than plus or minus 1/8 inch from plan location. Cumulative error shall not exceed minimum fastening requirements of sheathing or other finishing materials.

3.4 FIELD QUALITY CONTROL

A. Remove and replace work where test results indicate that it does not comply with specified requirements.

3.5 REPAIRS AND PROTECTION

A. Galvanizing Repairs: Prepare and repair damaged galvanized coatings on fabricated and installed cold-formed metal framing with galvanized repair paint according to ASTM A 780 and manufacturer's written instructions.

B. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer, that ensure that cold-formed metal framing is without damage or deterioration at time of Substantial Completion.

END OF SECTION 05 40 00

DIVISION 06 – WOOD & PLASTICS

SECTION 06 10 11 – ROUGH CARPENTRY

PART 1 - GENERAL

1.1 SUMMARY

A. Types of work in this section include, but is not limited to rough carpentry for:

1. Wood furring, grounds, nailers and blocking.
2. Plywood backing panels.

B. Exterior gypsum wall sheathing is specified in Section 07 24 00.

1.2 DEFINITIONS

A. Rough Carpentry: Carpentry work not specified in other Sections and not exposed, unless otherwise specified.

1.3 SUBMITTALS

A. Where dimensional lumber is provided to comply with minimum allowable unit stresses, submit listing of species and grade selected for each use, and submit evidence of compliance with specified requirements. Compliance may be in form of a signed copy of applicable portion of lumber producer's grading rules showing design values for selected species and grade. Design values shall be as approved by the Board of Review of American Lumber Standards Committee (ALSC).

B. Submit chemical treatment manufacturer's instructions for handling, storing, installation and finishing of each type of treated material.

C. Material test reports from a qualified independent testing agency indicating and interpreting test results relative to compliance of fire-retardant-treated wood products with requirements indicated.

D. Warranty of chemical treatment manufacturer for each type of treatment.

1.4 QUALITY ASSURANCE

A. Testing Agency Qualifications: To qualify for approval, an independent testing agency must demonstrate to Architect's satisfaction, based on evaluation of agency-submitted criteria conforming to ASTM E 699, that it has the experience and capability to satisfactorily conduct the testing indicated without delaying the Work.

B. Single-Source Responsibility for Engineered Wood Products: Obtain each type of engineered wood product from one source and by a single manufacturer.

C. Single-Source Responsibility for Fire-Retardant-Treated Wood: Obtain each type of fire-retardant-treated wood product from one source and by a single producer.

1.5 DELIVERY, STORAGE AND HANDLING

A. Keep materials dry at all times. Protect against exposure to weather and contact with damp or wet surfaces. Stack lumber and plywood and provide air circulation within stacks.

PART 2 - PRODUCTS

2.1 LUMBER

A. Lumber Standards: Comply with DOC PS 20, “American Softwood Lumber Standard”, and with applicable grading rules of inspection agencies certified by ALSC’s Board of Review.

B. Inspection Agencies: Inspection agencies, and the abbreviations used to reference them, include the following:

1. 1. NELMA - Northeastern Lumber Manufacturers Association.
2. 2. NLGA - National Lumber Grades Authority (Canadian).
3. 3. SPIB - Southern Pine Inspection Bureau.
4. 4. WCLIB - West Coast Lumber Inspection Bureau.
5. 5. WWPA - Western Wood Products Association.

C. C. Grade Stamps: Provide lumber with each piece factory marked with grade stamp of inspection agency evidencing compliance with grading rule requirements and identifying grading agency, grade, species, moisture content at time of surfacing, and mill. For exposed lumber, furnish pieces with grade stamps applied to ends or back of each piece, or omit grade stamps and provide grade-compliance certificates issued by inspection agency.

D. Where nominal sizes are indicated, provide actual sizes required by DOC PS 20 for moisture content specified. Where actual sizes are indicated, they are minimum dressed sizes for dry lumber.

1. Provide dressed lumber, S4S, unless otherwise indicated
2. Provide dry lumber with 19 percent maximum moisture content at time of dressing for 2” nominal (38 mm actual) thickness or less, unless otherwise indicated.

2.2 WOOD-PRESERVATIVE-TREATED MATERIALS

A. General: Where lumber or plywood is indicated as preservative treated or is specified to be treated, comply with applicable requirements of AWPA C2 (lumber) and AWPA C9 (plywood). Mark each treated item with the Quality Mark Requirements of an inspection agency approved by ALSC’s Board of Review.

1. Preservative Chemicals: Acceptable to authorities having jurisdiction and one of the following:

a. Ammoniacal copper zinc arsenate (ACZA).
b. Ammoniacal, or amine, copper quat (ACQ).
c. Copper bis (dimethyldithiocarbamate) (CDDC).
d. Ammoniacal copper citrate (CC).

2. For exposed items indicated to receive a stained or natural finish, use chemical formulations that do not require incising, contain colorants, bleed through, or otherwise adversely affect finishes.

B. Kiln-dry material after treatment to a maximum moisture content of 19 percent for lumber and 15 percent for plywood. Do not use material that is warped or does not comply with requirements for untreated material.

C. Mark each treated item with the treatment quality mark of an inspection agency approved by the American Lumber Standards Committee Board of Review.

D. Application: Treat items indicated on Drawings, and the following:

1. Wood cants, nailers, curbs, equipment support bases, blocking, stripping, and similar members in connection with roofing, flashing, vapor barriers, and waterproofing.
2. Wood sills, sleepers, blocking, furring, stripping and similar concealed members in contact with masonry or concrete.

E. Subject to compliance with requirements, provide wood-preservative-treated materials of one of the following:

1. Baxter: J. H. Baxter Co.
2. Chemical Specialties, Inc.
3. Continental Wood Preservers, Inc.
4. Hickson Corp.

2.3 FIRE-RETARDANT-TREATED MATERIALS

A. General: Where fire-retardant-treated materials are indicated, use materials, complying with requirements in this article, that are acceptable to authorities having jurisdiction, and with fire-test-response characteristics specified as determined by testing identical products per test method indicated by a qualified testing agency.

B. Fire-Retardant-Treated Lumber and Plywood by Pressure Process: Products with a flame spread index of 25 or less when tested according to ASTM E 84, and with no evidence of significant progressive combustion when the test is extended an additional 20 minutes, and with the flame front not extending more than 10.5 feet beyond the centerline of the burners at any time during the test.

C. Kiln-dry lumber after treatment to a maximum moisture content of 19 percent.

D. Identify fire-retardant-treated wood with appropriate classification marking of qualified testing agency.

E. Application: Treat items indicated on Drawings, or as specified.

2.4 MISCELLANEOUS LUMBER

A. Provide lumber for support or attachment of other work including cant strips, bucks, nailers, blocking, furring, grounds, stripping and similar members.

B. Fabricate miscellaneous lumber from dimension lumber of sizes indicated and into shapes shown.

C. Moisture Content: 19 percent maximum for lumber items not specified to receive wood preservative treatment.

D. Grade: For dimension lumber sizes, provide No. 3 or Standard grade lumber per ALSC's NGRs of any species. For board-size lumber, provide No. 3 Common grade per NELMA, NLGA or WWPA; No. 2 grade per SPIB; or Standard grade per NLGA WCLIB or WWPA of any species.

2.5 PLYWOOD BACKING PANELS

A. Plywood Backing Panels: For mounting electrical or telephone equipment, provide fire-retardant-treated Plywood Panels with grade, C-D Plugged Exposure 1, in thickness indicated or, if not otherwise indicated, not less than 1/2" (12.7 mm) thick.

2.6 FASTENERS

A. General: Provide fasteners of size and type indicated that comply with requirements specified in this Article for material and manufacture.

B. Where rough carpentry is exposed to weather, in ground contact, or in area of high relative humidity, provide fasteners with a hot-dip zinc coating per ASTM A 153 or of Type 304 stainless steel.

C. Fasteners used for pressure treated wood shall be Type 304 stainless steel.

D. Nails, Wire Brads, and Staples: FS FFN105.

E. Power Driven Fasteners: CABO NER272.

F. Wood Screws: ASME B18.6.1.

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 568, Property Class 4.6); with ASTM A 563 (ASTM A 563M) hex nuts and, where indicated, flat washers.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Discard units of material with defects which might impair quality of work, and units which are too small to use in fabricating work with minimum joints or optimum joint arrangement.

B. Set carpentry work accurately to required levels and lines, with members plumb and true and accurately cut and fitted.

C. Fit rough carpentry to other construction; scribe and cope as required for accurate fit. Correlate location of furring, nailers, blocking, grounds, and similar supports to allow attachment of other construction .

D. Apply field treatment complying with AWPA M4 to cut surfaces of preservative-treated lumber and plywood.

E. Securely attach rough carpentry work to substrate by anchoring and fastening, complying with "Table 2304.9.1-Fastening Schedule" of the International Building Code.

F. Countersink nail heads on exposed carpentry work and fill holes. Countersink bolts and nuts flush with surfaces where required to prevent interference with other work.

G. Use common wire nails, except as otherwise indicated. Use finishing nails for finish work. Select fasteners of size that will not penetrate members where opposite side will be exposed to view or will receive finish materials. Make tight connections between members. Install fasteners without splitting of wood; predrill as required.

H. Use hot-dip galvanized or stainless-steel nails where rough carpentry is exposed to weather, in ground contact, or in area of high relative humidity.

3.2 WOOD GROUNDS, NAILERS AND BLOCKING

A. Install wood grounds, nailers, blocking, and sleepers where shown and where required for screeding or attaching other work. Form to shapes shown and cut as required for true line and level of attached work. Coordinate locations with other work involved.

B. Attach to substrates as required to support applied loading. Countersink bolts and nuts flush with surfaces, unless otherwise shown. Build into masonry during installation of masonry work. Where possible, anchor to formwork before concrete placement.

C. Install permanent grounds of dressed, preservative treated, key beveled lumber not less than 1 1/2" (38 mm) wide and of thickness required to bring face of ground to exact thickness of finish material involved. Remove temporary grounds when no longer required.

END OF SECTION 06 10 11

DIVISION 06 – WOOD & PLASTICS

SECTION 06 40 00 – INTERIOR ARCHITETURAL WOODWORK

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:

1. Wood cabinets.
2. Plastic-laminate cabinets and countertops.
3. Shop finishing of woodwork.

B. Interior architectural woodwork includes wood furring, blocking, shims, and hanging strips unless concealed within other construction before woodwork installation.

C. Related Sections:

1. Division 06 Section 06 10 11, Rough Carpentry.
2. Division 09 Sections 09 91 00, Painting.

1.2 ACTION SUBMITTALS

A. Product Data: For solid-surfacing material, cabinet hardware and accessories and finishing materials and processes.

B. Shop Drawings: Show location of each item, dimensioned plans and elevations, large-scale details, attachment devices, and other components.

C. Samples:

1. Lumber and panel products for transparent finish, for each species and cut, finished on one side and one edge.
2. Plastic-laminates, for each type, color, pattern, and surface finish.

1.3 INFORMATIONAL SUBMITTALS

A. Woodwork Quality Standard Compliance Certificates: AWI Quality Certification Program certificates.

1.4 QUALITY ASSURANCE

A. Comply with applicable requirements of “Architectural Woodwork Quality Standards” published by the Architectural Woodwork Institute (AWI), except as otherwise indicated.

B. Mark each assembled unit of architectural woodwork with manufacturer's identification and grade mark evidencing compliance with indicated AWI quality grade. Locate grade mark on surfaces which will not be exposed after installation. For other items requiring field assembly, a certification of compliance may be substituted for marking of individual pieces.

C. Installer Qualifications: An experienced installer who has completed architectural woodwork similar in material, design and extent to that indicated for this Project and whose work has resulted in construction with a record of successful in-service performance.

D. Fabricator Qualifications: A firm experienced in producing architectural woodwork similar to that indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units. Fabricator shall be a member of AWI.

1.5 PROJECT CONDITIONS

A. Environmental Limitations: Do not deliver or install woodwork until building is enclosed, wet work is complete, and HVAC system is operating and maintaining temperature and relative humidity at occupancy levels during the remainder of the construction period.

PART 2 - PRODUCTS

2.1 LAMINATES

A. Fabricators: Subject to compliance with requirements, provide high pressure laminates by one of the following:

1. Formica Corp.
2. Nevamar Corp.
3. Wilson Art

2.2 WOODWORK MATERIALS

A. Certified Wood: Interior architectural woodwork shall be produced from wood obtained from forests certified by an FSC-accredited certification body to comply with FSC STD-01-001, "FSC Principles and Criteria for Forest Stewardship".

B. Wood Species and Cut for Transparent Finish: Red oak, plain sawn or sliced, or as indicated on drawings.

C. Wood Products:

1. Recycled Content of Medium-Density Fiberboard and Particleboard: Pre-consumer recycled content plus one-half of pre-consumer recycled content not less than 25 percent.
2. Low-Emitting Materials: Composite wood products shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chamber".
3. Hardboard: AHA A135.4.

4. Medium-Density Fiberboard: ANSI A208.2, Grade MD, made with binder containing no urea formaldehyde.
5. Particleboard: ANSI A208.1, Grade M-2.
6. Softwood Plywood: DOC PS 1.
7. Veneer-Faced Panel Products (Hardwood Plywood): HPVA HP-1, made with adhesive containing no urea formaldehyde.

D. High-Pressure Decorative Laminate: NEMA LD 3, grades as indicated or, if not indicated, as required by woodwork quality standard.

2.3 FIRE-RETARDANT-TREATED MATERIALS

A. Fire-Retardant-Treated Lumber and Plywood by Pressure Process: Comply with performance requirements of AWPA C20 (lumber) and AWPA C27 (plywood). Use Exterior Type or Interior Type A. Use fire-retardant-treatment formulations that do not bleed through or otherwise adversely affect finishes. Kiln-dry material after treatment.

B. Fire-Retardant Particleboard: Panels made from softwood particles and fire-retardant chemicals mixed together at time of panel manufacture with flame-spread index of 25 or less and smoke-developed index of 25 or less per ASTM E 84.

C. Fire-Retardant Fiberboard: ANSI A208.2 medium-density fiberboard panels made from softwood fibers, synthetic resins, and fire-retardant chemicals mixed together at time of panel manufacture with flame-spread index of 25 or less and smoke-developed index of 200 or less per ASTM E 84.

2.4 CABINET HARDWARE AND ACCESSORIES

A. General: Provide cabinet hardware and accessory materials associated with architectural woodwork, except for items specified in Division 08 Section "Door Hardware (Scheduled by Describing Products)."

B. Exposed Hardware Finishes: For exposed hardware, provide finish that complies with BHMA A156.18 for BHMA finish number indicated.

1. Satin Stainless Steel: BHMA 630.

2.5 MISCELLANEOUS MATERIALS

A. Furring, Blocking, Shims, and Hanging Strips: Softwood or hardwood lumber, kiln-dried to less than 15 percent moisture content.

B. Adhesives, General: Do not use adhesives that contain urea formaldehyde.

C. VOC Limits for Installation Adhesives: Installation adhesives shall have a VOC content of 30g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.6 FABRICATION

A. General: Complete fabrication to maximum extent possible before shipment to Project site. Where necessary for fitting at site, provide allowance for scribing, trimming, and fitting.

1. Interior Woodwork Grade: Custom.
2. Shop cut openings to maximum extent possible. Sand edges of cutouts to remove splinters and burrs. Seal edges of openings in countertops with a coat of varnish.
3. Install glass to comply with applicable requirements in Division 08 Section "Glazing" and in GANA's "Glazing Manual." For glass in wood frames, secure glass with removable stops.

B. Wood Cabinets for Transparent Finish:

1. AWI Type of Cabinet Construction: Flush overlay, or as indicated on Drawings.
2. Grain Direction: Vertically for drawer fronts, doors, and fixed panels.
3. Matching of Veneer Leaves: Book match.
4. Semiexposed Surfaces: Same species and cut indicated for exposed surfaces.
5. Provide dust panels of 1/4-inch (6.4-mm) plywood or tempered hardboard above compartments and drawers, unless located directly under tops.

C. **ALTERNATE #4** - Plastic-Laminate Cabinets:

1. AWI Type of Cabinet Construction: Flush overlay or as indicated on Drawings.
2. Laminate Cladding for Exposed Surfaces: High-pressure decorative laminate as follows:

    a. Horizontal Surfaces Other Than Tops: Grade HGS.
    b. Postformed Surfaces: Grade HGP.
    c. Vertical Surfaces: Grade HGS.
    d. Edges: Grade HGS.

3. Materials for Semiexposed Surfaces: High-pressure decorative laminate, Grade VGS.
4. Colors, Patterns, and Finishes: As selected by Architect from laminate manufacturer's full range of solid colors, wood grains, patterns, and matte finish.
5. Provide dust panels of 1/4-inch (6.4-mm) plywood or tempered hardboard above compartments and drawers, unless located directly under tops.

F. Plastic-Laminate Countertops:

6. High-Pressure Decorative Laminate Grade: HGS.
7. Colors, Patterns, and Finishes: As selected by Architect from laminate manufacturer's full range of solid colors, wood grains, patterns, and matte finish.
8. Edge Treatment: Same as laminate cladding on horizontal surfaces or lumber edge for transparent finish matching wood species and cut on cabinet surfaces; as indicated on Drawings.

2.7 SHOP FINISHING

A. Finish architectural woodwork at fabrication shop. Defer only final touchup, cleaning, and polishing until after installation.

B. Backpriming: Apply one coat of sealer or primer, compatible with finish coats, to concealed surfaces of woodwork. Apply two coats to back of paneling.

C. Transparent Finish:

1. Grade: Custom.
2. AWI Finish System: Acrylic lacquer.
3. WI Finish System: 2, water-reducible acrylic lacquer.
4. Staining: Match approved sample for color.
5. Wash Coat for Stained Finish: Apply a wash-coat sealer to woodwork made from closed-grain wood before staining and finishing.
6. Open-Grain Woods: After staining (if any), apply paste wood filler to open-grain woods and wipe off excess. Tint filler to match stained wood.
7. Sheen: Satin, 31-45 gloss units measured on 60-degree gloss meter per ASTM D 523.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Before installation, condition woodwork to average prevailing humidity conditions in installation areas. Examine shop-fabricated work for completion and complete work as required, including removal of packing and backpriming.

B. Grade: Install woodwork to comply with requirements for the same grade specified in Part 2 for fabrication of type of woodwork involved.

C. Install woodwork level, plumb, true, and straight to a tolerance of 1/8 inch in 96 inches (3 mm in 2400 mm). Shim as required with concealed shims.

D. Scribe and cut woodwork to fit adjoining work, refinish cut surfaces, and repair damaged finish at cuts.

E. Anchor woodwork to anchors or blocking built in or directly attached to substrates. Secure with countersunk, concealed fasteners and blind nailing as required for complete installation. Use fine finishing nails for exposed fastening, countersunk and filled flush with woodwork and matching final finish if transparent finish is indicated.

F. Standing and Running Trim: Install with minimum number of joints possible, using full-length pieces (from maximum length of lumber available) to greatest extent possible. Scarf running joints and stagger in adjacent and related members. Fill gaps, if any, between top of base and wall with plastic wood filler, sand smooth, and finish same as wood base if finished.

G. Cabinets: Install without distortion so doors and drawers fit openings properly and are accurately aligned. Adjust hardware to center doors and drawers in openings and to provide unencumbered operation.

H. Countertops: Anchor securely by screwing through corner blocks of base cabinets or other supports into underside of countertop. Calk space between backsplash and wall with sealant specified in Division 07 Section "Joint Sealants".

I. Paneling: Anchor paneling to supporting substrate with concealed panel hanger clips. Do not use face fastening, unless otherwise indicated.

3.2 ADJUSTMENTS, CLEANUP, FINISHING AND PROTECTTION

A. Repair damaged and defective woodwork wherever possible to eliminate defects functionally and visually; where not possible to repair properly, replace woodwork. Adjust joinery for uniform appearance.

B. Clean hardware, lubricate and make final adjustments for proper operation.

C. Clean woodwork on exposed and semi-exposed surfaces. Touch up shop applied finishes to restore damaged or soiled areas.

D. Complete the finishing work specified as work of this section, to whatever extent not completed at shop or prior to installation of woodwork.

E. Installer of architectural woodwork shall advise Contractor of procedures required to protect architectural woodwork during remainder of constriction period to ensure that work will be without damage or deterioration at time of acceptance.

F. Cover completed work with 4 mil polyethylene film protective enclosure, applied in a manner which will allow easy removal and without damage to woodwork or adjoining work. Remove cover immediately before time of final acceptance.

END OF SECTION 06 40 00

DIVISION 07 – THERMAL & MOISTURE PROTECTION

SECTION 07 21 00 – BUILDING INSULATION

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Foam-plastic board insulation, on vertical and horizontal under slab.
2. Glass-fiber blanket insulation, for soffit/ceiling conditions.
3. Vapor barrier/retarders, under slab.

B. Related Sections:

1. Rigid cavity insulation is specified in Section 04 20 00.
2. Roof insulation is specified in Section 07 52 00.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

1.3 INFORMATIONAL SUBMITTALS

A. Product test reports.

B. Research/evaluation reports.

PART 2 - PRODUCTS

2.1 FOAM-PLASTIC BOARD INSULATION

A. Extruded-Polystyrene Board Insulation: ASTM C 578, with maximum flame-spread and smoke-developed indexes of 75 and 450, respectively, per ASTM E 84.

1. Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following]:
   a. Dow Chemical Company (The).
   b. Owens Corning.
   c. CertainTeed Corp.

2. Type VI, 40 psi (276 kPa)

2.2 GLASS-FIBER BLANKET INSULATION

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. CertainTeed Corporation.
2. Johns Manville.
3. Owens Corning.

B. Foil faced, FSK-25 Glass-Fiber Blanket Insulation: ASTM C 665, Type I; with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively, per ASTM E 84; passing ASTM E 136 for combustion characteristics.

C. Banded liner system, to roof underside glass-fiber blankets, similar to Optiliner System by Owens Corning or equal.

2.3 VAPOR RETARDERS

A. Polyethylene Vapor Retarders: ASTM D 4397, 10 mils (0.25 mm) thick, with maximum permeance rating of 0.13 perm (7.5 ng/Pa x s x sq. m).

B. Vapor-Retarder Tape: Pressure-sensitive tape of type recommended by vapor-retarder manufacturer for sealing joints and penetrations in vapor retarder.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Comply with insulation manufacturer's written instructions applicable to products and applications indicated.

B. Install insulation that is undamaged, dry, and unsoiled and that has not been left exposed to ice, rain, or snow at any time.

C. Extend insulation to envelop entire area to be insulated. Cut and fit tightly around obstructions and fill voids with insulation. Remove projections that interfere with placement.

D. Provide sizes to fit applications indicated and selected from manufacturer's standard thicknesses, widths, and lengths. Apply single layer of insulation units to produce thickness indicated unless multiple layers are otherwise shown or required to make up total thickness.

E. Glass-Fiber or Mineral-Wool Blanket Insulation: Install in cavities formed by framing members according to the following requirements:

1. Use insulation widths and lengths that fill the cavities formed by framing members. If more than one length is required to fill the cavities, provide lengths that will produce a snug fit between ends.

2. Place insulation in cavities formed by framing members to produce a friction fit between edges of insulation and adjoining framing members.
3. For metal-framed wall cavities where cavity heights exceed 96 inches (2438 mm), support unfaced blankets mechanically and support faced blankets by taping flanges of insulation to flanges of metal studs.

F. Miscellaneous Voids: Install insulation in miscellaneous voids and cavity spaces where required to prevent gaps in insulation using the following materials:

3.2 INSTALLATION OF VAPOR RETARDERS

A. Place vapor retarders on side of construction indicated on Drawings. Extend vapor retarders to extremities of areas to protect from vapor transmission. Secure vapor retarders in place with adhesives or other anchorage system as indicated.

B. Seal joints caused by pipes, conduits, electrical boxes, and similar items penetrating vapor retarders with vapor-retarder tape to create an airtight seal between penetrating objects and vapor retarders.

C. Repair tears or punctures in vapor retarders immediately before concealment by other work. Cover with vapor-retarder tape or another layer of vapor retarders.

3.3 INSTALLATION OF BELOW-GRADE INSULATION

A. On vertical surfaces, set insulation units using manufacturer's recommended adhesive according to manufacturer's written instructions.

1. Extend insulation a minimum of 36 inches (915 mm) below exterior grade line or as indicated on drawings.

B. On horizontal surfaces, loosely lay insulation units according to manufacturer's written instructions. Stagger end joints and tightly abut insulation units.

1. Extend insulation and thickness as indicated on drawings.

END OF SECTION 07 21 00

DIVISION 07 – THERMAL & MOISTURE PROTECTION

SECTION 07 27 26 – FLUID APPLIED AIR BARRIER

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes materials and installation methods of the primary air barrier membrane system to masonry and gypsum sheathing walls.

B. Related Sections:
1. Section 04 20 00 – Unit Masonry
2. Section 07 24 00 - EIFS (includes sheathing).

1.2 REFERENCES

A. The following standards are applicable to this section:
1. ASTM E 283: Standard Test Method for Determining the Rate of Air Leakage Through Exterior Windows, Curtain Walls and Doors Under Specified Pressure Differences Across the Specimen.
2. ASTM E 330: Standard Test Method for Structural Performance of Exterior Windows, Curtain Walls and Doors by Uniform Static Air Pressure Difference.
3. ASTM E 96: Water Vapor Transmission of Materials
4. CGSB 37-GP-56M: Membrane, Modified, Bituminous, Prefabricated and Reinforced.

1.3 SYSTEM DESCRIPTION

A. Provide a continuous air barrier system for the building envelope and where indicated.

1.4 SUBMITTALS

A. Prior to commencing the Work, submit documentation from an approved independent testing laboratory certifying that the air leakage rates of the air barrier membranes, including primary membrane and transition sheets.

B. Prior to commencing the Work, submit copies of manufacturer’s current ISO certification. Membrane, primers, sealants and adhesives shall be included.

C. Prior to commencing the Work, submit references clearly indicating that the membrane manufacturer has successfully completed projects on an annual basis of similar scope and nature for a minimum of fifteen years. Submit references for a minimum of ten projects.

D. Prior to commencing the Work, submit manufacturer’s product data, samples and compet set of standard details for the air barrier membrane system showing a continuous plane of air tightness throughout the building envelope.

1.5 QUALITY ASSURANCE

A. Installer: Submit in writing a document stating that the applicator of the primary air barrier membranes specified in this section is recognized by the manufacturer as suitable for the execution of the Work.

B. Perform Work in accordance with the manufacturer's written instructions of the air barrier membrane and this specification.

C. Maintain one copy of the manufacturer's written instructions on site.

D. At the beginning of the Work and at all times during the execution of the Work, allow access to Work site by the air barrier membrane manufacturer's representative.

E. Components used in this section shall be sourced from one manufacturer, including sheet membrane, air barrier sealants, primers, mastics and adhesives.

F. Pre-Installation Conference: Convene prior to commencing Work of this section.

G. Mock-up:

1. Where directed, construct typical exterior wall panel incorporating substrate, window frame, attachment of insulation, and showing air barrier membrane application details.
2. Allow 24 hours for inspection of mock-up before proceeding with air barrier Work. Mock-up may remain as part of the Work.

1.6 DELIVERY, STORAGE AND HANDLING

A. Deliver materials to the job site in undamaged and original packaging indicating the name of the manufacturer and product.

B. Store role materials on end in original packaging.

C. Store air barrier membranes, adhesives and primers at temperatures of 40°F and above to facilitate handling.

D. Keep solvent away from open flame or excessive heat.

E. Protect rolls from direct sunlight until ready to use.

1.7 PROJECT CONDITIONS

A. Perform Work only when conditions are acceptable to the manufacturer of the materials being installed.

B. Ensure all preparation work is complete prior to installing air/vapor barrier membrane.

1.8 COORDINATION

A. Ensure continuity of the air barrier membrane system throughout the scope of this section.

PART 2 - PRODUCTS

2.1 MANUFACTURER AND PRODUCTS

A. Subject to compliance with requirements membrane Basis of Design shall be as manufactured by Henry Company, or comparable products of the following, or as approved equal:

1. Carlisle Coatings & Waterproofing Inc.; Barritech VP.
2. Grace, W. R., & Co. - Conn.; Perm-A-Barrier VP.
3. Tremco Incorporated, an RPM company; ExoAir 230.

2.02 MEMBRANES

A. Primary air and rain barrier membrane for temperatures above 40 degrees F and rising shall be Air-Bloc 31MR manufactured by Henry; a one component water based elastomeric emulsion membrane, trowel or spray applied. Membrane shall have the following physical properties:
1. Air permeability: 0.0002 CFM/ft^2 @ 1.6 lbs/ft^2 to ASTM E2178 and ASTM E283 and have no increased air leakage when subjected to a sustained wind load of 10.5 lbs/ft^2 for 1 hour and gust wind load pressure of 62.8 lbs/ft^2 for 10 seconds when tested at 1.6 lbs/ft^2 to ASTM E331
2. Tested to ASTM E2357 for Air Leakage of Air Barrier Assemblies
3. 0 rating - No fungal growth as tested to ASTM D 5590
4. Water vapor permeance (45 mil dry thickness): 21 perms to ASTM E96 Method B
5. Elongation (ASTM D412): 925%
6. Low temperature flexibility and crack bridging: Pass -4 degrees F to ASTM C836
7. Long term flexibility: Pass to CGSB 71-GP-24M
8. Water tightness (CGSB 37-GP-56M): Pass

B. Self-adhering vapor permeable air barrier membrane for transition and joint treatment detailing shall be Blueskin VP 160 manufactured by Henry, a self-adhering membrane consisting of engineered film and a patented, permeable adhesive with a split-back poly-release film.

C. Self-adhering membrane for window and door sill flashing, door openings, inside and outside corners (optional) and other transitions shall be Blueskin SA, LT, or HT manufactured by Henry; an SBS modified bitumen, self-adhering sheet membrane with a blue engineered thermoplastic film.

E. Through-wall flashing membrane (Self-Adhering) shall be Blueskin® TWF manufactured by Henry; an SBS modified bitumen, self-adhering sheet membrane complete with a yellow engineered thermoplastic film.

2.03 ADHESIVE AND PRIMERS

A. Primer for self-adhering membranes at temperatures above 25 degrees F shall be Aquatac™ Primer manufactured by Henry; a polymer emulsion based adhesive, quick setting.

B. Adhesive for self-adhering membranes at all temperatures shall be Blueskin® Adhesive manufactured by Henry, a synthetic rubber based adhesive, quick setting.

2.04 PENETRATION AND TERMINATION SEALANT

A. Termination Sealant shall be HE925 BES Sealant manufactured by Henry; a moisture cure, medium modulus polymer modified sealing compound.

2.05 INSULATION ADHESIVE

A. Insulation adhesive shall be Air-Bloc 21 Insulation Adhesive manufactured by Henry; a synthetic, trowel applied, rubber based adhesive.

EXECUTION

2.2 EXAMINATION

A. Verify that surfaces and conditions are ready to accept the Work of this section. Notify Contractor in writing of any discrepancies. Commencement of the work or any parts thereof shall mean acceptance of the prepared substrate.

2.3 PREPARATION

A. All surfaces must be sound, dry, clean and free of oil, grease, dirt, excess mortar or other contaminants. Fill spalled areas in substrate to provide an even plane. Strike masonry surfaces flush and smooth.

2.4 INSTALLATION

A. Primer for Transition Sheet:

1. Apply primer for self-adhering membranes at rate recommended by manufacturer.
2. Apply primer to all areas to receive transition sheet as indicated on drawings by roller or spray and allow minimum 30 minutes open time. Primed surfaces not covered by transition membrane during the same working day must be re-primed.

B. Transition Sheet:

1. Position self-adhered transition membrane and remove protective film. Press firmly into place. Ensure minimum 2” overlap at all end and side laps.
2. Promptly roll all laps with a counter top roller to affect seal.
3. Ensure all preparatory work is complete prior to installing primary air-barrier membrane.

C. Primary Air Barrier: When transition membrane is installed, apply primary air barrier by spray, trowel or brush over entire surface as indicated, to a wet film thickness of 90 mils requiring an average application of 18.6ft^2/gal.. Overlap membrane a minimum of 1”. Spray, trowel or brush around all projections ensuring a complete and continuous seal.

D. Application of Termination Sealant: Seal membrane termination, heads of mechanical fasteners, masonry tie fasteners, around penetrations, duct work, electrical and other apparatus extending through the primary water resistive air barrier membrane and around the perimeter edge of membrane terminations at window and door frames with specified termination sealant.

2.5 PROTECTION OF FINISHED WORK

A. Membrane materials are not designed for permanent exposure. Product shall be designed to withstand job site exposure for up to six weeks (less in summer applications), however good practice calls for covering as soon as possible. Wherever possible, begin covering membrane on south exposures, followed by remainder of surface.

END OF SECTION 07 27 26

DIVISION 07 – THERMAL & MOISTURE PROTECTION

SECTION 07 62 00 – SHEET METAL FLASHING AND TRIM

PART 1 - GENERAL

1.1 SUMMARY

1. Formed wall sheet metal flashing fabrications.

B. Related Sections:

1. Integral masonry flashings specified in Section 04 20 00, Unit Masonry.
2. Joint Sealants, Section 07 92 00.
3. Roof Specialties, Section 07 71 00.

1.2 SUBMITTALS

A. Submit manufacturer's product data, installation instructions and general recommendations for each specified sheet material and fabricated product.

B. Submit shop drawings showing layout, joining, profiles and anchorages of any fabricated work at 1/4" scale, details at 3" scale.

1.3 PROJECT CONDITIONS

A. Coordinate work of this section with interfacing and adjoining work for proper sequencing of each installation. Ensure best possible weather resistance and durability of the work and protection of materials and finishers.

PART 2 - PRODUCTS

2.1 FLASHING AND SHEET METAL MATERIALS

A. Stainless Steel Sheet: ASTM A 240/A 240M or ASTM A 666, Type 304; 0.016 inch (0.40 mm) thick except as otherwise indicated.

B. Aluminum Sheet: ASTM B 209, Alloy 3003, temper H14, AA-C22A41; 0.024 inch (0.61 mm) thick except as otherwise indicated.

C. Miscellaneous Materials and Accessories:

1. Fasteners: Same metal as flashing/sheet metal, or other noncorrosive metal as recommended by sheet manufacturer. Match finish of exposed heads with material being fastened.

2. Bituminous Coating: SSPC – Paint 12, solvent type bituminous mastic, nominally free of sulfur, compounded for 15 mil dry film thickness per coat.

3. Mastic Sealant: Polyisobutylene, nonhardening, nonskinning, nondrying, nonmigrating sealant.

4. Elastomeric sealant: Generic type recommended by manufacturer of metal and fabricator of components being sealed and complying with requirements of joing sealants as specified in Section 07920 – Joint Sealers.

5. Paper slip sheet: 5 lb. rosin sized building paper.

6. Polyethylene Underlayment: 6 mil carbonated polyethylene film; FS L-P-512.

7. Metal accessories: Provide sheet metal clips, straps, anchoring devices and similar accessory units as required for installation of work, matching or compatible with material being installe; noncorrosive, size and gauge required for performance.

2.2 FABRICATED UNITS

A. Shop fabricate work to greatest extent possible. Comply with details shown, and with applicable requirements of SMACNA “Architectural Sheet Metal Manual” and other recognized industry practices. Fabricate for waterproof and weather resistant performance; with expansion provisions for running work, sufficient to permanently prevent leakage, damage or deterioration of the work. Form work to fit substrates. Comply with material manufacturer’s instructions and recommendations for forming metal. Form exposed sheet metal work without excessive oil canning, buckling and tool marks, true to line and levels as indicated, with exposed edges folded back to form hems.

B. Fabricate nonmoving seams in sheet metal with flat lock seams. For metal other than aluminum, tin edges to be seamed, form seams and solder. Form aluminum seams with epoxy seam sealer; rivet joints for additional strength where required.

C. Where movable, nonexpansion type joints are indicated or required for proper performance of work, form metal to provide for proper installation of elastomeric sealant, in compliance with SMACNA standards.

D. Provide for separation of metal from noncompatible metal or corrosive substrates by coating concealed surfaces at locations of contact, with bituminous coating or other permanent separation as recommended by manufacture/fabricator.

E. Fabricate work with lines and corners of exposed units true and accurate. Form exposed faces flat and free of buckles, excessive waves and avoidable tool marks; considering temper and reflectivity of metal. Provide uniform, neat seams with minimum exposure of solder, welds and sealant. Except as otherwise shown, fold back sheet metal to form hem on concealed side of exposed edges.

2.3 ALUMINUM FINISHES

A. Unless otherwise specified, provide High-Performance Organic Finish: 2-coat fluropolymer finish complying with AAMA 2605 and containing not less than 70% PVDF resin by weight in color coat. Prepare, pre-treat and apply coating to exposed metal surfaces to comply with coating and resin manufacturer’s written instructions. Color as selected by Architect from manufacturer’s full range.

2.4 WALL SHEET METAL FABRICATIONS

A. Through-Wall Flashing: Fabricate continuous flashings in minimum 96-inch- (2400-mm-) long, sections, under copings, at shelf angles, and where indicated. Fabricate discontinuous lintel, sill, and similar flashings to extend 6 inches (150 mm) beyond each side of wall openings. Form with 2-inch- (50-mm-) high, end dams where flashing is discontinuous. Fabricate from the following materials:

1. Stainless Steel: 0.016 inch (0.40 mm), 2D dull, cold rolled finish.

PART 3 - EXECUTION

3.1 INSTALLATION REQUIREMENTS

A. Except as otherwise indicated, comply with manufacturer's installation instructions and recommendations and with SMACNA "Architectural Sheet Metal Manual". Anchor units of work securely in place by methods indicated, providing for thermal expansion of metal units; conceal fasteners where possible and set units true to line and level as indicated Install work with laps, joints, and seams which will be permanently watertight and weatherproof.

B. Metal Protection: Where dissimilar metals will contact each other or corrosive substrates, protect against galvanic action by painting contact surfaces with bituminous coating or by other permanent separation as recommended by SMACNA.

C. Bed flanges of work in a thick coat of bituminous roofing cement where required for waterproof performance.

3.2 WALL FLASHING INSTALLATION

A. General: Install sheet metal wall flashing to intercept and exclude penetrating moisture according to SMACNA recommendations and as indicated. Coordinate installation of wall flashing with installation of wall-opening components such as windows, doors, and louvers.

3.3 ROOF DRAINAGE AND FLASHING INSTALLATION

A. General: Install sheet metal flashing and trim to comply with performance requirements and SMACNA's "Architectural Sheet Metal Manual." Provide concealed fasteners where possible, set units true to line, and level as indicated. Install work with laps, joints, and seams that will be permanently watertight and weather resistant.

3.4 CLEANING AND PROTECTION

A. Clean exposed metal surfaces, removing substances which might cause corrosion of metal or deterioration of finishes.

B. Installer shall advise Contractor of required procedures for surveillance and protection of flashings and sheet meal work during construction, to ensure that work will be with out damage or deterioration, other than natural weathering, at time of substantial completion.

END OF SECTION 07 62 00

DIVISION 07 – THERMAL & MOISTURE PROTECTION

SECTION 07 84 00 – THROUGH PENETRATION FIRESTOP SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Penetrations in fire-resistance-rated walls.
   2. Penetrations in horizontal assemblies.
   3. Penetrations in smoke barriers.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.
B. Product Schedule: For each penetration firestopping system. Include location and design designation of qualified testing and inspecting agency.
   1. Where Project conditions require modification to a qualified testing and inspecting agency's illustration for a particular penetration firestopping condition, submit illustration, with modifications marked, approved by penetration firestopping manufacturer's fire-protection engineer as an engineering judgment or equivalent fire-resistance-rated assembly.

1.3 INFORMATIONAL SUBMITTALS

A. Installer Certificates: From Installer indicating penetration firestopping has been installed in compliance with requirements and manufacturer's written recommendations.
B. Product test reports.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: A firm that has been evaluated by UL and found to comply with its "Qualified Firestop Contractor Program Requirements" or recognized by the authorities having jurisdiction.
B. Fire-Test-Response Characteristics: Penetration firestopping shall comply with the following requirements:
   1. Penetration firestopping tests are performed by UL.
   2. Penetration firestopping is identical to those tested per testing standard referenced in "Penetration Firestopping" Article. Provide rated systems bearing marking of qualified testing and inspection agency.
C. Preinstallation Conference: Conduct conference at Project site.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Grace Construction Products.
   2. Nelson Firestop Products
   3. 3M Fire Protection Products.
   4. Tremco, Inc.; Tremco Fire Protection Systems Group.

2.2 PENETRATION FIRESTOPPING

A. Provide penetration firestopping that is produced and installed to resist spread of fire according to requirements indicated, resist 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: Ratings determined per ASTM E 814 or UL 1479, based on testing at a positive pressure differential of 0.01-inch wg.
1. F-Rating: Not less than the fire-resistance rating of constructions penetrated.

C. Penetrations in Horizontal Assemblies: Ratings determined per ASTM E 814 or UL 1479, based on testing at a positive pressure differential of 0.01-inch wg.
1. F-Rating: At least 1 hour, but not less than the fire-resistance rating of constructions penetrated.
2. T-Rating: At least 1 hour, but not less than the fire-resistance rating of constructions penetrated except for floor penetrations within the cavity of a wall.

D. Penetrations in Smoke Barriers: Provide penetration firestopping with ratings determined per UL 1479.
1. L-Rating: Not exceeding 5.0 cfm/sq. ft. of penetration opening at 0.30-inch wg at both ambient and elevated temperatures.

E. Exposed Penetration Firestopping: Provide products with flame-spread and smoke-developed indexes of less than 25 and 450, respectively, as determined per ASTM E 84.

F. VOC Content: Penetration firestopping sealants and sealant primers shall comply with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA Method 24):
1. Sealants: 250 g/L.
2. Sealant Primers for Nonporous Substrates: 250 g/L.
3. Sealant Primers for Porous Substrates: 775 g/L.

G. 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 manufacturer and approved by qualified testing and inspecting agency for firestopping indicated.

PART 3 - EXECUTION

3.1 INSTALLATION

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. Install penetration firestopping to comply with manufacturer's written installation instructions and published drawings for products and applications indicated.

C. 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 indicated.
1. After installing fill materials and allowing them to fully cure, remove combustible forming materials and other accessories not indicated as permanent components of firestopping.

D. Install fill materials for firestopping by proven techniques to produce the following results:
   1. Fill voids and cavities formed by openings, forming materials, accessories, and penetrating items as required to achieve fire-resistance ratings indicated.
   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.

3.2 IDENTIFICATION

A. Identify penetration firestopping with preprinted metal or plastic labels. Attach labels permanently to surfaces adjacent to and within 6 inches (150 mm) of firestopping edge so labels will be visible to anyone seeking to remove penetrating items or firestopping. 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."
   2. Contractor's name, address, and phone number.
   3. Designation of applicable testing and inspecting agency.
   4. Date of installation.
   5. Manufacturer's name.
   6. Installer's name.

3.3 FIELD QUALITY CONTROL

A. Owner will engage a qualified testing agency to perform tests and inspections.

B. Where deficiencies are found or penetration firestopping is damaged or removed because of testing, repair or replace penetration firestopping to comply with requirements.

C. Proceed with enclosing penetration firestopping with other construction only after inspection reports are issued and installations comply with requirements.

END OF SECTION 07 84 00

DIVISION 07 – THERMAL & MOISTURE PROTECTION

SECTION 07 92 00 – JOINT SEALANTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Silicone joint sealants.
   2. Urethane joint sealants.
   3. Latex joint sealants.
   4. Preformed joint sealants.
   5. Acoustical joint sealants.

1.2 PRECONSTRUCTION TESTING

A. Preconstruction Field-Adhesion Testing: Before installing sealants, field test their adhesion to Project joint substrates. 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.

1.3 ACTION SUBMITTALS

A. Product Data: For each joint-sealant product indicated.
B. Samples: For each kind and color of joint sealant required.
C. 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. Product test reports.
B. Preconstruction compatibility and adhesion test reports.
C. Preconstruction field-adhesion test reports.
D. Field-adhesion test reports.
E. Warranties.

1.5 QUALITY ASSURANCE

A. Testing Agency Qualifications: Qualified according to ASTM C 1021 to conduct the testing indicated.
B. Preinstallation Conference: Conduct conference at Project site.

1.6 WARRANTY

A. Special Installer's Warranty: Manufacturer's standard form in which 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: Ten years from date of Substantial Completion.
B. Special Manufacturer's Warranty: Manufacturer's standard form in which joint-sealant manufacturer agrees to furnish joint sealants to repair or replace those that do not comply with performance and other requirements specified in this Section within specified warranty period.
   1. Warranty Period: Ten years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MATERIALS, GENERAL

A. VOC Content of Interior Sealants: Sealants and sealant primers used inside the weatherproofing system shall comply with the following limits for VOC content when calculated according to 40 CFR 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.

B. 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.
   1. Suitability for Immersion in Liquids. Where sealants are indicated for Use I for joints that will be continuously immersed in liquids, provide products that have undergone testing according to ASTM C 1247. Liquid used for testing sealants is deionized water, unless otherwise indicated.

C. 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.

D. 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.

2.2 SILICONE JOINT SEALANTS

A. Mildew-Resistant Silicone Joint Sealant: ASTM C 920.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. BASF Building Systems.
      b. Dow Corning Corporation.
      c. GE Advanced Materials - Silicones.
      d. Sika Corporation; Construction Products Division.
      e. Tremco Incorporated.
   2. Type: Single component (S) or multicomponent (M).
   3. Grade: Pourable (P) or nonsag (NS).
   4. Class: 100/50
   5. Uses Related to Exposure: Traffic (T) or Nontraffic (NT) as indicated or to suit location and application.

2.3 URETHANE JOINT SEALANTS

A. Urethane Joint Sealant: ASTM C 920.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. BASF Building Systems.
      b. Bostik, Inc.
      c. Sika Corporation; Construction Products Division.
      d. Tremco Incorporated.
   2. Type: Single component or multicomponent.
   3. Grade: Pourable or nonsag.
   4. Class: 100/50.
   5. Uses Related to Exposure: Traffic (T) or Nontraffic (NT) as indicated or to suit location and application.

2.4 LATEX JOINT SEALANTS

A. Latex Joint Sealant: Acrylic latex or siliconized acrylic latex, ASTM C 834, Type OP, Grade NF.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. BASF Building Systems.
      b. Bostik, Inc
      c. Tremco Incorporated.

2.5 PREFORMED JOINT SEALANTS

A. Preformed Foam Joint Sealant: Manufacturer's standard preformed, precompressed, open-cell foam sealant manufactured from urethane foam with minimum density of 10 lb/cu. ft. and impregnated with a nondrying, water-repellent agent. Factory produce in precompressed sizes in roll or stick form to fit joint widths indicated; coated on one side with a pressure-sensitive adhesive and covered with protective wrapping.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. EMSEAL Joint Systems, Ltd.
      b. Pecora Corporation.
      c. Schul International, Inc.

2.6 ACOUSTICAL JOINT SEALANTS

A. Acoustical Joint Sealant: Manufacturer's standard nonsag, paintable, nonstaining latex sealant complying with ASTM C 834. Product effectively reduces airborne sound transmission through perimeter joints and openings in building construction as demonstrated by testing representative assemblies according to ASTM E 90.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Pecora Corporation.
      b. Tremco Incorporated.
      c. USG Corporation.

2.7 JOINT SEALANT BACKING

A. Cylindrical Sealant Backings: ASTM C 1330, Type C (closed-cell material with a surface skin, as approved in writing by joint-sealant manufacturer for joint application indicated, and of size and density to control sealant depth and otherwise contribute to producing optimum sealant performance.
B. Bond-Breaker Tape: Polyethylene tape or other plastic tape recommended by sealant manufacturer.

2.8 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.
C. Masking Tape: Nonstaining, nonabsorbent material compatible with joint sealants and surfaces adjacent to joints.

PART 3 - EXECUTION

3.1 PREPARATION

A. Surface Cleaning of Joints: Clean out joints immediately before installing joint sealants to comply with joint-sealant manufacturer's written instructions.
   1. Remove laitance and form-release agents from concrete.
   2. 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.

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.

3.2 INSTALLATION

A. Sealant Installation Standard: Comply with recommendations in ASTM C 1193 for use of joint sealants as applicable to materials, applications, and conditions indicated.

B. 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.

C. Install bond-breaker tape behind sealants where sealant backings are not used between sealants and backs of joints.

D. 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.

E. 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.

F. Acoustical Sealant Installation: Comply with ASTM C 919 and with manufacturer's written recommendations.

G. 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.

3.3 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 3 tests for the first for each kind of sealant and joint substrate.
   b. Perform 1 test for each 1000 feet of joint length thereafter or 1 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.

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.

3.4 JOINT-SEALANT SCHEDULE

A. Joint-Sealant Application: Exterior joints in horizontal traffic surfaces.
1. Joint Locations:
   a. Control and expansion joints in pavers.
   b. Isolation and contraction joints in cast-in-place concrete slabs.
   c. Joints in stone paving units, including steps.
   d. Joints between different materials listed above.
   e. Other joints as indicated.
2. Joint Sealant: Silicone.
3. Joint Sealant: Urethane.
4. Joint Sealant: Preformed foam.
5. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.

B. Joint-Sealant Application: Exterior joints in vertical surfaces and horizontal nontraffic surfaces.
1. Joint Locations:
   a. Construction joints in cast-in-place concrete.
   b. Control and expansion joints in unit masonry.
   c. Joints in dimension stone cladding.
   d. Joints in exterior insulation and finish systems.
   e. Joints between different materials listed above.
   f. Perimeter joints between materials listed above & frames of doors, windows & louvers.
   g. Control and expansion joints in ceilings and other overhead surfaces.
   h. Other joints as indicated.
2. Joint Sealant: Silicone.
3. Joint Sealant: Urethane.
4. Joint Sealant: Preformed foam.
5. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.

C. Joint-Sealant Application: Interior joints in horizontal traffic surfaces.
1. Joint Locations:
   a. Isolation joints in cast-in-place concrete slabs.
   b. Control and expansion joints in stone flooring.
   c. Control and expansion joints in tile flooring.
   d. Other joints as indicated.
2. Joint Sealant: Silicone.
3. Joint Sealant: Urethane.
4. Joint Sealant: Preformed foam.
5. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.

D. Joint-Sealan Application: Interior joints in vertical surfaces and horizontal nontraffic surfaces.
1. Joint Locations:
   a. Control and expansion joints on exposed interior surfaces of exterior walls.
   b. Perimeter joints of exterior openings where indicated.
   c. Tile control and expansion joints.

d. Vertical joints on exposed surfaces of interior unit masonry, concrete, walls and partitions.
e. Perimeter joints between interior wall surfaces and frames of interior doors, windows and elevator entrances.
f. Other joints as indicated.

2. Joint Sealant: Latex.
3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.

E. Joint-Sealant Application: Mildew-resistant interior joints in vertical surfaces and horizontal nontraffic surfaces.

4. Joint Sealant Location:
   a. Joints between plumbing fixtures and adjoining walls, floors, and counters.
   b. Tile control and expansion joints where indicated.
   c. Other joints as indicated.
5. Joint Sealant: Silicone.
6. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.

E. Joint-Sealant Application: Interior acoustical joints in vertical surfaces and horizontal nontraffic surfaces.

1. Joint Location:
   a. Acoustical joints where indicated and at all perimeter and around openings in acoustic walls, partitions, ceilings and floors.
   b. Other joints as indicated.
2. Joint Sealant: Acoustical.
3. Joint-Sealant Color: As selected by Architect from manufacturer's full range.

END OF SECTION 07 92 00

DIVISION 07 – THERMAL & MOISTURE PROTECTION

SECTION 07 95 00 – EXPANSION CONTROL

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
1. Interior expansion control systems.

B. Related Sections:
1. Section 07 53 24 – EPDM Roofing for expansion control at roof.

1.2 ACTION SUBMITTALS

A. Shop Drawings: For each expansion control system specified. Include plans, elevations, sections, details, splices, blockout requirement, attachments to other work, and line diagrams.

PART 2 - PRODUCTS

2.1 SYSTEM DESCRIPTION

A. General: Provide expansion control systems of design, basic profile, materials, and operation indicated. Provide units with capability to accommodate variations in adjacent surfaces.
1. Furnish units in longest practicable lengths to minimize field splicing. Install with hairline mitered corners where expansion control systems change direction or abut other materials.
2. Include factory-fabricated closure materials and transition pieces, T-joints, corners, curbs, cross-connections, and other accessories as required to provide continuous expansion control systems.

2.2 INTERIOR EXPANSION CONTROL SYSTEMS

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:

B. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated by Architectural Art Mfg., Inc or a comparable product by one of the following:
1. Balco, Inc.
2. Construction Specialties, Inc.
3. MM Systems Corporation.

C. Source Limitations: Obtain expansion control systems from single source from single manufacturer.

D. Floor-to-Floor:
1. Basis-of-Design Product: C12-33-9
2. Type: Elastomeric seal.

E. Wall-to-Wall:
1. Basis-of-Design Product: C10-54-44.

2. Type: Elastomeric seal.

F. Ceiling-to-Wall:
1. Basis-of-Design Product: C10-64-44.
2. Type: Elastomeric seal.

2.3 MATERIALS

A. Aluminum: ASTM B 221 (ASTM B 221M), Alloy 6063-T5 for extrusions; ASTM B 209 (ASTM B 209M), Alloy 6061-T6 for sheet and plate.
B. Elastomeric Seals: ASTM E 1783; preformed elastomeric membranes or extrusions to be installed in metal frames.
C. Nonmetallic, Shrinkage-Resistant Grout: ASTM C 1107/C 1107M.
D. Accessories: Manufacturer's standard anchors, clips, fasteners, and other accessories as indicated or required for complete installations.

PART 3 - EXECUTION

3.1 PREPARATION

A. Prepare substrates according to expansion control system manufacturer's written instructions.

B. Coordinate and furnish anchorages, setting drawings, and instructions for installing expansion control systems.

3.2 INSTALLATION

A. Comply with manufacturer's written instructions for storing, handling, and installing expansion control systems and materials unless more stringent requirements are indicated.

B. Metal Frames: Perform cutting, drilling, and fitting required to install expansion control systems.

3.3 PROTECTION

A. Do not remove protective covering until finish work in adjacent areas is complete.

B. Protect the installation from damage by work of other Sections.

END OF SECTION 07 95 00

DIVISION 08 – OPENINGS

SECTION 08 11 00 – METAL DOORS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
1. Standard hollow metal doors and frames.
2. Painting is specified in Section 09 91 00.
3. Door hardware is specified in Section 08 71 00.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings: Include elevations, door edge details, frame profiles, metal thicknesses, preparations for hardware, and other details.

C. Schedule: Prepared by or under the supervision of supplier, using same reference numbers for details and openings as those on Drawings.

1.3 QUALITY ASSURANCE

A. Fire-Rated Door Assemblies: Assemblies complying with NFPA 80 that are listed and labeled by a qualified testing agency, for fire-protection ratings indicated, based on testing according to NFPA 252 and UL 10.

B. Fire-Rated, Borrowed-Light Frame Assemblies: Assemblies complying with NFPA 80 that are listed and labeled, by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire-protection ratings indicated, based on testing according to NFPA 257 and UL 9. Label each individual glazed lite.

C. Field Measurements: Verify actual dimensions of openings by field measurements before fabrication.

D. Coordinate installation of doors in Aluminum window frame system.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
1. Amweld Building Products, LLC
2. Benchmark; a division of Therma-Tru Corporation.
3. Ceco Door Products: an Assa Abloy Group Company.

2.2 MATERIALS

A. Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, CS, Type B; suitable for exposed applications.

B. Hot-Rolled Steel Sheet: ASTM A 1011/A 1011M, CS, Type B.

C. Metallic-Coated Steel Sheet: ASTM A 653/A 653M, Commercial Steel (CS), Type B; with minimum G60 (Z180) or A60 (ZF180) metallic coating.

D. Frame Anchors: ASTM A 591/A 591M, Commercial Steel (CS), 40Z (12G) coating designation; mill phosphatized.
1. For anchors built into exterior walls, steel sheet complying with ASTM A 1008/A 1008M or ASTM A 1011/A 1011M, hot-dip galvanized according to ASTM A 153/A 153M, Class B.

E. Inserts, Bolts, and Fasteners: stainless steel

F. Grout: ASTM C 476, except with a maximum slump of 4 inches, as measured according to ASTM C 143/C 143M.

G. Mineral-Fiber Insulation: ASTM C 665, Type I.

H. Glazing: Division 8 Section "Glazing."

I. Bituminous Coating: Cold-applied asphalt mastic, SSPC-Paint 12, compounded for 15-mil dry film thickness per coat.

2.3 STANDARD HOLLOW METAL DOORS

A. General: Comply with ANSI/SDI A250.8.
1. Design: Flush panel
2. Core Construction: Manufacturer's standard kraft-paper honeycomb, polystyrene, polyurethane, polyisocyanurate, mineral-board, or vertical steel-stiffener core.
   a. Fire Door Core: As required to provide fire-protection and temperature-rise ratings indicated.
3. Vertical Edges for Single-Acting Doors: Manufacturer's standard.
4. Top and Bottom Edges: Closed with flush or inverted 0.042-inch-thick, end closures or channels of same material as face sheets.
5. Tolerances: SDI 117, "Manufacturing Tolerances for Standard Steel Doors and Frames."

B. Doors: Face sheets fabricated from metallic-coated steel sheet. Comply with ANSI/SDI A250.8 for level and model and ANSI/SDI A250.4 for physical performance level:

C. Hardware Reinforcement: ANSI/SDI A250.6.

2.4 STOPS AND MOLDINGS

A. Moldings for Glazed Lites in Doors: Minimum 0.032 inch thick, same material as door face sheet.

B. Fixed Frame Moldings: Formed integral with hollow metal frames, a minimum of 5/8 inch high unless otherwise indicated.

C. Loose Stops for Glazed Lites in Frames: Minimum 0.032 inch thick, same material as frames.

D. Terminated Stops: Where indicated, terminate stops 6 inches above finish floor with a 45-degree angle cut, and close open end of stop with steel sheet closure. Cover opening in extension of frame with welded-steel filler plate, with welds ground smooth and flush with frame.

2.5 FABRICATION

A. Tolerances: Fabricate hollow metal work to tolerances indicated in SDI 117.

B. Hollow Metal Doors:
1. Exterior Doors: Provide weep-hole openings in bottom of exterior doors. Seal joints in top edges of doors against water penetration.
2. Glazed Lites: Factory cut openings in doors.

C. Hardware Preparation: Factory prepare hollow metal work to receive templated mortised hardware according to the Door Hardware Schedule and templates furnished as specified in Division 8 Section "Door Hardware."
1. Locate hardware as indicated, or if not indicated, according to ANSI/SDI A250.8.
2. Reinforce doors and frames to receive nontemplated, mortised and surface-mounted door hardware.
3. Comply with applicable requirements in ANSI/SDI A250.6 and ANSI/DHI A115 Series specifications for preparation of hollow metal work for hardware.
4. Coordinate locations of conduit and wiring boxes for electrical connections with Division 26 electrical Sections.

D. Stops and Moldings: Provide stops and moldings around glazed lites where indicated. Form corners of stops and moldings with butted or mitered hairline joints.
1. Single Glazed Lites: Provide fixed stops and moldings welded on secure side of hollow metal work.
2. Multiple Glazed Lites: Provide fixed and removable stops and moldings so that each glazed lite is capable of being removed independently.
3. Provide fixed frame moldings on outside of exterior and on secure side of interior doors and frames.
4. Provide loose stops and moldings on inside of hollow metal work.
5. Coordinate rabbet width between fixed and removable stops with type of glazing and type of installation indicated.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Hollow Metal Doors: Fit hollow metal doors accurately in frames, within clearances specified below. Shim as necessary.
1. Non-Fire-Rated Standard Steel Doors:
   a. Jambs and Head: 1/8 inch plus or minus 1/16 inch.
   b. Between Edges of Pairs of Doors: 1/8 inch plus or minus 1/16 inch.
   c. Between Bottom of Door and Top of Threshold: Maximum 3/8 inch.
   d. Between Bottom of Door and Top of Finish Floor (No Threshold): Maximum ¾ inch.
2. Fire-Rated Doors: Install doors with clearances according to NFPA 80.

B. Glazing: Comply with installation requirements in Division 8 Section "Glazing" and with hollow metal manufacturer's written instructions.
   1. Secure stops with countersunk flat- or oval-head machine screws spaced uniformly not more than 9 inches o.c. and not more than 2 inches o.c. from each corner.

3.2 ADJUSTING AND CLEANING

A. Final Adjustments: Check and readjust operating hardware items immediately before final inspection. Leave work in complete and proper operating condition. Remove and replace defective work, including hollow metal work that is warped, bowed, or otherwise unacceptable.

B. 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.

C. Metallic-Coated Surfaces: Clean abraded areas and repair with galvanizing repair paint according to manufacturer's written instructions.

END OF SECTION 08 11 00

DIVISION 08 – OPENINGS

SECTION 08 51 00 – ALUMINUM ENTRANCES AND STOREFRONTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
1. Exterior storefront framing.

B. Related Section:
1. Section 08 71 00 – Door Hardware
2. Section 08 80 00 - Glazing

1.2 PERFORMANCE REQUIREMENTS

A. General Performance: Aluminum-framed systems shall withstand the effects of the following performance requirements without exceeding performance criteria or failure due to defective manufacture, fabrication, installation, or other defects in construction:
1. Movements of supporting structure indicated on Drawings including, but not limited to, story drift and deflection from uniformly distributed and concentrated live loads.
2. Dimensional tolerances of building frame and other adjacent construction.
3. Failure includes the following:
a. Deflection exceeding specified limits.
b. Thermal stresses transferring to building structure.
c. Framing members transferring stresses, including those caused by thermal and structural movements to glazing.
d. Noise or vibration created by wind and by thermal and structural movements.
e. Loosening or weakening of fasteners, attachments, and other components.
f. Failure of operating units.

B. Deflection of Framing Members: (All loads must be approved by Project Structural Engineer)
1. Deflection Normal to Wall Plane: Limited to [edge of glass in a direction perpendicular to glass plane shall not exceed L/175 of the glass edge length for each individual glazing lite] [1/175 of clear span for spans up to 13 feet 6 inches and to 1/240 of clear span plus 1/4 inch for spans greater than 13 feet 6 inches or an amount that restricts edge deflection of individual glazing lites to 3/4 inch, whichever is less.
2. Deflection Parallel to Glazing Plane: Limited to L/360 of clear span or 1/8 inch, whichever is smaller.

C. Structural-Test Performance: Provide aluminum-framed systems tested according to ASTM E 330 as follows:

1. When tested at 150 percent of positive and negative wind-load design pressures, systems, including anchorage, do not evidence material failures, structural distress, and permanent deformation of main framing members exceeding 0.2 percent of span.
2. Test Durations: 10seconds.

D. Air Infiltration: Provide aluminum-framed systems with maximum air leakage through fixed glazing and framing areas of 0.06 cfm/sq. ft. of fixed wall area when tested according to ASTM E 283 at a minimum static-air-pressure difference of 1.57 lbf/sq. ft. 6.24 lbf/sq. ft.

E. Water Penetration under Static Pressure: Provide aluminum-framed systems that do not evidence water penetration through fixed glazing and framing areas when tested according to ASTM E 331 at a minimum static-air-pressure difference of 20 percent of positive wind-load design pressure, but not less than 6.24 lbf/sq. ft..

1.3 ACTION SUBMITTALS

A. Shop Drawings: For aluminum-framed systems. Include plans, elevations, sections, details, and attachments to other work.
   1. Include details of provisions for system expansion and contraction and for drainage of moisture in the system to the exterior.

B. Samples: For each type of exposed finish required.

C. Other Action Submittals:
   1. Entrance Door Hardware Schedule: Prepared by or under the supervision of supplier, detailing fabrication and assembly of entrance door hardware, as well as procedures and diagrams.

1.4 INFORMATIONAL SUBMITTALS

A. Product test reports.
B. Warranties: Sample of special warranties.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation of units required for this Project.

B. Engineering Responsibility: Prepare data for aluminum-framed systems, including Shop Drawings, based on testing and engineering analysis of manufacturer's standard units in systems similar to those indicated for this Project.

C. Accessible Entrances: Comply with applicable provisions in the current IBC/ADA Accessibility Guidelines.

D. Source Limitations for Aluminum-Framed Systems: Obtain from single source from single manufacturer.

1.6 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of aluminum-framed systems that do not comply with requirements or that fail in materials or workmanship within specified warranty period.
   1. Warranty Period: 5 years from date of Substantial Completion.

B. Special Finish Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components on which finishes do not comply with requirements or that fail in materials or workmanship within specified warranty period. Warranty does not include normal weathering.
   1. Warranty Period: 5 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Basis-of Design Product:
   1. Kawneer Company Inc.
   2. Series 516/518 Thermal Windows - Fixed
   3. 4" (101.6 mm) 516 frame depth

B. Subject to compliance with Requirements, Manufacturers of equal systems may be submitted for approval and include:
   1. EFCO, LLC.
   2. Tubelite Inc.
   3. YKK AP America Inc.

2.2 MATERIALS

A. Aluminum: Alloy and temper recommended by manufacturer for type of use and finish indicated.
   1. Sheet and Plate: ASTM B 209.
   2. Extruded Bars, Rods, Profiles, and Tubes: ASTM B 221.
   3. Extruded Structural Pipe and Tubes: ASTM B 429.
   4. Structural Profiles: ASTM B 308/B 308M.
   5. Welding Rods and Bare Electrodes: AWS A5.10/A5.10M.

B. Steel Reinforcement: Manufacturer's standard zinc-rich, corrosion-resistant primer, complying with SSPC-PS Guide No. 12.00; applied immediately after surface preparation and pretreatment. Select surface preparation methods according to recommendations in SSPC-SP COM and prepare surfaces according to applicable SSPC standard.
   1. Structural Shapes, Plates, and Bars: ASTM A 36/A 36M.
   2. Cold-Rolled Sheet and Strip: ASTM A 1008/A 1008M.
   3. Hot-Rolled Sheet and Strip: ASTM A 1011/A 1011M.

2.3 FRAMING SYSTEMS

A. Framing Members: Manufacturer's standard extruded-aluminum framing members of thickness required and reinforced as required to support imposed loads.
   1. Construction: Thermally broken for exterior walls.
   2. Glazing System: Retained mechanically with gaskets on four sides.
   3. Glazing Plane: As indicated.

B. Brackets and Reinforcements: Manufacturer's standard high-strength aluminum with nonstaining, nonferrous shims for aligning system components.

C. Fasteners and Accessories: Manufacturer's standard corrosion-resistant, nonstaining, nonbleeding fasteners and accessories compatible with adjacent materials.
   1. Use self-locking devices where fasteners are subject to loosening or turning out from thermal and structural movements, wind loads, or vibration.
   2. Reinforce members as required to receive fastener threads.
   3. Use concealed fasteners fabricated from stainless steel.

D. 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.

E. Concealed Flashing: Dead-soft, 0.018-inch-thick stainless steel, ASTM A 240/A 240M of type recommended by manufacturer.

F. Framing System Gaskets and Sealants: Manufacturer's standard, recommended by manufacturer for joint type.
1. Sealants used inside the weatherproofing system shall have a VOC content of 250g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.4 GLAZING SYSTEMS

A. Glazing: As specified in Division 8 Section "Glazing."

B. Glazing Gaskets: Manufacturer's standard compression types; replaceable, molded or extruded, of profile and hardness required to maintain watertight seal.

C. Spacers and Setting Blocks: Manufacturer's standard elastomeric type.

2.5 ENTRANCE DOOR SYSTEMS

A. Exterior Entrance Doors: Insulated Hollow Metal Steel Doors – refer to Section 08 11 00

B. Entrance Door finishes. Painted finish on exterior doors.

2.6 ENTRANCE DOOR HARDWARE

A. Provide manufacturer's standard hardware fabricated from aluminum, stainless steel, or other corrosion-resistant material compatible with aluminum; designed to smoothly operate, tightly close, and securely aluminum-framed entrance doors.
1. Entrance Door Hardware Sets: Provide quantity, item, size, finish or color indicated, and products complying with BHMA standard.
2. Opening-Force Requirements:

a. Egress Doors: Not more than 15 lbf to release the latch and not more than 30 lbf to set the door in motion and not more than 15 lbf to open the door to its minimum required width.

B. Standard Hardware:
1. Weatherstripping:
Sill Sweep Strips: EPDM blade gasket sweep strip in an aluminum extrusion applied to the interior exposed surface of the bottom rail with concealed fasteners (Necessary to meet specified performance tests).
2. Threshold: Extruded aluminum, one piece per door opening, with ribbed surface.

2.7 ACCESSORY MATERIALS

A. Bituminous Paint: Cold-applied, asphalt-mastic paint complying with SSPC-Paint 12 requirements except containing no asbestos; formulated for 30-mil thickness per coat.

B. Provide removable exterior side insect screens at project-in vents units.

2.8 FABRICATION

A. Form or extrude aluminum shapes before finishing.

B. Weld in concealed locations to greatest extent possible to minimize distortion or discoloration of finish. Remove weld spatter and welding oxides from exposed surfaces by descaling or grinding.

C. Framing Members, General: Fabricate components that, when assembled, have the following characteristics:
1. Profiles that are sharp, straight, and free of defects or deformations.
2. Accurately fitted joints with ends coped or mitered.
3. Means to drain water passing joints, condensation within framing members, and moisture migrating within the system to exterior.
4. Physical and thermal isolation of glazing from framing members.
5. Accommodations for thermal and mechanical movements of glazing and framing to maintain required glazing edge clearances.
6. Provisions for field replacement of glazing from exterior.
7. Fasteners, anchors, and connection devices that are concealed from view to greatest extent possible.

D. Mechanically Glazed Framing Members: Fabricate for flush glazing without projecting stops.

E. Entrance Door Frames: Reinforce as required to support loads imposed by door operation and for installing entrance door hardware.

F. Entrance Doors: Reinforce doors as required for installing entrance door hardware.

G. Entrance Door Hardware Installation: Factory install entrance door hardware to the greatest extent possible. Cut, drill, and tap for factory-installed entrance door hardware before applying finishes.

H. After fabrication, clearly mark components to identify their locations in Project according to Shop Drawings.

2.9 ALUMINUM FINISHES

A. Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.

B. Factory Finishing:
1. Kawneer Permanodic™ AA-M10C21A31, AAMA 611, Architectural Class II Clear Anodic Coating (Color #17 Clear) (Standard).

PART 3 - EXECUTION

3.1 INSTALLATION

A. General:
1. Comply with manufacturer's written instructions. Do not install damaged components.
2. Fit joints to produce hairline joints free of burrs and distortion.
3. Install anchors with separators and isolators to prevent metal corrosion and electrolytic deterioration.
4. Seal joints watertight unless otherwise indicated.

B. Metal Protection:

1. Where aluminum will contact dissimilar metals, protect against galvanic action by painting contact surfaces with primer or applying sealant or tape, or by installing nonconductive spacers as recommended by manufacturer for this purpose.
2. Where aluminum will contact concrete or masonry, protect against corrosion by painting contact surfaces with bituminous paint.

C. Install components to drain water passing joints, condensation occurring within framing members, and moisture migrating within the system to exterior.

D. Set continuous sill members and flashing in full sealant bed as specified in Division 7 Section "Joint Sealants" to produce weathertight installation.

E. Install components plumb and true in alignment with established lines and grades, and without warp or rack.

F. Install glazing as specified in Division 8 Section "Glazing."

G. Entrance Doors: Install doors to produce smooth operation and tight fit at contact points.
1. Exterior Doors: Install to produce weathertight enclosure and tight fit at weather stripping.
2. Field-Installed Entrance Door Hardware: Install surface-mounted entrance door hardware according to entrance door hardware manufacturers' written instructions using concealed fasteners to greatest extent possible.

END OF SECTION 08 51 00

DIVISION 06 – OPENINGS

SECTION 08 51 13 – ALUMINUM WINDOWS

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 Kawneer Architectural Aluminum Windows including perimeter trims, stools, accessories, shims and anchors, and perimeter sealing of window units.
   1. Types of aluminum windows include:
      a. Kawneer Series 516 Thermal Windows, Fixed Window, 4" (101.6 mm) 516 frame depth.
      b. Kawneer Series 526 Thermal Windows, Project-In: CW-PG70-AP, 2-1/4" (57.2 mm) frame depth.

B. Related Sections:
   1. 072700 “Air Barriers”
   2. 079200 “Joint Sealants”
   3. 084113 “Aluminum-Framed Entrances and Storefronts”
   4. 084313 “Aluminum-Framed Storefronts”
   5. 084413 “Glazed Aluminum Curtain Walls”

1.3 Definitions

A. Definitions: For fenestration industry standard terminology and definitions refer to American Architectural Manufactures Association (AAMA) – AAMA Glossary (AAMA AG).

1.4 Performance Requirements

A. General Performance: Aluminum-framed window system shall withstand the effects of the following performance requirements without failure due to defective manufacture, fabrication, installation, or other defects in construction.

B. Fixed Window Performance Requirements:

   1. Fixed window air tightness shall meet the FIXED rating (less than 0.045 cfm/ft^2 (0.25 (m^3 /h) m^{-1}) at 1.57 psf (75 Pa)) when tested in accordance with CAN/CSA-A440 Windows.

   2. Fixed window water tightness shall meet the B7 rating (no water leakage at 14.6 psf (700 Pa)) when tested in accordance with CAN/CSA-A440 Windows.

   3. Structural performance shall be based on CSA Standard CAN3-S157 “Strength Design in Aluminum” and a maximum deflection of 1/175 of the span.

   4. Windload resistance for fixed windows shall meet the C5 rating when tested with configurations in accordance with CAN/CSA-A440 Windows.

   5. The fixed window thermal transmittance U-Factor shall be:
      a. Series 516 Window; 0.39 BTU /hr·ft^2 · °F (2.2 W/m^2 · °C) when tested in accordance with AAMA 1503.1 and CAN/CSA-A440.2.
      b. Series 518 Window; 0.37 BTU /hr·ft^2 · °F (2.1 W/m^2 · °C) when tested in accordance with AAMA 1503.1 and CAN/CSA-A440.2.

      (Note to Specifier: Thermal performance depends on glass specified. Above tests were performed using 25mm double glazed insulated glass unit with 0.10 low emmissivity coating on surface 3, argon gas filled interspace and a thermally broken aluminum glazing spacer.)

Test size 4ft x 6ft (1219mm x 1829mm).

6. The fixed window condensation temperature index of the frame (I_f) shall be:
   a. Series 516 Window; 66 and temperature index of the glass (Ig) shall be 68 when tested in accordance with CAN/CSA-A440 Windows.
   b. Series 518 Window; 67 and temperature index of the glass (I_g) shall be 67 when tested in accordance with CAN/CSA-A440 Windows.

C. Project-In Performance Requirements:
   1. Provide aluminum windows of performance indicated that comply with AAMA/WDMA/CSA 101/I.S.2/A440 (NAFS).
      a. Performance Class and Grade: Project-In: CW-PG70-AP.
   2. Air Infiltration: The test specimen shall be tested in accordance with ASTM E 283 at a minimum window size of 48" x 32" (1219.2 x 812.8 mm). The air infiltration rate shall not exceed 0.10 cfm/ft^2 at a static air pressure differential of 6.2 psf (300 Pa).
   3. Water Resistance: The test specimen shall be tested in accordance with ASTM E 547 and ASTM E 331 at a minimum window size of 32" x 60" (1219.2 x 812.8 mm). There shall be no leakage as defined in the test method at a static air pressure differential of 12.11 psf (580 Pa).
   4. Uniform Load Deflection:
      a. Project-In: A minimum static air pressure difference of 70 psf (3352 Pa) shall be applied in the positive and negative direction in accordance with ASTM E330. There shall be no deflection in excess of L/175 of the span of any framing member.
      b. Project-Out: A minimum static air pressure difference of 45 psf (2155 Pa) shall be applied in the positive and negative direction in accordance with ASTM E330. There shall be no deflection in excess of L/175 of the span of any framing member.
   5. Uniform Load Structural:
      a. Project-In: A minimum static air pressure difference of 105 psf (5027 Pa) shall be applied in the positive and negative direction in accordance with ASTM E330. The unit shall be evaluated after each load.
      b. Project-Out: A minimum static air pressure difference of 67.5 psf (3232 Pa) shall be applied in the positive and negative direction in accordance with ASTM E330. The unit shall be evaluated after each load.
   6. Component Testing: Window components shall be tested in accordance with procedures described in AAMA/WDMA/CSA 101/I.S.2/A440.
   7. Energy Efficiency:
      a. Thermal Transmittance Test (U-Factor): When tested in accordance with AAMA 1503, the conductive thermal transmittance (U-Factor) shall not be more than:
         1) Project-In: U-Factor not more than .46 BTU/hr/sf/°F or ____ BTU/hr/sf/°F per AAMA 507 or NFRC100 when using project specified glass.
         2) Project-Out: U-Factor not more than .45 BTU/hr/sf/°F or ____ BTU/hr/sf/°F per AAMA 507 or NFRC100 when using project specified glass.
      b. Condensation Resistance Test (CRF): When tested in accordance with AAMA 1503, the condensation resistance factor (CRF) shall not be less than:
         1) Project-In: (CRF_f) not less than 58 with clear glass.
            Project-In: (CRF_g) not less than 68 with clear glass.
         2) Project-Out: (CRF_f) frame not less than 58 with clear glass.
            Project-Out: (CRF_g) glass not less than 61 with clear glass.
   8. Condensation Index (I): When tested to CSA A-440.2, the condensation index shall not be less than:

a. 1" insulating glass made with exterior 3/16" soft coat low E glass, therm-oplastic butyl spacer, argon gas, and interior 3/16" clear glass:
Project-In: Temperature Index (I_f) frame not less than 47.
Project-In: Temperature Index (I_g) glass not less than 66.
b. 1" insulating glass made with exterior 3/16" soft coat low E glass, therm-oplastic butyl spacer, argon gas, and interior 3/16" clear glass:
Project-Out: Temperature Index (I_f) frame not less than 53.
Project-Out: Temperature Index (I_g) glass not less than 57.

9. Operating window air tightness shall meet the A3 rating (less than 0.10 cfm/ft (0.55 (m^3/h)/m) at 1.57 psf (75 Pa)) when tested in accordance with CAN/CSA-A440 Windows.
10. Operating window water tightness shall meet the B5 rating (no water leakage at 10.4 psf (500 Pa)) when tested in accordance with CAN/CSA-A440 Windows.
11. Wind load resistance for operating windows shall meet the C5 rating when tested with configurations in accordance with CAN/CSA-A440 Windows.
12. Operating windows shall meet performance criteria for ease of operation, sash strength and stiffness in accordance with CAN/CSA-A440 Windows.
13. The thermal transmittance (U-Factor) of the window when tested in accordance with CAN/CSA A440.2 shall be:
Project-In U = 0.43 BTU/hr · ft^2 · F
(2.4 W/m^2 · °C)
Project-Out U = 0.42 BTU/hr · ft^2 · F
(2.4 W/m^2 · °C)

(Note to Specifier: Thermal performance depends on glass specified. Above tests were performed using 25mm double glazed insulated glass unit with 0.10 low emissivity coating on surface 3, argon gas filled interspace and a thermally broken aluminum glazing spacer.)
Test size 4 ft x 6 ft (1219 mm x 1829 mm).
14. The condensation index of the frame when tested in accordance with CAN/CSA-A440 Windows shall be:
Project-In I_f = 55
Project-Out I_f = 60
15. Forced Entry Resistance: All windows shall conform to ASTM F588, Grade 10.
16. Thermal Barrier Test: Thermal break shall be designed in accordance with AAMA TIR-A8 and tested in accordance with AAMA 505.

D. Environmental Product Declarations (EPD): Shall have a Type III Product-Specific EPD created from a Product Category Rule.

1.5 Submittals

A. Product Data: Include construction details, material descriptions, fabrication methods, dimensions of individual components and profiles, hardware, finishes, and operating instructions for each type of aluminum window indicated.
1. Recycled Content:
a. Provide documentation that aluminum has a minimum of 50% mixed pre- and post-consumer recycled content with a sample document illustrating project specific information that will be provided after product shipment.
b. Once product has shipped, provide project specific recycled content information, including:
1) Indicate recycled content; indicate percentage of pre- and post-consumer recycled content per unit of product.
2) Indicate relative dollar value of recycled content product to total dollar value of product included in project.

3) Indicate location recovery of recycled content.
4) Indicate location of manufacturing facility.

B. Shop Drawings: Include plans, elevations, sections, details, hardware, attachments to other work, operational clearances and installation details.

C. Samples for Initial Selection: For units with factory-applied color finishes including samples of hardware and accessories involving color selection.

D. Samples for Verification: For aluminum windows and components required.

E. Product Schedule: For aluminum windows. Use same designations indicated on Drawings.

F. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency for each type, class, grade, and size of aluminum window. Test results based on use of downsized test units will not be accepted.

1.6 Quality Assurance

A. Installer Qualifications: An installer which has had successful experiences with installation of the same or similar units required for this project and other projects of similar size and scope.

B. Manufacturer Qualifications: A manufacturer capable of fabricating aluminum windows that meet or exceed performance requirements indicated and of documenting this performance by inclusion of test reports, and calculations.

C. Source Limitations: Obtain aluminum windows through one source from a single manufacturer.

D. Product Options: Drawings indicate size, profiles, and dimensional requirements of aluminum windows and are based on the specific system indicated. Refer to Division 01 Section “Product Requirements.” Do not modify size and dimensional requirements.
1. Do not modify intended aesthetic effects, as judged solely by Architect, except with Architect's approval. If modifications are proposed, submit comprehensive explanatory data to Architect for review.

E. 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 for type(s) of window(s) indicated, in location(s) shown on Drawings.

F. Pre-installation Conference: Conduct conference at Project site to comply with requirements in Division 01 Section “Project Management and Coordination.”

1.7 Project Conditions

A. Field Measurements: Verify aluminum window openings by field measurements before fabrication and indicate measurements on Shop Drawings.

1.8 Warranty

A. Manufacturer’s Warranty: Submit, for Owner’s acceptance, manufacturer’s standard warranty.
1. Warranty Period: Two (2) years from Date of Substantial Completion of the project provided however that the Limited Warranty shall begin in no event later than six months from date of shipment by manufacturer.

PART 2 - PRODUCTS

2.1 Manufacturers

A. Basis-of-Design Product:
1. Kawneer Company Inc.
2. Series 516/518 Thermal Windows - Fixed
3. 4" (101.6 mm) 516 frame depth

B. Basis-of-Design Product:
   1. Kawneer Company Inc.
   2. Series 526 Thermal Windows - Project-In
   3. 2-1/4" (57.2 mm) frame depth
   4. Project-In: CW-PG70-AP
   5. Project-Out: CW-PG45-AP

C. Subject to compliance with requirements, provide a comparable product by the following:
   1. EFCO, LLC
   2. Tubelite Inc
   3. YKK AP America Inc.

D. Substitutions: Refer to Substitutions Section for procedures and submission requirements.
   1. Pre-Contract (Bidding Period) Substitutions: Submit written requests ten (10) days prior to bid date.
   2. Post-Contract (Construction Period) Substitutions: Submit written request in order to avoid window installation and construction delays.
   3. Product Literature and Drawings: Submit product literature and drawings modified to suit specific project requirements and job conditions.
   4. Certificates: Submit certificate(s) certifying substitute manufacturer (1) attesting to adherence to specification requirements for window system performance criteria, and (2) has been engaged in the design, manufacturer and fabrication of aluminum windows for a period of not less than ten (10) years. (Company Name)
   5. Test Reports: Submit test reports verifying compliance with each test requirement required by the project.
   6. Samples: Provide samples of typical product sections and finish samples in manufacturer's standard sizes.

E. Substitution Acceptance: Acceptance will be in written form, either as an addendum or modification, and documented by a formal change order signed by the Owner and Contractor.

2.2 Materials

A. Aluminum Extrusions: Alloy and temper recommended by aluminum window manufacturer for strength, corrosion resistance, and application of required finish and not less than 0.070" wall thickness at any location for the main frame and sash members.

B. Fasteners: Aluminum, nonmagnetic stainless steel or other materials to be non-corrosive and compatible with aluminum window members, trim, hardware, anchors, and other components.

C. Anchors, Clips, and Accessories: Aluminum, nonmagnetic stainless steel, or zinc-coated steel or iron complying with ASTM B 633 for SC 3 severe service conditions; provide sufficient strength to withstand design pressure indicated.

D. Reinforcing Members: Aluminum, nonmagnetic stainless steel, or nickel/chrome-plated steel complying with ASTM B 456 for Type SC 3 severe service conditions, or zinc-coated steel or iron complying with ASTM B 633 for SC 3 severe service conditions; provide sufficient strength to withstand design pressure indicated.

E. Sealant: For sealants required within fabricated windows, provide window manufacturer's standard, permanently elastic, non-shrinking, and non-migrating type recommended by sealant manufacturer for joint size and movement.

2.3 Window Framing System

A. Series 516/518 Thermal Window – Fixed

B. 526 Thermal Windows – Project-In

2.4 Glazing

A. Glass and Glazing Materials: Refer to Division 08 Section “Glazing” for glass units and glazing requirements applicable to glazed aluminum window units.

B. Glazing System: Glazing method shall be a wet/dry type in accordance with manufacturer’s standards. Exterior glazing shall be silicone back bedding sealant. Interior glazing shall be snap-in type glazing beads with an interior gasket in accordance with AAMA 702 or ASTM C864.

2.5 Hardware

A. General: Provide manufacturer's standard hardware fabricated from aluminum, stainless steel, or other corrosion-resistant material compatible with aluminum; designed to smoothly operate, tightly close, and securely lock aluminum windows, and sized to accommodate sash weight and dimensions.

B. Project-In Window: Provide the following operating hardware:
   1. 4-Bar Hinges
   2. Cast White Bronze Cam Locks (Standard)
   3. Weep Covers

2.6 Accessories

A. Insect Screens: Insect screen frames shall be extruded aluminum finished to match window frame and rigidly joined at the corners. Screen shall be 18 x 16 glassfiber mesh. Splines shall be extruded elastomer removable to permit re-screening.

2.7 Fabrication

A. Framing Members, General: Fabricate components that, when assembled, have the following characteristics:
   1. Profiles that are sharp, straight, and free of defects or deformations.
   2. Accurately fit joints; make joints flush, hairline and weatherproof.
   3. Means to drain water passing joints, condensation within framing members, and moisture migrating within the system to exterior.
   4. Physical and thermal isolation of glazing from framing members.
   5. Accommodations for thermal and mechanical movements of glazing and framing to maintain required glazing edge clearances.
   6. Provisions for field replacement of glazing.
   7. Fasteners, anchors, and connection devices that are concealed from view to greatest extent possible.

B. Window framing shall be designed for screw spline corner construction. All framing joints shall be sealed to provide neat weathertight connections.

C. Fabricate aluminum windows in sizes indicated. Include a complete system for assembling components and anchoring windows.

D. Fabricate aluminum windows that are re-glazable without dismantling sash or framing.

E. Thermally Improved Construction: Fabricate aluminum windows with an integral, concealed, low-conductance thermal barrier; located between exterior materials and window members exposed on interior side; in a manner that eliminates direct metal-to-metal contact. Thermal barriers shall be designed in accordance with AAMA TIR A8.
   1. Frame thermal barrier shall be Kawneer IsoPort™ with a minimum of 1/4" (6mm) separation consisting of a one piece polyamide strip installed continuously and mechanically bonded to the aluminum.

F. Mullions: Provide mullions and cover plates as shown, matching window units, complete with anchors for support to structure and installation of window units. Allow for erection tolerances and

provide for movement of window units due to thermal expansion and building deflections, as indicated. Provide mullions and cover plates capable of withstanding design loads of window units.

G. Sub frames: Provide sub frames with anchors for window units as shown, of profile and dimensions indicated but not less than 0.093-inch (2.4-mm) thick extruded aluminum. Miter or cope corners, and join with concealed mechanical joint fasteners. Finish to match window units. Provide sub frames capable of withstanding design loads of window units.

H. Glazing Stops: Provide snap-on glazing stops coordinated with Division 08 Section “Glazing” and glazing system indicated. Provide glazing stops to match frame.

2.8 Aluminum Finishes

A. Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.
B. Factory Finishing:
   1. Kawneer Permanodic™ AA-M10C21A31, AAMA 611, Architectural Class II Clear Anodic Coating (Color #17 Clear) (Standard).

PART 3 - EXECUTION

3.1 Examination

A. Examine openings, substrates, structural support, anchorage, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of work. Verify rough opening dimensions, levelness of sill plate and operational clearances. Examine wall flashings, vapor retarders, water and weather barriers, and other built-in components to ensure a coordinated, weather tight window installation.
   1. Masonry Surfaces: Visibly dry and free of excess mortar, sand, and other construction debris.
   2. Wood Frame Walls: Dry, clean, sound, well nailed, free of voids, and without offsets at joints. Ensure that nail heads are driven flush with surfaces in opening and within 3 inches (76 mm) of opening.
   3. Metal Surfaces: Dry; clean; free of grease, oil, dirt, rust, corrosion, and welding slag; without sharp edges or offsets at joints.
   4. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 Installation

A. Comply with Drawings, Shop Drawings, and manufacturer's written instructions for installing windows, hardware, accessories, and other components.

B. Install aluminum framed window system level, plumb, square, true to line, without distortion or impeding thermal movement, anchored securely in place to structural support, and in proper relation to wall flashing and other adjacent construction.

C. Set sill members in bed of sealant or with gaskets, as indicated, for weather tight construction.

D. Install aluminum framed window system and components to drain condensation, water penetrating joints, and moisture migrating within system to the exterior.

E. Separate aluminum from dissimilar materials to prevent corrosion or electrolytic action at points of contact.

3.3 Adjusting, Cleaning, And Protection

A. Adjust operating sashes, screens, hardware, and accessories for a tight fit at contact points and weatherstripping for smooth operation and weather tight closure. Lubricate hardware and moving parts.

B. Clean aluminum surfaces immediately after installing windows. Avoid damaging protective coatings and finishes. Remove excess sealants, glazing materials, dirt, and other substances.

C. Clean glass immediately after installing windows. Comply with manufacturer's written recommendations for final cleaning and maintenance. Remove nonpermanent labels, and clean surfaces.

D. Remove and replace glass that has been broken, chipped, cracked, abraded, or damaged during construction period.

E. Protect window surfaces from contact with contaminating substances resulting from construction operations. In addition, monitor window surfaces adjacent to and below exterior concrete and masonry surfaces during construction for presence of dirt, scum, alkaline deposits, stains, or other contaminants. If contaminating substances do contact window surfaces, remove contaminants immediately according to manufacturer's written recommendations.

DISCLAIMER STATEMENT

This guide specification is intended to be used by a qualified construction specifier. The guide specification is not intended to be verbatim as a project specification without appropriate modifications for the specific use intended. The guide specification must be used and coordinated with the procedures of each design firm, and the particular requirements of a specific construction project.

END OF SECTION 085113

DIVISION 08 – OPENINGS

SECTION 08 70 13 – HARDWARE SCHEDULE

1.1 DOOR HARDWARE SCHEDULE

A. The hardware sets represent the design intent and direction of the owner and architect. They are a guideline only and should not be considered a detailed hardware schedule. Discrepancies, conflicting hardware and missing items should be brought to the attention of the architect with corrections made prior to the bidding process. Omitted items not included in a hardware set should be scheduled with the appropriate additional hardware required for proper application and functionality.

Hardware set H-01

Exterior Classroom Egress Door

Door Number

101, 102, 103, 104, 105, 106, 107, 108, 133, 134, 135, 136, 137, 138, 147, 152, 156

	Qty	Description	
Hinge – Continuous	1 EA	SL24 CL HD x 83" x SDTF x CL	SELECT
Exit Device - Rim	1 EA	1008D-S x 40" x CD x IC7 (Installed) x IC7 (Dogging) x 630	DETEX
Core	1 EA	CONSTRUCTION CORE IC-(COMBINATED)	PDQ
Core	2 EA	IC CORE x 26D x "A" KEYWAY M.K. TO SCHED.	PDQ
Closer	1 EA	5101 BC DS x 689	PDQ
Kick Plate	1 EA	K1050 x 4BE x 10" x 32" x US32D	ROCKWOOD
Door Seal	1 EA	5040W x 17’ x W	NGP
Sweep	1 EA	200NA x 36" x A	NGP
Threshold	1 EA	8427 x 36" x MILL	NGP

Hardware set H-02

Exterior Stairway Egress Doors

Door Number

S-1, S-2

	Qty	Description	
Hinge – Continuous	2 EA	SL24 CL HD x 83" x SDTF x CL	SELECT
Removable Mullion	1 EA	90KR	DETEX
Exit Device - Rim	2 EA	1008D-S x 40" x HD x IC7 (Installed) x IC7 (Dogging) x 630	DETEX

Core	1 EA	CONSTRUCTION CORE IC-(COMBINATED)	PDQ
Core	2 EA	IC CORE x 26D x "A" KEYWAY M.K. TO SCHED.	PDQ
Closer	2 EA	7101 BC DS x 689	PDQ
Kick Plate	2 EA	K1050 x 4BE x 10" x 32" x US32D	ROCKWOOD
Door Seal	2 EA	5040W x 17’ x W	NGP
Sweep	2 EA	200NA x 36" x A	NGP
Threshold	1 EA	8427-6 x MILL	NGP

Hardware set KEY

	Qty	Description	
Key Control Cabinet	1 EA	WC-150 x	TELKEE
Master Keying	5 EA	MASTER KEYS	PDQ
Key Blank	2 EA	CONTROL KEY -IC	PDQ

END OF SECTION 08 70 13

DIVISION 08 – OPENINGS

SECTION 08 71 13 – DOOR HARDWARE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes commercial door hardware for the following:

1. Swinging doors.

B. Door hardware includes, but is not necessarily limited to, the following:

1. Mechanical door hardware.
2. Cylinders specified for doors in other sections.

C. Related Sections:

1. Division 08 Section “Hollow Metal Doors and Frames”.
2. Division 08 Section “Aluminum-Framed Entrances and Storefronts”.

D. Codes and References: Comply with the version year adopted by the Authority Having Jurisdiction.

1. ANSI A117.1 - Accessible and Usable Buildings and Facilities.
2. ICC/IBC - International Building Code.
3. NFPA 80 - Fire Doors and Windows.
4. NFPA 101 - Life Safety Code.
5. NFPA 105 - Installation of Smoke Door Assemblies.
6. State Building Codes, Local Amendments.

E. Standards: All hardware specified herein shall comply with the following industry standards:

1. ANSI/BHMA Certified Product Standards - A156 Series
2. UL10C – Positive Pressure Fire Tests of Door Assemblies

1.3 SUBMITTALS

A. Product Data: Manufacturer's product data sheets including installation details, material descriptions, dimensions of individual components and profiles, operational descriptions and finishes.

B. Door Hardware Schedule: Prepared by or under the supervision of supplier, detailing fabrication and assembly of door hardware, as well as procedures and diagrams. Coordinate the final Door

Hardware Schedule with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish of door hardware.

1. Organization: Organize the Door Hardware Schedule into door hardware sets indicating complete designations of every item required for each door or opening. Organize door hardware sets in same order as in the Door Hardware Sets at the end of Part 3. Submittals that do not follow the same format and order as the Door Hardware Sets will be rejected and subject to resubmission.

2. Content: Include the following information:

   a. Type, style, function, size, label, hand, and finish of each door hardware item.
   b. Manufacturer of each item.
   c. Fastenings and other pertinent information.
   d. Location of door hardware set, cross-referenced to Drawings, both on floor plans and in door and frame schedule.
   e. Explanation of abbreviations, symbols, and codes contained in schedule.
   f. Mounting locations for door hardware.
   g. Door and frame sizes and materials.

3. Submittal Sequence: Submit the final Door Hardware Schedule at earliest possible date, particularly where approval of the Door Hardware Schedule must precede fabrication of other work that is critical in the Project construction schedule. Include Product Data, Samples, Shop Drawings of other work affected by door hardware, and other information essential to the coordinated review of the Door Hardware Schedule.

C. Keying Schedule: Prepared under the supervision of the Owner, separate schedule detailing final keying instructions for locksets and cylinders in writing. Include keying system explanation, door numbers, key set symbols, hardware set numbers and special instructions. Owner to approve submitted keying schedule prior to the ordering of permanent cylinders.

D. Operating and Maintenance Manuals: Provide manufacturers operating and maintenance manuals for each item comprising the complete door hardware installation in quantity as required in Division 01, Closeout Submittals. The manual to include the name, address, and contact information of the manufacturers providing the hardware and their nearest service representatives. The final copies delivered after completion of the installation test to include "as built" modifications made during installation, checkout, and acceptance.

E. Warranties and Maintenance: Special warranties and maintenance agreements specified in this Section.

1.4 QUALITY ASSURANCE

A. Manufacturers Qualifications: Engage qualified manufacturers with a minimum 5 years of documented experience in producing hardware and equipment similar to that indicated for this Project and that have a proven record of successful in-service performance.

B. Installer Qualifications: Installers, trained by the primary product manufacturers, with a minimum 3 years documented experience installing both standard and electrified builders hardware similar in material, design, and extent to that indicated for this Project and whose work has resulted in construction with a record of successful in-service performance.

C. Door Hardware Supplier Qualifications: Experienced commercial door hardware distributors with a minimum 5 years documented experience supplying both mechanical and electromechanical

hardware installations comparable in material, design, and extent to that indicated for this Project. Supplier recognized as a factory direct distributor in good standing by the manufacturers of the primary materials with a warehousing facility in Project's vicinity. Supplier to have on staff a certified Architectural Hardware Consultant (AHC) available during the course of the Work to consult with Contractor, Architect, and Owner concerning standard door hardware and keying.

1. Scheduling Responsibility: Preparation of door hardware and keying schedules.

D. Source Limitations: Obtain each type and variety of Door Hardware specified in this Section from a single source, qualified supplier unless otherwise indicated.

E. Regulatory Requirements: Comply with NFPA 70, NFPA 80, NFPA 101 and ANSI A117.1 requirements and guidelines as directed in the model building code including, but not limited to, the following:

1. Where indicated to comply with accessibility requirements, comply with Americans with Disabilities Act (ADA), "Accessibility Guidelines for Buildings and Facilities (ADAAG)," ANSI A117.1 as follows:

   a. Handles, Pulls, Latches, Locks, and other Operating Devices: Shape that is easy to grasp with one hand and does not require tight grasping, tight pinching, or twisting of the wrist.
   b. Door Closers: Comply with the following maximum opening-force requirements indicated:

      1) Interior Hinged Doors: 5 lbf applied perpendicular to door.
      2) Fire Doors: Minimum opening force allowable by authorities having jurisdiction.

   c. Thresholds: Not more than 1/2 inch high. Bevel raised thresholds with a slope of not more than 1:2.

2. NFPA 101: Comply with the following for means of egress doors:

   a. Latches, Locks, and Exit Devices: Not more than 15 lbf to release the latch. Locks shall not require the use of a key, tool, or special knowledge for operation.

   b. Thresholds: Not more than 1/2 inch high.

3. Fire-Rated Door Assemblies: Provide door hardware for assemblies complying with NFPA 80 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire ratings indicated, based on testing according to NFPA 252 (neutral pressure at 40" above sill) or UL-10C.

   a. Test Pressure: Positive pressure labeling.

F. Each unit to bear third party permanent label demonstrating compliance with the referenced standards.

G. Keying Conference: Conduct conference to comply with requirements in Division 01 Section "Project Meetings." Keying conference to incorporate the following criteria into the final keying schedule document:

1. Function of building, purpose of each area and degree of security required.

2. Plans for existing and future key system expansion.
3. Requirements for key control storage and software.
4. Installation of permanent keys, cylinder cores and software.
5. Address and requirements for delivery of keys.

H. Pre-Submittal Conference: Conduct coordination conference in compliance with requirements in Division 01 Section "Project Meetings" with attendance by representatives of Supplier(s), Installer(s), and Contractor(s) to review proper methods and the procedures for receiving, handling, and installing door hardware.

1. Prior to installation of door hardware, conduct a project specific training meeting to instruct the installing contractors' personnel on the proper installation and adjustment of their respective products. Product training to be attended by installers of door hardware for hollow metal doors. Training will include the use of installation manuals, hardware schedules, templates and physical product samples as required.
2. Review sequence of operation narratives for each unique access controlled opening.
3. Review and finalize construction schedule and verify availability of materials.
4. Review the required inspecting, testing, commissioning, and demonstration procedures

I. At completion of installation, provide written documentation that components were applied to manufacturer's instructions and recommendations and according to approved schedule.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Inventory door hardware on receipt and provide secure lock-up and shelving for door hardware delivered to Project site. Do not store accessories at Project site without prior authorization.

B. Tag each item or package separately with identification related to the final Door Hardware Schedule, and include basic installation instructions with each item or package.

C. Deliver, as applicable, permanent keys, cylinders & cores directly to Owner via registered mail or overnight package service. Instructions for delivery to the Owner shall be established at the "Keying Conference".

1.6 COORDINATION

A. Templates: Obtain and distribute to the parties involved templates for doors, frames, and other work specified to be factory prepared for installing hardware. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing hardware to comply with indicated requirements.

1.7 WARRANTY

A. General Warranty: Reference Division 01, General Requirements. Special warranties specified in this Article shall not deprive Owner of other rights Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by Contractor under requirements of the Contract Documents.

B. Warranty Period: Written warranty, executed by manufacturer(s), agreeing to repair or replace components of door hardware that fails in materials or workmanship within specified warranty period after final acceptance by the Owner. Failures include, but are not limited to, the following:

1. Structural failures including excessive deflection, cracking, or breakage.
2. Faulty operation of the hardware.
3. Deterioration of metals, metal finishes, and other materials beyond normal weathering.

C. Standard Warranty Period: One year from date of Substantial Completion, unless otherwise indicated.

D. Special Warranty Periods:

1. Ten years for mortise locks and latches.
2. Seven years for heavy duty cylindrical (bored) locks and latches.
3. Five years for exit hardware.
4. Twenty five years for manual surface door closers.

1.8 MAINTENANCE SERVICE

A. Maintenance Tools and Instructions: Furnish a complete set of specialized tools and maintenance instructions as needed for Owner's continued adjustment, maintenance, and removal and replacement of door hardware.

B. Continuing Service: Beginning at Substantial Completion, and running concurrent with the specified warranty period, provide continuous (6) months full maintenance including repair and replacement of worn or defective components, lubrication, cleaning, and adjusting as required for proper door opening operation. Provide parts and supplies as used in the manufacture and installation of original products.

PART 2 - PRODUCTS

2.1 SCHEDULED DOOR HARDWARE

A. General: Provide door hardware for each door to comply with requirements in Door Hardware Sets and each referenced section that products are to be supplied under.

1. Designations: Requirements for quantity, item, size, finish or color, grade, function, and other distinctive qualities of each type of door hardware are indicated in the Door Hardware Sets at the end of Part 3. Products are identified by using door hardware designations, as follows:

a. Named Manufacturer's Products: Product designation and manufacturer are listed for each door hardware type required for the purpose of establishing requirements. Manufacturers' names are abbreviated in the Door Hardware Schedule.

B. Substitutions: Requests for substitution and product approval for inclusive mechanical door hardware in compliance with the specifications must be submitted in writing and in accordance with the procedures and time frames outlined in Division 01, Substitution Procedures. Approval of requests is at the discretion of the architect, owner, and their designated consultants.

2.2 HANGING DEVICES

A. Continuous Geared Hinges: ANSI/BHMA A156.26 certified continuous geared hinge with minimum 0.120-inch thick extruded 6060 T6 aluminum alloy hinge leaves and a minimum overall width of 4 inches. Hinges are non-handed, reversible and fabricated to template screw locations. Provide concealed flush mount (with or without inset), full surface, or half surface, in standard and heavy duty models, as specified in the Hardware Sets. Concealed continuous hinges to be U.L. listed for use on up to and including 90 minute rated door installations and U.L. listed for windstorm components where applicable. Factory cut hinges for door size and provide with removable service power transfer panel where indicated at electrified openings.

1. Acceptable Manufacturers:

    a. Select Hinges
    b. Bommer Industries (BO).
    c. McKinney Products (MK).
    d. Pemko Manufacturing (PE).

2.3 CYLINDERS AND KEYING

A. General: Cylinder manufacturer to have minimum (10) years experience designing secured master key systems and have on record a published security keying system policy.

B. Source Limitations: Obtain each type of keyed cylinder and keys from the same source manufacturer as locksets and exit devices, unless otherwise indicated.

C. Cylinders: Original manufacturer cylinders complying with the following:

1. Mortise Type: Threaded cylinders with rings and straight- or clover-type cam.
2. Rim Type: Cylinders with back plate, flat-type vertical or horizontal tailpiece, and raised trim ring.
3. Bored-Lock Type: Cylinders with tailpieces to suit locks.
4. Mortise and rim cylinder collars to be solid and recessed to allow the cylinder face to be flush and be free spinning with matching finishes.
5. Keyway: Manufacturer’s Standard.

D. Permanent Cores: Manufacturer's standard; finish face to match lockset; complying with the following:
1. Removable Cores: Core insert, removable by use of a special key, and for use with only the core manufacturer's cylinder and door hardware. Provide removable core (small or large format) as specified in Hardware Sets.

E. Patented Cylinders: ANSI/BHMA A156.5, Grade 1, certified cylinders employing a utility patented and restricted keyway requiring the use of patented controlled keys. Provide bump resistant, fixed core cylinders as standard with solid recessed cylinder collars. Cylinders are to be factory keyed where permanent keying records will be established and maintained.

1. Provide a 6 pin multi-level master key system comprised of patented controlled keys and security and high security cylinders operated by one (1) key of the highest level.

    a. Level 2 Cylinders: Provide utility patented controlled keyway and side bar locking incorporating unique angled bottom pins for geographical exclusivity. Cylinders constructed to provide protection against bumping and picking.

2. Acceptable Manufacturer:

   a. Sargent Manufacturing (SA) - Degree Series.
   b. Corbin Russwin (RU) – Access 3 Series.
   c. Medeco (MC) - X4 Series.
   d. PDQ Locks

F. Keying System: Each type of lock and cylinders to be factory keyed. Conduct specified "Keying Conference" to define and document keying system instructions and requirements. Furnish factory cut, nickel-silver large bow permanently inscribed with a visual key control number as directed by Owner. Incorporate decisions made in keying conference, and as follows:

1. Great-Grand Master Key System: Cylinders are operated by a change key, a master key, a grand master key, and a great-grand master key.

G. Key Quantity: Provide the following minimum number of keys:

1. Top Master Key: One (1)
2. Change Keys per Cylinder: Two (2)
3. Master Keys (per Master Key Group): Two (2)
4. Grand Master Keys (per Grand Master Key Group): Two (2)
5. Construction Keys (where required): Ten (10)
6. Construction Control Keys (where required): Two (2)
7. Permanent Control Keys (where required): Two (2)

H. Construction Keying: Provide construction master keyed cylinders or temporary keyed construction cores where specified. Provide construction master keys in quantity as required by project Contractor. Replace construction cores with permanent cores. Furnish permanent cores for installation as directed under specified "Keying Conference".

I. Key Registration List: Provide keying transcript list to Owner's representative in the proper format for importing into key control software.

J. Key Control Cabinet: Provide a key control system including envelopes, labels, and tags with self-locking key clips, receipt forms, 3-way visible card index, temporary markers, permanent markers, and standard metal cabinet. Key control cabinet shall have expansion capacity of 150% of the number of locks required for the project.

1. Acceptable Manufacturers:

   a. Lund Equipment (LU).
   b. MMF Industries (MM).
   c. Telkee (TK).

2.4 MECHANICAL LOCKS AND LATCHING DEVICES

A. Cylindrical Locksets, Grade 1 (Heavy Duty): ANSI/BHMA A156.2, Series 4000, Grade 1 certified cylindrical (bored) locksets furnished in the functions as specified in the Hardware Sets. Lock chassis fabricated of heavy gauge steel, zinc dichromate plated, with through-bolted application. Furnish with solid cast levers, standard 2 3/4” backset, and 1/2" (3/4" at rated paired openings) throw brass or stainless steel latchbolt. Locks are to be non-handed and fully field reversible.

1. Acceptable Manufacturers:

a. Corbin Russwin Hardware (RU) – CL3300 Series.
b. Sargent Manufacturing (SA) – 10 Line.
c. Stanley Best (BE) – 9K Series.
d. PDQ Locks

B. Lock Trim Design: As specified in Hardware Sets.

2.5 LOCK AND LATCH STRIKES

A. Strikes: Provide manufacturer's standard strike with strike box for each latch or lock bolt, with curved lip extended to protect frame, finished to match door hardware set, unless otherwise indicated, and as follows:
1. Aluminum-Frame Strike Box: Provide manufacturer's special strike box fabricated for aluminum framing.

B. Standards: Comply with the following:
1. Strikes for Bored Locks and Latches: BHMA A156.2.

2.6 CONVENTIONAL EXIT DEVICES

A. General Requirements: All exit devices specified herein shall meet or exceed the following criteria:

1. At doors not requiring a fire rating, provide devices complying with NFPA 101 and listed and labeled for "Panic Hardware" according to UL305. Provide proper fasteners as required by manufacturer including hex nuts and bolts at openings specified in the Hardware Sets.

2. Where exit devices are required on fire rated doors, provide devices complying with NFPA 80 and with UL labeling indicating "Fire Exit Hardware". Provide devices with the proper fasteners for installation as tested and listed by UL. Consult manufacturer’s catalog and template book for specific requirements.

a. Fire Exit Removable Mullions: Provide keyed removable mullions for use with fire exit devices complying with NFPA 80 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire and panic protection, based on testing according to UL 305 and NFPA 252. Mullions to be used only with exit devices for which they have been tested.

3. Except on fire rated doors, provide exit devices with hex key dogging device to hold the pushbar and latch in a retracted position. Provide optional keyed cylinder dogging on devices where specified in Hardware Sets.

4. Devices must fit flat against the door face with no gap that permits unauthorized dogging of the push bar. The addition of filler strips is not acceptable except in any case where the door light extends behind the device as in a full glass configuration.

5. Flush End Caps: Provide heavy weight impact resistant flush end caps made of architectural metal in the same finish as the devices as in the Hardware Sets. Plastic end caps will not be acceptable.

6. Lever Operating Trim: Where exit devices require lever trim, furnish manufacturer's heavy duty trim with cold forged escutcheons, beveled edges, and four threaded studs for thru-bolts.

    a. Lock Trim Design: As indicated in Hardware Sets, provide finishes and designs to match that of the specified locksets. Provided free-wheeling type trim where indicated.
    b. Where function of exit device requires a cylinder, provide an interchangeable core type keyed cylinder (Rim or Mortise) as specified in Hardware Sets.

7. Vertical Rod Exit Devices: Provide and install interior surface and concealed vertical rod exit devices as Less Bottom Rod (LBR) unless otherwise indicated.

8. Rail Sizing: Provide exit device rails factory sized for proper door width application.

9. Through Bolt Installation: For exit devices and trim as indicated in Door Hardware Sets.

B. Conventional Push Rail Exit Devices (Heavy Duty): ANSI/BHMA A156.3, Grade 1 certified panic and fire exit hardware devices furnished in the functions specified in the Hardware Sets. Mounting rails to be formed from smooth stainless steel, brass or bronze architectural materials no less than 0.072" thick, with push rails a minimum of 0.062" thickness. Painted or aluminum metal rails are not acceptable. Exit device latch to be investment cast stainless steel, pullman type, with deadlock feature.

1. Acceptable Manufacturers:

    a. DETEX Corp.– 10 Series
    b. Corbin Russwin Hardware (RU) - ED4000 / ED5000 Series.
    c. Sargent Manufacturing (SA) - 80 Series.
    d. Von Duprin (VD) - 35A/98 XP Series.

C. Tube Steel Removable Mullions: ANSI/BHMA A156.3 removable steel mullions with malleable-iron top and bottom retainers and a primed paint finish. Provide keyed removable feature, stabilizers, and mounting brackets as specified in the Hardware Sets. At openings designed for severe wind load conditions due to hurricanes or tornadoes, provide manufacturers approved mullion and accessories to meet applicable state and local windstorm codes.

1. Acceptable Manufacturers:

    a. DETEX Corp. – 90Series
    b. Corbin Russwin Hardware (RU) - 700/900 Series.
    c. Sargent Manufacturing (SA) - 980S Series.
    d. Von Duprin (VD) - 9954 Series.

2.7 DOOR CLOSERS

A. All door closers specified herein shall meet or exceed the following criteria:

1. General: Door closers to be from one manufacturer, matching in design and style, with the same type door preparations and templates regardless of application or spring size. Closers to be non-handed with full sized covers including installation and adjusting information on inside of cover.

2. Standards: Closers to comply with UL-10C and UBC 7-2 for Positive Pressure Fire Test and be U.L. listed for use of fire rated doors.

3. Cycle Testing: Provide closers which have surpassed 15 million cycles in a test witnessed and verified by UL.

4. Size of Units: Comply with manufacturer's written recommendations for sizing of door closers depending on size of door, exposure to weather, and anticipated frequency of use. Where closers are indicated for doors required to be accessible to the physically handicapped, provide units complying with ANSI ICC/A117.1.

5. Closer Arms: Provide heavy duty, forged steel closer arms unless otherwise indicated in Hardware Sets.

    a. Where closers are indicated to have mechanical dead-stop, provide heavy duty arms and brackets with an integral positive stop.
    b. Where closers are indicated to have mechanical hold open, provide heavy duty units with an additional built-in mechanical holder assembly designed to hold open against normal wind and traffic conditions. Holder to be manually selectable to on-off position.
    c. Where closers are indicated to have a cushion-type stop, provide heavy duty arms and brackets with spring stop mechanism to cushion door when opened to maximum degree.
    d. Closers shall not be installed on exterior or corridor side of doors; where possible install closers on door for optimum aesthetics. Provide drop plates or other accessories as required for proper mounting.

6. Closer Accessories: Provide door closer accessories including custom templates, special mounting brackets, spacers and drop plates, and through-bolt or security type fasteners as specified in the door Hardware Sets.

B. Door Closers, Surface Mounted (Heavy Duty): ANSI/BHMA A156.4, Grade 1 surface mounted, heavy duty door closers with complete spring power adjustment, sizes 1 thru 6; and fully operational adjustable according to door size, frequency of use, and opening force. Closers to be rack and pinion type, one piece cast iron or aluminum alloy body construction, with adjustable backcheck and separate non-critical valves for closing sweep and latch speed control. Provide non-handed units standard.

1. Acceptable Manufacturers:

    a. PDQ – 5100 Series
    b. Corbin Russwin Hardware (RU) - DC8000 Series.
    c. Norton Door Controls (NO) - 7500 Series.
    d. Yale Locks and Hardware (YA) - 4400 Series.

C. Door Closers, Surface Mounted (Unitrol): ANSI/BHMA 156.4, Grade 1 certified surface mounted, heavy duty door closers with complete spring power adjustment, sizes 1 thru 6; and fully operational adjustable according to door size, frequency of use, and opening force. Unitrol arms to have door stop mechanism to absorb dead stop shock on arm and top hinge. Hold-open arms to have a spring loaded mechanism in addition to shock absorber assembly. Arms to be provided with rigid steel main arm and secondary arm lengths proportional to the door width.

1. Acceptable Manufacturers:

    a. PDQ – 7100 Series

b. Corbin Russwin Hardware (RU) - Unitrol DC8000 Series.
c. Norton Door Controls (NO) - Unitrol 7500 Series.
d. Yale Locks and Hardware (YA) - Unitrol 4400 Series.

2.8 ARCHITECTURAL TRIM

A. Door Protective Trim

1. General: Door protective trim units to be of type and design as specified below or in the Hardware Sets.

2. Size: Fabricate protection plates (kick, armor, or mop) not more than 2" less than door width (LDW) on stop side of single doors and 1” LDW on stop side of pairs of doors, and not more than 1" less than door width on pull side. Coordinate and provide proper width and height as required where conflicting hardware dictates. Height to be as specified in the Hardware Sets.

3. Metal Protection Plates: ANSI/BHMA A156.6 certified metal protection plates (kick, armor, or mop), beveled on four edges (B4E), fabricated from the following:

   a. Stainless Steel: 300 series, 050-inch thick, with countersunk screw holes (CSK).

4. Fasteners: Provide manufacturer's designated fastener type as specified in the Hardware Sets.

5. Acceptable Manufacturers:

   a. Hiawatha, Inc. (HI).
   b. Rockwood Manufacturing (RO).
   c. Trimco (TC).

2.9 ARCHITECTURAL SEALS

A. General: Thresholds, weatherstripping, and gasket seals to be of type and design as specified below or in the Hardware Sets. Provide continuous weatherstrip gasketing on exterior doors and provide smoke, light, or sound gasketing on interior doors where indicated. At exterior applications provide non-corrosive fasteners and elsewhere where indicated.

B. Smoke Labeled Gasketing: Assemblies complying with NFPA 105 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for smoke control ratings indicated, based on testing according to UL 1784.

1. Provide smoke labeled perimeter gasketing at all smoke labeled openings.

C. Fire Labeled Gasketing: Assemblies complying with NFPA 80 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire ratings indicated, based on testing according to UL-10C.

1. Provide intumescent seals as indicated to meet UL10C Standard for Positive Pressure Fire Tests of Door Assemblies, and UBC 7-2, Fire Tests of Door Assemblies.

D. Sound-Rated Gasketing: Assemblies that are listed and labeled by a testing and inspecting agency, for sound ratings indicated, based on testing according to ASTM E 1408.

E. Replaceable Seal Strips: Provide only those units where resilient or flexible seal strips are easily replaceable and readily available from stocks maintained by manufacturer.

F. Acceptable Manufacturers:

1. Pemko Manufacturing (PE).
2. Reese Enterprises, Inc. (RS).
3. Zero International (ZE).
4. National Guard Products (NGP).

2.10 FABRICATION

A. Fasteners: Provide door hardware manufactured to comply with published templates generally prepared for machine, wood, and sheet metal screws. Provide screws according to manufacturers recognized installation standards for application intended.

2.11 FINISHES

A. Standard: Designations used in the Hardware Sets and elsewhere indicate hardware finishes complying with ANSI/BHMA A156.18, including coordination with traditional U.S. finishes indicated by certain manufacturers for their products.

B. Provide quality of finish, including thickness of plating or coating (if any), composition, hardness, and other qualities complying with manufacturer's standards, but in no case less than specified by referenced standards for the applicable units of hardware.

C. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine scheduled openings, with Installer present, for compliance with requirements for installation tolerances, labeled fire door assembly construction, wall and floor construction, and other conditions affecting performance.

B. Notify architect of any discrepancies or conflicts between the door schedule, door types, drawings and scheduled hardware. Proceed only after such discrepancies or conflicts have been resolved in writing.

3.2 PREPARATION

A. Hollow Metal Doors and Frames: Comply with ANSI/DHI A115 series.

3.3 INSTALLATION

A. Install each item of mechanical hardware and access control equipment to comply with manufacturer's written instructions and according to specifications.

1. Installers are to be trained and certified by the manufacturer on the proper installation and adjustment of fire, life safety, and security products including: hanging devices; locking devices; closing devices; and seals.

B. Mounting Heights: Mount door hardware units at heights indicated in following applicable publications, unless specifically indicated or required to comply with governing regulations:

1. Standard Steel Doors and Frames: DHI's "Recommended Locations for Architectural Hardware for Standard Steel Doors and Frames."
2. Where indicated to comply with accessibility requirements, comply with ANSI A117.1 "Accessibility Guidelines for Buildings and Facilities."

C. Retrofitting: Install door hardware to comply with manufacturer's published templates and 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 specified in Division 9 Sections. Do not install surface-mounted items until finishes have been completed on substrates involved.

D. Thresholds: Set thresholds for exterior and acoustical doors in full bed of sealant complying with requirements specified in Division 7 Section "Joint Sealants."

E. Storage: Provide a secure lock up for hardware delivered to the project but not yet installed. Control the handling and installation of hardware items so that the completion of the work will not be delayed by hardware losses before and after installation.

3.4 FIELD QUALITY CONTROL

A. Field Inspection: Supplier will perform a final inspection of installed door hardware and state in report whether work complies with or deviates from requirements, including whether door hardware is properly installed, operating and adjusted.

3.5 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.

3.6 CLEANING AND PROTECTION

A. Protect all hardware stored on construction site in a covered and dry place. Protect exposed hardware installed on doors during the construction phase. Install any and all hardware at the latest possible time frame.

B. Clean adjacent surfaces soiled by door hardware installation.

C. Clean operating items as necessary to restore proper finish. and provide final protection and maintain conditions that ensure door hardware is without damage or deterioration at time of owner occupancy.

3.7 DEMONSTRATION

A. Instruct Owner's maintenance personnel to adjust, operate, and maintain mechanical and electromechanical door hardware.

END OF SECTION 087100

DIVISION 08 – OPENINGS

SECTION 08 80 00 – GLAZING

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes glazing for the following products and applications, including those specified in other Sections where glazing requirements are specified by reference to this Section:
   1. Windows.
   2. Doors.
   3. Storefront framing (glass and spandrels)

B Related Sections:
   1. Section 08 11 14 – Steel Doors and Frames
   2. Section 08 41 00 – Aluminum Entrances and Storefronts
   3. Section 08 51 00 – Aluminum Windows

1.2 PERFORMANCE REQUIREMENTS

A. Delegated Design: Design glass, including comprehensive engineering analysis according to ASTM E by a qualified professional engineer, using the following design criteria:
   1. Design Wind Pressures: As indicated on Drawings.
   2. Vertical Glazing: For glass surfaces sloped 15 degrees or less from vertical, design glass to resist design wind pressure based on glass type factors for short-duration load.
   3. Differential Shading: Design glass to resist thermal stresses induced by differential shading within individual glass lites.

1.3 PRECONSTRUCTION TESTING

A. Preconstruction Adhesion and Compatibility Testing: Test each glazing material type, tape sealant, gasket, glazing accessory, and glass-framing member for adhesion to and compatibility with elastomeric glazing sealants.
   1. Testing will not be required if data are submitted based on previous testing of current sealant products and glazing materials matching those submitted.

1.4 ACTION SUBMITTALS

A. Product Data: For each glass product and glazing material indicated.

B. Glass Samples: For each type of glass product; 12 inches (300 mm) square.

C. Glazing Schedule: List glass types and thicknesses for each size opening and location. Use same designations indicated on Drawings.

1.5 QUALITY ASSURANCE

Paragraph below is defined in Division 1 Section "Submittal Procedures" as a "Delegated-Design Submittal." Retain if Work of this Section is required to withstand specific design loads and design responsibilities have been delegated to Contractor or if structural data are required as another way to verify compliance with performance requirements. Professional engineer qualifications are specified in Division 1 Section "Quality Requirements."

A. Glazing Publications: Comply with published recommendations of glass product manufacturers and organizations below, unless more stringent requirements are indicated. Refer to these publications for glazing terms not otherwise defined in this Section or in referenced standards.
   1. GANA Publications: GANA's "Laminated Glazing Reference Manual" and GANA's "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 labeling 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. Fire-Protection-Rated Glazing Labeling: Permanently mark fire-protection-rated glazing with certification label of a testing agency acceptable to authorities having jurisdiction. Label shall indicate manufacturer's name, test standard, whether glazing is for use in fire doors or other openings, whether or not glazing passes hose-stream test, whether or not glazing has a temperature rise rating of 450 deg F (250 deg C), and the fire-resistance rating in minutes.

D. Insulating-Glass Certification Program: Permanently marked either on spacers or on at least one component lite of units with appropriate certification label of IGCC.

E. Detention Door Glazing: Label shall indicate manufacturer's name, type of glass, thickness, and entry/ballistic performance standard with which glass complies.

1.6 WARRANTY

A. Manufacturer's Special Warranty on Insulating Glass: Manufacturer's standard form in which 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.

B. Manufacturer's Special Warranty on Laminated Glass: Manufacturer's standard form in which 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.

PART 2 - PRODUCTS

2.1 GLASS PRODUCTS, GENERAL

A. Thickness: Where glass thickness is indicated, it is a minimum. Provide glass lites in thicknesses as needed to comply with requirements indicated.

B. Strength: Where float glass is indicated, provide annealed float glass, Kind HS heat-treated float glass, or Kind FT heat-treated float glass as needed to comply with "Performance Requirements" Article. Where heat-strengthened glass is indicated, provide Kind HS heat-treated float glass or Kind FT heat-treated float glass[as needed to comply with "Performance Requirements" Article. Where fully tempered glass is indicated, provide Kind FT heat-treated float glass.

C. Windborne-Debris-Impact Resistance: Provide exterior glazing that passes protection testing requirements in ASTM E 1996 for Wind Zones as indicated by drawings and wind analysis when tested according to ASTM E 1886. Test specimens shall be no smaller in width and length than glazing indicated for use on the Project and shall be installed in same manner as glazing indicated for use on the Project.
1. Large-Missile Test: For glazing located within 30 feet (9.1 m) of grade.
2. Small-Missile Test: For glazing located more than 30 feet (9.1 m) above grade.

D. 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. 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).
2. 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.
3. Visible Reflectance: Center-of-glazing values, according to NFRC 300.

2.2 GLASS PRODUCTS

A. Float Glass: ASTM C 1036, Type I, Quality-Q3, Class I, complying with other requirements specified and with visible light transmission not less than 91 percent.
1. Products: Subject to compliance with requirements, provide one of the following:
a. Pilkington North America
b. PPG Industries, Inc.

B. Heat-Treated Float Glass: ASTM C 1048; Type I; Quality-Q3; Class I (clear) unless otherwise indicated; of kind and condition indicated for code required safety glazing.

2.3 INSULATING GLASS

A. Manufacturers: Basis of Design: PPG – Solarban 60, clear, or comparable products by approved manufacture.

B. Insulating-Glass Units: Factory-assembled units consisting of sealed lites of glass separated by a dehydrated interspace, qualified according to ASTM E 2190, and complying with other requirements specified.
1. Sealing System: Dual seal.
2. Spacer: Manufacturer's standard spacer material and construction Aluminum with mill or clear anodic finish.

2.4 FIRE-PROTECTION-RATED GLAZING

A. Fire-Protection-Rated Glazing, General: Listed and labeled by a testing agency acceptable to authorities having jurisdiction, for fire-protection ratings indicated, based on testing according to NFPA 252 for door assemblies and NFPA 257 for window assemblies.

B. Laminated Glass with Intumescent Interlayers: Laminated glass made from multiple plies of uncoated, clear float glass; with intumescent interlayers; complying with testing requirements in 16 CFR 1201 for Category II materials.
   1. Products: Subject to compliance with requirements, provide one of the following or equal:
      a. InterEdge, Inc., a subsidiary of AFG Industries, Inc.; Pyrobel.
      b. Pilkington Group Limited (distributed by Technical Glass Products); PyroStop

2.6 INSULATED MEATAL SPANDREL GLAZING PANELS

A. Panels shall consist of metal laminated to stabilizer substrates with an insulating core material. Panels are designed to be glazed into a window system.

B. Panels are to be 1” nominal thickness.
   1. Face: .032 aluminum. (smooth)
   2. Finish: as selected from manufacturer’s standard colors
   3. Substrate: 1/8” hardboard.
   4. Core: Isocyanurate foam board.
   5. Back: .032 aluminum. (smooth)

C. Exposed aluminum surfaces: All exposed surfaces, face and back, of insulated metal panels shall be finished with Polyvinyl-fluoride system meeting “Kynar 500”, Duranar Fluoropolymer or equal manufacturer’s standard 2-coat thermo-cured system. Dry film thickness not less than 1.5 mils,and conforming to AAMA 605.2. Color shall be selected from manufacturer’s standard colors.

D. Products: Subject to compliance with requirements, provide one of the following or equal:
   1. Columbia Architectural Products, Inc., Beltsville Maryland 20705 (301-937-4383).
   2. AlumFab Metal, Burnsville,MN 55337.
   3. Mapes Panels, LLC, Lincoln, NE 68504

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2.7 GLAZING GASKETS

A. Dense Compression Gaskets: Molded or extruded gaskets of profile and hardness required to maintain watertight seal, made from one of the following:
   1. Neoprene complying with ASTM C 864.
   2. EPDM complying with ASTM C 864.
   3. Silicone complying with ASTM C 1115.
   4. Thermoplastic polyolefin rubber complying with ASTM C 1115.

B. Soft Compression Gaskets: Extruded or molded, closed-cell, integral-skinned neoprene thermoplastic polyolefin rubber gaskets complying with ASTM C 509, Type II, black; of profile and hardness required to maintain watertight seal.
   1. Application: Use where soft compression gaskets will be compressed by inserting dense compression gaskets on opposite side of glazing or pressure applied by means of pressure-glazing stops on opposite side of glazing.

2.8 GLAZING SEALANTS

A. General:
   1. Compatibility: Provide glazing sealants that are compatible with one another and with other materials they will contact, including glass products, seals of insulating-glass units, and glazing channel substrates, under conditions of service and application, as demonstrated by sealant manufacturer based on testing and field experience.
   2. Suitability: Comply with sealant and glass manufacturers' written instructions for selecting glazing sealants suitable for applications indicated and for conditions existing at time of installation.

3. Sealants used inside the weatherproofing system, shall have a VOC content of not more than 250 g/L when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
4. Sealants used inside the weatherproofing system shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
5. 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.

C. Glazing Sealant: Neutral-curing silicone glazing sealant complying with ASTM C 920, Type S, Grade NS, Class 25, Use NT.

D. Glazing Sealants for Fire-Rated Glazing Products: Products that are approved by testing agencies that listed and labeled fire-resistant glazing products with which they are used for applications and fire-protection ratings indicated.

2.9 GLAZING TAPES

A. Back-Bedding Mastic Glazing Tapes: Preformed, butyl-based, 100 percent solids elastomeric tape; nonstaining and nonmigrating in contact with nonporous surfaces; with or without spacer rod as recommended in writing by tape and glass manufacturers for application indicated; and complying with ASTM C 1281 and AAMA 800 for products indicated below:
1. AAMA 804.3 tape, where indicated.
2. AAMA 806.3 tape, for glazing applications in which tape is subject to continuous pressure.
3. AAMA 807.3 tape, for glazing applications in which tape is not subject to continuous pressure.

B. Expanded Cellular Glazing Tapes: Closed-cell, PVC foam tapes; factory coated with adhesive on both surfaces; and complying with AAMA 800 for the following types:
1. AAMA 810.1, Type 1, for glazing applications in which tape acts as the primary sealant.
2. AAMA 810.1, Type 2, for glazing applications in which tape is used in combination with a full bead of liquid sealant.

2.10 MISCELLANEOUS GLAZING MATERIALS

A. Cleaners, Primers, and Sealers: Types recommended by sealant or gasket manufacturer.

B. Setting Blocks: Elastomeric material with a Shore, Type A durometer hardness of 85, plus or minus 5.

C. Spacers: Elastomeric blocks or continuous extrusions of hardness required by glass manufacturer to maintain glass lites in place for installation indicated.

D. Edge Blocks: Elastomeric material of hardness needed to limit glass lateral movement (side walking).

E. 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.

F. Perimeter Insulation for Fire-Resistive Glazing: Product that is approved by testing agency that listed and labeled fire-resistant glazing product with which it is used for application and fire-protection rating indicated.

2.11 GLASS TYPES

A. GLASS TYPE GL-1: CLEAR TEMPERED INSULATED GLASS
(Low E-coated clear insulating glass.)
1. Overall Unit Thickness: 1 inch (25 mm).
2. Thickness of Outer Glass Lite: 1/4" (6.0 mm).
3. Outdoor Lite: Fully tempered Float Glass.
4. Interspace Content: Air.
5. Indoor Lite: Fully tempered Float Glass.
6. Low-E Coating: Pyrolytic on third surface.

B. GLASS TYPE GL-2; OPAQUE TEMPERED INSULATED GLASS
1. Overall Unit Thickness: 1 inch (25 mm).
2. Thickness of Outer Glass Lite: 1/4" (6.0 mm).
3. Outdoor Lite: Fully tempered Float Glass.
4. Interspace Content: Air.
5. Indoor Lite: Fully tempered Float Glass.
6. Low-E Coating: Pyrolytic on third surface.

C. GLASS TYPE GL-3: METAL SPANDREL PANEL
(Insulated core metal panel)
1. Thickness 1- inch (25 mm).
2. Provide warranty – Panel two (2) years; Paint finish twenty (20) years.

PART 3 - EXECUTION

3.1 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. Adjust glazing channel dimensions as required by Project conditions during installation to provide necessary bite on glass, minimum edge and face clearances, and adequate sealant thicknesses, with reasonable tolerances.

C. Protect glass edges from damage during handling and installation. Remove damaged glass from Project site and legally dispose of off Project site. Damaged glass is glass with edge damage or other imperfections that, when installed, could weaken glass and impair performance and appearance.

D. Apply primers to joint surfaces where required for adhesion of sealants, as determined by preconstruction testing.

E. Install setting blocks in sill rabbets, sized and located to comply with referenced glazing publications, unless otherwise required by glass manufacturer. Set blocks in thin course of compatible sealant suitable for heel bead.

F. Do not exceed edge pressures stipulated by glass manufacturers for installing glass lites.

G. Provide spacers for glass lites where length plus width is larger than 50 inches (1270 mm).

H. Provide edge blocking where indicated or needed to prevent glass lites from moving sideways in glazing channel, as recommended in writing by glass manufacturer and according to requirements in referenced glazing publications.

3.2 TAPE GLAZING

A. Position tapes on fixed stops so that, when compressed by glass, their exposed edges are flush with or protrude slightly above sightline of stops.

B. Install tapes continuously, but not necessarily in one continuous length. Do not stretch tapes to make them fit opening.

C. Cover vertical framing joints by applying tapes to heads and sills first and then to jambs. Cover horizontal framing joints by applying tapes to jambs and then to heads and sills.

D. Place joints in tapes at corners of opening with adjoining lengths butted together, not lapped. Seal joints in tapes with compatible sealant approved by tape manufacturer.

E. Apply heel bead of elastomeric sealant.

F. Center glass lites in openings on setting blocks and press firmly against tape by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings.

G. Apply cap bead of elastomeric sealant over exposed edge of tape.

3.2 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.

3.3 SEALANT GLAZING (WET)

A. Install continuous spacers, or spacers combined with cylindrical sealant backing, between glass lites and glazing stops to maintain glass face clearances and to prevent sealant from extruding

into glass channel and blocking weep systems until sealants cure. Secure spacers or spacers and backings in place and in position to control depth of installed sealant relative to edge clearance for optimum sealant performance.

B. Force sealants into glazing channels to eliminate voids and to ensure complete wetting or bond of sealant to glass and channel surfaces.

C. Tool exposed surfaces of sealants to provide a substantial wash away from glass.

3.4 CLEANING AND PROTECTION

A. Protect exterior glass from damage immediately after installation by attaching crossed streamers to framing held away from glass. Do not apply markers to glass surface. Remove nonpermanent labels and clean surfaces.

B. Protect glass from contact with contaminating substances resulting from construction operations. If, despite such protection, contaminating substances do come into contact with glass, remove substances immediately as recommended in writing by glass manufacturer.

C. Examine glass surfaces adjacent to or below exterior concrete and other masonry surfaces at frequent intervals during construction, but not less than once a month, for buildup of dirt, scum, alkaline deposits, or stains; remove as recommended in writing by glass manufacturer.

D. Remove and replace glass that is broken, chipped, cracked, or abraded or that is damaged from natural causes, accidents, and vandalism, during construction period.

END OF SECTION 08 80 00

DIVISION 09 – FINISHES

SECTION 09 29 00 – GYPSUM BOARD

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Interior gypsum board.
   2. Tile backing panels.
   3. Sound attenuation blankets
   4. Acoustic joint sealants

B. Related Sections:
   1. Section 09 91 00 - Painting

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.
B. Samples: For each type of product.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Fire-Resistance-Rated Assemblies: For fire-resistance-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E 119 by an independent testing agency.
B. STC-Rated Assemblies: For STC-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E 90 and classified according to ASTM E 413 by an independent testing agency.
C. Low Emitting Materials: For ceiling and wall assemblies, provide materials and construction identical to those tested in assembly and complying with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

2.2 INTERIOR GYPSUM BOARD

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Georgia-Pacific Gypsum LLC.
   2. National Gypsum Company.
   3. USG Corporation.

B. Gypsum Wallboard: ASTM C 1396/C 1396M.
   1. Thickness: 1/2 inch or 5/8 inch, as indicated on Drawings.
   2. Long Edges: Tapered.

C. Gypsum Board, Type X: ASTM C 1396/C 1396M.
   1. Thickness: 1/2 inch or 5/8 inch, as indicated on Drawings.
   2. Long Edges: Tapered.

D. Gypsum Ceiling Board: ASTM C 1396/C 1396M.

1. Thickness: 1/2 inch (12.7 mm).
2. Long Edges: Tapered.

E. Moisture- and Mold-Resistant Gypsum Board: ASTM C 1396/C 1396M. With moisture- and mold-resistant core and paper surfaces.
1. Core: As indicated.
2. Long Edges: Tapered.
3. Mold Resistance: ASTM D 3273, score of 10.

2.3 SPECIALTY GYPSUM BOARD

A. Gypsum Board, Type C: ASTM C 1396/C 1396M. Manufactured to have increased fire-resistive capability.
1. Products: Subject to compliance with requirements, provide one of the following:
a. Georgia-Pacific Gypsum LLC; Fireguard C.
b. National Gypsum Company.
c. USG Corporation; Firecode C Core.
2. Thickness: As required by fire-resistance-rated assembly indicated on Drawings.
3. Long Edges: Tapered.

2.4 TILE BACKING PANELS

A. Glass-Mat, Water-Resistant Backing Board: ASTM C 1178/C 1178M, with manufacturer's standard edges.
1. Products: Subject to compliance with requirements, provide one of the following:
a. CertainTeed Corp.; GlasRoc Tile Backer.
b. Georgia-Pacific Gypsum LLC; DensShield Tile Backer.
c. USG Corporation
2. Core: As indicated on Drawings.
3. Mold Resistance: ASTM D 3273, score of 10.

B. Cementitious Backer Units: ANSI A118.9 and ASTM C 1288 or 1325, with manufacturer's standard edges.
1. Products: Subject to compliance with requirements, provide one the following:
a. James Hardie Building Products, Inc.; Hardiebacker or Hardiebacker 500.
b. National Gypsum Company, Permabase Cement Board.
c. USG Corporation; DUROCK Cement Board.
2. Thickness: As indicated.
3. Mold Resistance: ASTM D 3273, score of 10.

C. Water-Resistant Gypsum Backing Board: ASTM C 1396/C 1396M, with manufacturer's standard edges.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. Georgia-Pacific Gypsum LLC.
b. USG Corporation.
c. National Gypsum Company.

2.5 ACCESSORIES

A. Interior Trim: ASTM C 1047.
1. Material: Galvanized or aluminum-coated steel sheet or rolled zinc.
B. Exterior Trim: ASTM C 1047.
1. Material: Hot-dip galvanized steel sheet, plastic, or rolled zinc.
C. Aluminum Trim: ASTM B 221 (ASTM B 221M), Alloy 6063-T5.

2.6 JOINT TREATMENT MATERIALS

A. General: Comply with ASTM C 475/C 475M.

B. Joint Tape:
1. Interior Gypsum Board: Paper.
2. Exterior Gypsum Soffit Board: Paper.
3. Glass-Mat Gypsum Sheathing Board: 10-by-10 glass mesh.
4. Tile Backing Panels: As recommended by panel manufacturer.

C. Joint Compound for Interior Gypsum Board: For each coat use formulation that is compatible with other compounds applied on previous or for successive coats.

2.7 AUXILIARY MATERIALS

A. Laminating Adhesive: Adhesive or joint compound recommended for directly adhering gypsum panels to continuous substrate.
1. Laminating adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
2. Laminating adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

B. Stainless Steel Drill Screws: ASTM C 1002, unless otherwise indicated.

C. Sound Attenuation Blankets: ASTM C 665, Type I (blankets without membrane facing) mineral wool 2.5 pcf density, in 3” and 5” thickness for installation in stud partition cavities. Fiberglass batt insulation is not acceptable. At fire resistance-rated assemblies comply with the mineral fiber requirements of assembly. All sound blanket material shall be formaldehyde free.

D. Acoustical Joint Sealant: ASTM C 834. Product effectively reduces airborne sound transmission through perimeter joints and openings as demonstrated by testing according to ASTM E 90.
1. Products: Subject to compliance with requirements, provide one of the following:
a. Pecora Corporation; AC-20 FTR or AIS-919.
b. Specified Technologies, Inc.; Smoke N Sound Acoustical Sealant.
c. USG Corporation; SHEETROCK Acoustical Sealant.
2. Acoustical joint sealant shall have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
3. Acoustical joint sealant shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

PART 3 - EXECUTION

3.1 APPLYING AND FINISHING PANELS

A. Examine panels before installation. Reject panels that are wet, moisture damaged, and mold damaged.

B. Isolate perimeter of gypsum board applied to non-load-bearing partitions at structural abutments, except floors. Provide 1/4- to 1/2-inch- (6.4- to 12.7-mm-) wide spaces at these locations and trim edges with edge trim where edges of panels are exposed. Seal joints between edges and abutting structural surfaces with acoustical sealant.

C. Install 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.
   1. Aluminum Trim: Install in locations as indicated on Drawings.
   2. Control Joints: Install control joints according to ASTM C 840 and in specific locations approved by Architect for visual effect.

D. Prefill open joints, rounded or beveled edges, and damaged surface areas.

E. Contractor to provide diagonal bracing if area is more than 6’ deep in either direction. Stainless steel fasteners to be spaced at a minimum of 8” oc and a minimum of two per attachment point.

F. Apply joint tape over gypsum board joints, except for trim products specifically indicated as not intended to receive tape.

G. Gypsum Board Finish Levels: Finish panels to levels indicated below and according to ASTM C 840:
   1. Level 1: Concealed spaces, ceiling plenum areas, and where indicated.
   2. Level 2: Panels that are substrate for tile, panels that are substrate for acoustical tile and where indicated on Drawings.
   3. Level 4: Typical at panel surfaces that will be exposed to view unless otherwise indicated.
      a. Primer and its application to surfaces are specified in other Division 9 Sections.
   4. Level 5: Where indicated on Drawings.
      a. Primer and its application to surfaces are specified in other Division 9 Sections.

H. Protect adjacent surfaces from drywall compound and texture finishes and promptly remove from floors and other non-drywall surfaces. Repair surfaces stained, marred, or otherwise damaged during drywall application.

I. Remove and replace panels that are wet, moisture damaged, and mold damaged.

END OF SECTION 09 22 00

DIVISION 09 – FINISHES

SECTION 09 51 00 – ACOUSTICAL PANEL CEILINGS

PART 1 - GENERAL

1.1 SUMMARY

A. Acoustical panels and suspension systems for ceilings.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.
B. Samples: For each exposed product and for each color and texture specified.

1.3 INFORMATIONAL SUBMITTALS

A. Product test reports.
B. Evaluation reports.
C. Field quality-control reports.

1.4 CLOSEOUT SUBMITTALS

A. Maintenance data.

1.5 QUALITY ASSURANCE

A. Testing Agency Qualifications: Qualified according to NVLAP.

1.6 EXTRA STOCK

A. After completion of work, deliver to the site not less than 5 percent of each installed materials

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Seismic Performance: Acoustical ceiling shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
B. 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: Comply with ASTM E 1264.
   2. Smoke-Developed Index: 50 or less.

2.2 ACOUSTICAL PANEL CEILINGS, GENERAL

A. Low-Emitting Materials: Acoustical panel ceilings shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
B. Glass-Fiber-Based Panels: Made with binder containing no urea formaldehyde.
C. Acoustical Panel Standard: Comply with ASTM E 1264.
D. Metal Suspension System Standard: Comply with ASTM C 635.

E. Attachment Devices: Size for five times the design load indicated in ASTM C 635, Table 1, "Direct Hung," unless otherwise indicated. Comply with seismic design requirements.

2.3 ACOUSTICAL PANELS TYPES

A. Basis-of-Design Product: Subject to compliance with requirements, provide Armstrong Corporation or comparable product by one of the following:
   1. CertainTeed Corporation.
   2. USG Corporation.

B. Type -1, Basis-of-Design Product: Armstrong, Cortega, Item # 824.
   1. Color: White.
   2. Edge/Joint Detail: Square lay-in..
   3. Thickness: 5/8 inch.
   4. Modular Size: 24 by 24 inches.

2.4 METAL SUSPENSION SYSTEM

A. Basis-of-Design Product: Subject to compliance with requirements, provide Donn DX/DXL140, 15/16 inch grid profile, or comparable product by one of the following:
   1. Armstrong Corporation.
   2. Chicago Metallic Corporation.

B. Narrow-Face, Capped, Double-Web, Steel Suspension System: Main and cross runners roll formed from cold-rolled steel sheet; prepainted, electrolytically zinc coated, or hot-dip galvanized according to ASTM A 653/A 653M, not less than G30 (Z90) coating designation; with prefinished 15/16-inch wide metal caps on flanges.
   1. Structural Classification: Intermediate-duty system.
   2. End Condition of Cross Runners: Override (stepped) type.
   3. Face Design: Flanges formed with an integral center reveal.
   4. Cap Material/Color Cold-rolled sheet.Flat White 050.

C. Roll-Formed, Sheet-Metal Edge Moldings and Trim: Type and profile indicated or, if not indicated, manufacturer's standard moldings for edges and penetrations that comply with seismic design requirements; formed from sheet metal of same material, finish, and color as that used for exposed flanges of suspension-system runners.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install acoustical panel ceilings to comply with ASTM C 636/C 636M and seismic design requirements indicated, according to manufacturer's written instructions and CISCA's "Ceiling Systems Handbook."

B. Measure each ceiling area and establish layout of acoustical panels to balance border widths at opposite edges of each ceiling. Avoid using less-than-half-width panels at borders, and comply with layout shown on reflected ceiling plans.
   1. Arrange directionally patterned acoustical panels as indicated on reflected ceiling plans.

C. Provide panel hold-down clips at Lobby/Vestibule areas.

END OF SECTION 09 51 00

DIVISION 09 – FINISHES

SECTION 09 65 19 - RESILIENT FLOORING AND ACCESSORIES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
1. Vinyl composition floor tile.
2. Resilient cove and straight base.
3. Resilient molding accessories

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings: Layout of floor tile where room floor pattern is indicated.

C. Samples: Full-size units of each color and pattern of floor tile required.

1.3 CLOSEOUT SUBMITTALS

A. Maintenance data.

1.4 PROJECT CONDITIONS

A. Maintain ambient temperatures within range recommended by manufacturer in spaces to receive floor tile.

B. Until Substantial Completion, maintain ambient temperatures within range recommended by manufacturer.

C. Close spaces to traffic during floor tile installation.

D. Close spaces to traffic for 48 hours after floor tile installation.

E. Install floor tile after other finishing operations, including painting, have been completed.

1.5 EXTRA STOCK

A. After completion of work, deliver to the site not less than 5 percent of each installed materials.

PART 2 - PRODUCTS

2.1 VINYL COMPOSITION FLOOR TILE

A. Products: Subject to compliance with requirements, provide one of the following:
1. Armstrong World Industries, Inc.; Standard Excelon.
2. Congoleum Corporation; Dura Ceramic Dimensions, Elite.
3. Johnsonite Tarkett Group Inc.; Azrock TexTile.

B. Tile Standard: ASTM F 1066, Class 1, solid-color tile.

C. Wearing Surface: Smooth.

D. Thickness: 1/8 inch (3.2 mm).

E. Size: 12 by 12 inches (305 by 610 mm).

F. Colors and Patterns: As selected by Architect from full range of standard colors.

2.2 RESILIENT BASE

A. Products: Subject to compliance with requirements, provide one of the following:
1. Johnsonite.
2. Musson Rubber Co..
3. Roppe Corporation.

B. Wall base: Rubber base complying with FS SS-W-40, Type I, with matching endstops and preformed or molded corner units.

C. Thickness: 0.125 inch (3.2 mm). Height: 4” (101.6 mm).

D. Style: Standard cove for all resilient flooring and straight base for carpet, unless otherwise indicated.

E. Colors and Patterns: As selected by Architect from full range of industry colors.

2.3 RESILIENT MOLDING ACCESSORY

A. Description: Nosing for resilient floor covering, reducer strip for resilient floor covering, joiner for tile and carpet and transition strips.

B. Material: Rubber.

C. Profile and Dimensions: As required.

2.4 INSTALLATION MATERIALS

A. Trowelable Leveling and Patching Compounds: Latex-modified, portland cement based or blended hydraulic-cement-based formulation provided or approved by manufacturer for applications indicated.

B. Adhesives: Water-resistant type recommended by manufacturer to suit floor tile and substrate conditions indicated.

   a. VCT and Asphalt Tile Adhesives: Not more than 50 g/L.
   b. Rubber Floor Adhesives: Not more than 60 g/L.

C. Floor Polish: Provide protective liquid floor polish products as recommended by manufacturer.

PART 3 - EXECUTION

3.1 PREPARATION

A. Prepare substrates according to manufacturer's written instructions to ensure adhesion of resilient products.

B. Concrete Substrates: Prepare according to ASTM F 710.

   1. Verify that substrates are dry and free of curing compounds, sealers, and hardeners.
   2. Remove substrate coatings and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, using mechanical methods recommended by manufacturer. Do not use solvents.
   3. Alkalinity and Adhesion Testing: Perform tests recommended by manufacturer. Proceed with installation only after substrates pass testing.
   4. Moisture Testing: Perform tests recommended by floor covering manufacturer. Proceed with installation only after substrates pass testing.

C. Fill cracks, holes, and depressions in substrates with trowelable leveling and patching compound and remove bumps and ridges to produce a uniform and smooth substrate.

D. Do not install floor tiles until they are same temperature as space where they are to be installed.

E. Sweep and vacuum clean substrates to be covered by resilient products immediately before installation.

3.2 FLOOR TILE INSTALLATION

A. Comply with manufacturer's written instructions for installing floor tile.

B. Lay out floor tiles from center marks established with principal walls, discounting minor offsets, so tiles at opposite edges of room are of equal width. Adjust as necessary to avoid using cut widths that equal less than one-half tile at perimeter.
   1. Lay tiles square with room axis.

C. Match floor tiles for color and pattern by selecting tiles from cartons in the same sequence as manufactured and packaged, if so numbered. Discard broken, cracked, chipped, or deformed tiles.
   1. Lay tiles in pattern of colors and sizes indicated.

D. Scribe, cut, and fit floor tiles to butt neatly and tightly to vertical surfaces and permanent fixtures including built-in furniture, cabinets, pipes, outlets, and door frames.

E. Extend floor tiles into toe spaces, door reveals, closets, and similar openings. Extend floor tiles to center of door openings.

F. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on floor tiles as marked on substrates. Use chalk or other nonpermanent, nonstaining marking device.

G. Adhere floor tiles to flooring substrates using a full spread of adhesive applied to substrate to produce a completed installation without open cracks, voids, raising and puckering at joints, telegraphing of adhesive spreader marks, and other surface imperfections.

3.3 CLEANING AND PROTECTION

A. Comply with manufacturer's written instructions for cleaning and protection of floor tile.

1. Floor Polish: Remove soil, visible adhesive, and surface blemishes from floor tile surfaces before applying liquid floor polish. Apply two coats.

B. Cover floor tile until Substantial Completion.

END OF SECTION 09 65 19

DIVISION 09 – FINISHES

SECTION 09 91 00 – PAINTING

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes surface preparation and the application of paint systems on the following substrates:

B. Exterior:
1. Concrete.
2. Concrete masonry units (CMU).
3. Steel.
4. Galvanized metal.
5. Existing painted precast fascia panels.

C. Interior:
1. Concrete.
2. Concrete masonry units (CMU).
3. Steel.
4. Cast iron.
5. Galvanized metal.
6. Wood.
7. Gypsum board.

1.2 DEFINITIONS

A. Gloss Level: According to ASTM D 523.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product. Include preparation requirements and application instructions.
B. Samples: For each type of paint system and each color and gloss of topcoat.
C. Product List: For each product indicated. Include printout of current "MPI Approved Products List" for each product category specified, with the proposed product highlighted.

1.4 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
1. Paint: 2 gallons of each material and color applied.

1.5 QUALITY ASSURANCE

A. Mockups: Apply mockups of each paint system indicated and each color and finish selected to verify preliminary selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
1. Architect will select one surface to represent surfaces and conditions for application of each paint system specified in Part 3.
2. Final approval of color selections will be based on mockups.
a. If preliminary color selections are not approved, apply additional mockups of additional colors selected by Architect at no added cost to Owner.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Products: Subject to compliance with requirements, provide products as indicated on the drawings and as scheduled. Refer to Part 3 articles for the paint category schedule.

2.2 PAINT, GENERAL

A. MPI Standards: Provide products that comply with named products or MPI standards indicated and that are listed in its "MPI Approved Products List."
B. Material Compatibility:
   1. Provide materials for use within each paint system that are compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
   2. For each coat in a paint system, provide products recommended in writing by manufacturers of topcoat for use in paint system and on substrate indicated.
C. VOC Content: Provide materials that comply with VOC limits of authorities having jurisdiction.
D. Colors: As selected by Architect from manufacturer’s full range.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.
B. Maximum Moisture Content of Substrates: When measured with an electronic moisture meter as follows:
   1. Concrete: 12 percent.
   2. Masonry (Clay and CMU): 12 percent.
   3. Wood: 15 percent.
   4. Gypsum Board: 12 percent.
C. Verify suitability of substrates, including surface conditions and compatibility with existing finishes and primers.
D. Proceed with coating application only after unsatisfactory conditions have been corrected. Application of coating indicates acceptance of surfaces and conditions.

3.2 PREPARATION

A. Comply with manufacturer's written instructions and recommendations in "MPI Manual" applicable to substrates and paint systems indicated.

B. Remove hardware, covers, plates, and similar items already in place that are removable and are not to be painted. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and painting.
   1. After completing painting operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection if any.

C. Clean substrates of substances that could impair bond of paints, including dust, dirt, oil, grease, and incompatible paints and encapsulants. Remove incompatible primers and reprime substrate with compatible primers or apply tie coat as required to produce paint systems indicated.

3.3 APPLICATION

A. Apply paints according to manufacturer's written instructions and recommendations in "MPI Manual."
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.

3.4 CLEANING AND PROTECTION

A. Protect work of other trades against damage from paint application. Correct damage to work of other trades by cleaning, repairing, replacing, and refinishing, as approved by Architect, and leave in an undamaged condition.
B. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

3.5 EXTERIOR PAINTING SCHEDULE

A. Concrete Substrates, Nontraffic Surfaces:
1. Latex System:
a. Prime Coat: Latex, exterior, matching topcoat.
b. Prime Coat: Primer, alkali resistant, water based.
c. Intermediate Coat: Latex, exterior, matching topcoat.
d. Topcoat: Latex, exterior (Gloss Level 1 as scheduled), 2 coats.

B. CMU Substrates:
1. Latex System:
a. Prime Coat: Block filler, latex, interior/exterior.
b. Intermediate Coat: Latex, exterior, matching topcoat.
c. Topcoat: Latex, exterior (Gloss as scheduled), 2 coats.

C. Steel Substrates
1. Alkyd System:
a. Prime Coat: Primer, alkyd, anticorrosive for metal**,** MPI #79.
b. Prime Coat: Shop primer specified in Division 5 Section where substrate is specified.
c. Intermediate Coat: Exterior alkyd enamel matching topcoat.
d. Topcoat: Alkyd, exterior, (Gloss Level as scheduled), 2 coats.

D. Galvanized Metal Substrates
1. Alkyd System:
a. Prime Coat: Primer, galvanized metal, as recommended by topcoat manufacturer for exterior use on galvanized-metal substrates with topcoat indicated.
b. Intermediate Coat: Exterior alkyd enamel matching topcoat.
c. Topcoat: Alkyd, exterior, (Gloss Level as scheduled), 2 coats.

A. Cement Plaster/Stucco Substrates:
1. Latex System:
a. Prime Coat: Latex, exterior, matching topcoat.
b. Intermediate Coat: Latex, exterior, matching topcoat.
c. Topcoat: Latex, exterior, low sheen (Gloss Level 3-4), 2 coats.

3.6 INTERIOR PAINTING SCHEDULE

A. Concrete Substrates,

1. Latex System:
   a. Prime Coat: Primer, sealer, latex, interior.
   b. Prime Coat: Latex, interior, matching topcoat.
   c. Topcoat: Latex, interior, flat (Gloss Level as scheduled), 2 coats.

B. CMU Substrates:
1. Latex System:
   a. Block Filler: Block filler, latex, interior/exterior.
   b. Intermediate Coat: Latex, interior, matching topcoat.
   c. Topcoat: Latex, interior (Gloss Level as scheduled), 2 coats.

C. Steel Substrates:
1. Alkyd System:
   a. Prime Coat: Primer, alkyd, anti-corrosive, for metal.
   b. Prime Coat: Shop primer specified in Division 5 Section where substrate is specified.
   c. Intermediate Coat: Alkyd, interior, matching topcoat.
   d. Topcoat: Alkyd, interior (Gloss Level as scheduled), 2 coats.

D. Galvanized Metal Substrates:
1. Latex over Waterborne Primer System.
   a. Prime Coat: Primer, galvanized, water based.
   b. Intermediate Coat: Latex, interior matching topcoat.
   c. Topcoat: Latex, interior (Gloss Level as scheduled), 2 coats.

E. Wood Substrates:
1. Latex System:
   a. Prime Coat: Primer, latex, for interior wood.
   b. Intermediate Coat: Latex, interior, matching topcoat.
   c. Topcoat: latex, interior, (Gloss Level as scheduled), 2 coats.
2. Alkyd System:
   a. Prime Coat: Primer sealer, alkyd, interior.
   b. Intermediate Coat: Alkyd, interior, matching topcoat.
   c. Topcoat: Alkyd, interior (Gloss Level as scheduled), 2 coats.

F. Gypsum Board and Plaster Substrates:
1. Latex System:
   a. Prime Coat: Primer sealer, latex interior.
   b. Prime Coat: Latex, interior, matching topcoat.
   c. Intermediate Coat: Latex, interior, matching topcoat.
   d. Topcoat: Latex, interior (Gloss Level as scheduled), 2 coats.

END OF SECTION 09 91 00

SECTION 12 21 13 – ROLLER SHADES

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Sunscreen roller shades.

1.02 REFERENCES

A. ASTM G 21 - Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi.
B. NFPA 70 - National Electrical Code.
C. NFPA 701 - Fire Tests for Flame-Resistant Textiles and Films.
D. GREENGUARD - Indoor Air Quality Certified
E. GREENGUARD Children & Schools - Indoor Air Quality Certified

1.03 SUBMITTALS

A. Submit for approval samples, color selection choices, shop drawings, product data, mock-ups, warranty, and extra stock.

1.03 QUALITY ASSURANCE

A. Comply with governing codes and regulations. Provide products of acceptable manufacturers which have been in satisfactory use in similar service for three years. Use experienced installers. Deliver, handle, and store materials in accordance with manufacturer's instructions.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Basis of Design: Roller Shades and other components described in these Specifications shall be obtained from :
   1. Inpro Corporation
      580 W. 18766 Apollo Drive
      Muskego, WI 53150
B. Substitutions: Equal as approved by Architect as defined in Substitution Procedures or products of one of the following:
   1. Hunter Douglas
   2. Insolroll Corporation
   3. Lutron Electronics
C. Provide all roller shades from a single source.

2.02 ROLLER SHADE TYPE

A. Manually Operated Cordless Shades:
   1. Mounting: Inside or Outside (dependent on site conditions)
   2. Configuration: Single solar shade cloth.
   3. Fabric Type: Alkenz Shade Cloth, 3000HT, 3%
   4. Fabric Color: HT03-White/Light Grey

2.03 SHADE BAND

A. Shade Bands: Construction of shade band includes the fabric, the hem weight, hem-pocket, shade roller tube, and the attachment of the shade band to the roller tube. Sewn hems are not acceptable.
   1. Hem Pockets and Hem Weights: Fabric hem pocket with RF-welded seams and concealed hem weights. Hem weights shall be of appropriate size and weight for shade band. Hem weight shall be continuous inside the hem pocket. Hem pocket construction and hem weights shall be similar, for all shades within one room.
   2. Shade Band and Shade Roller Attachment:
      a. Use extruded aluminum shade roller tube of a diameter and wall thickness required to support shade fabric without excessive deflection. Roller tubes less than 1.55” (39.37 mm) in diameter for manual shades are not acceptable.
      b. Provide for neutral mechanical engagement with drive / brake mechanism.
      c. Provide for positive mechanical attachment of shade band to roller tube; shade band shall be made removable / replaceable with 0.625” x 0.3125” extruded ABS guide slats.

2.04 SHADE FABRICATION

A. Fabricate units to completely fill existing openings from head to sill and jamb-to-jamb, unless specifically indicated otherwise.
B. Fabricate shade cloth to hang flat without buckling or distortion. Fabricate with trimmed edges to hang straight without curling or raveling.
C. Fabricate units for manual operation without the use of cords or chains using an internal lift spring completely contained within the shade roller tube.
D. For railroaded shadebands, provide seams in railroaded multi-width shadebands as required to meet size requirements and in accordance with seam alignment as acceptable to Architect. Seams shall be properly located.

2.05 COMPONENTS

A. Access and Material Requirements:
   1. Provide shade hardware allowing for the removal of shade roller tube from brackets without removing hardware from opening and without requiring end or center supports to be removed.
   2. Use only PVC/ABS with UV inhibitors or Styrene based plastics for all plastic components of shade hardware.
B. Manually Operated, Cordless WebbGlide Hardware and Shade Brackets
   1. Shade Roller:
      a. Tube: Provide extruded aluminum alloy 6061 or 6063, 1.75” diameter with exterior 0.15” x 0.84” slot for attaching shade fabric using 0625” x .3125” extruded ABS guide slats to provide horizontal adjustment of shade fabric while preventing removal of fabric after installation.
      b. Lift Mechanism: Inner lift spring shall be constructed of .058” blue spring steel. Drive pins shall be heat-treated 1” x .024” steel.
   2. Bottom Rail:
      a. Provide Bottom rail of proper size and weight to properly balance lifting mechanism. Bottom rail shall be 0.625” OD. steel tube, lightweight and corrosion resistant. It shall be applied to shade inside a bar-welded (radio-wave molecular bond) self-fabric pocket sized so the bottom rail shall slide smoothly and snugly inside. 0.375” OD. steel rod shall be inserted into the tube acting as weight. When side tracks are used, injection-molded thermoplastic guide tips shall be attached at each end with stainless steel compression springs and aluminum rivets, and shall fit easily in side tracks to provide braking system for shade.
   3. Bracket Plates:

a. Provide mounting bracket plates constructed of 18 gauge galvanized steel with embossed drive pin slots, and 0.25” x 0.562” nylon bushing inserts pressed into each idler pin aperture. Shall be corrosion resistant and will not buckle, bend or break under the shear forces created by the roller tension, shade material, or normal operation.
    i. When fabric valance is, each bracket shall have a lip for attachment.

4. Privacy Track (when used)
    a. Provide vertical guide tracks extruded from PVC with UV inhibiting colorant, 1” x 1” with flanges on both sides to maintain privacy and reduce light leaks. Tracks shall be attached using double-coated foam adhesive PSA tape.

PART 3 – EXECUTION

3.01.1 EXAMINATION

A. Do not begin installation until substrates have been properly prepared
B. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

3.02 PREPERATION

A. Clean surfaces thoroughly prior to installation.
B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

3.03.1 INSTALLATION

A. Install roller shades level, plumb, square, and true according to manufacturer’s written instructions, and located so shade band is not closer than 0.75” to interior face of glass. Allow proper clearances for window operation hardware.
B. Adjust and balance roller shades to operate smoothly, easily, safely, and free from binding or malfunction throughout entire operational range.
C. Clean roller shade surfaces after installation, according to manufacturer’s written instructions.
D. Engage Installer to train Owner’s maintenance personnel to adjust, operate and maintain roller shade systems.

3.03.2 PROTECTION

A. Protect installed products until completion of project.
B. Touch-up, repair or replace damaged products before Substantial Completion.

END OF SECTION

ONTENTS

DIVISION 21 - FIRE SUPPRESSION
DIVISION 22 - PLUMBING
DIVISION 23 - HEATING, VENTILATING, AND AIR CONDITIONING (HVAC)

DIVISION 22 - PLUMBING

SECTION 22 05 00 - STANDARD CONDITIONS FOR PLUMBING

PART 1 - GENERAL

1.01 REFERENCE

A. Requirements established within the portions of this project manual titled Division 1, General Requirements are collectively applicable to the work of this section.
B. Instructions to Bidders, Special Conditions and addenda as issued are part of this specification.
C. Plumbing drawings along with all other project drawings and specifications represent the work of this section.
D. Drawings, Contract, General Conditions and Supplementary Conditions form a part of this section, by reference thereto and shall have the same force and effect as if printed herewith in full. Failure to review these sections shall not relieve the Contractor of his responsibility to fully comply with the terms therein.

1.02 SCOPE

A. Provide labor, material, equipment, and supervision necessary to install complete operating plumbing systems as indicated on the drawings and specified herein, including all work at the site and within the proposed construction areas to accomplish the required work.
B. It shall be the contractor’s responsibility to coordinate his work and the work of his subcontractors to insure that all the work is covered. He shall designate who is responsible for various portions of work which may overlap so that there is complete coverage of all required work. It is the position of the owner and the A/E that all work is the responsibility of the mechanical contractor within this division of the work.
C. All work shown on the drawings and not expressly mentioned in the specifications and all work specified but not shown on the drawings, but necessary for the proper execution of same shall be performed by the contractor. It is not the intent of the drawings and specifications to describe every feature and detail of the work.
D. No additions to the contract amount will be approved for any materials, equipment, or labor to perform additional work unless it can be clearly shown to be beyond the scope and intent of the drawings and specifications.
E. Plumbing contractor's scope of work shall include but not be limited to the following:
    1. Fuel gas piping.
    2. Demolition of existing work to accommodate new work.
    3. Repair existing areas affected by new construction. Patch, repair, and finish to match existing.
    4. Fire stopping of penetrations. (See Section 22 05 50).

1.03 REGULATIONS, CODES, AND STANDARDS

A. Work shall be performed in accordance with the latest adopted codes, amendments, regulations, and ordinances of the authorities having jurisdiction. Observe all safety regulations including the

requirements of OSHA.

B. Obtain and pay for all permits, connection charges, inspections, and certificates required to complete the work.

C. Latest editions of any referenced standards shall govern.

D. Contractor shall arrange and pay for all tests and inspections specified herein or required by above agencies and furnish required certificate of inspection to owner.

E. Where the contract documents are more stringent but not in conflict with the applicable codes, the more stringent requirements shall be followed.

1.04 SUBMISSIONS

A. The procedure for submissions of shop drawings shall be as specified in Division 1, or as a minimum, as indicated below.

B. Furnish submissions of shop drawings and samples of materials and equipment as indicated in these sections, on the drawings, or as directed by the A\E. Submissions will be made in a timely fashion such that adequate time exists to review the drawings, or material, and arrive at the site in accordance with the project schedule.

C. Submissions will not be accepted with work defined as "By Others". Identify contractor by name and with his approval so indicated. Submissions are required prior to purchasing, fabrication, or installation of any material or equipment. Submissions shall be reviewed and certified by the submitting contractor that they are in accordance with the project documents.

D. When requested by the engineer, shop drawings shall be required to be submitted to designated agencies for review and approval prior to submission to the engineer.

E. Contractor shall arrange and pay for all tests and inspections specified herein or required by above agencies and furnish required certificate of inspection to owner.

F. Contractor to forward a copy of submittals which have electrical requirements to the Electrical Contractor (EC) for coordination of voltage, amperage, and phase. Response to be received from EC prior to ordering of equipment by mechanical contractor.

G. Submissions shall include warrantees by the manufacturer for equipment being provided. Submissions for commonly related items such as fixtures, trim, carriers, drains shall be combined in a single brochure with all items being furnished clearly identified.

H. Shop drawings and submittals shall be checked and stamped by the contractor before submitting. They shall conform to measurements made at the site, the contract requirements, and coordinated with all other trades.

I. Specific models in catalog sheets must be identified as well as all options, voltages, phases, etc. identified so as to be clear on what is being provided.

J. Contractor and manufacturers shall be responsible for all physical characteristics of the equipment and field verify with final locations, coordinate with floor plans, confirm service access, clearances, confirm equipment arrangements, electrical disconnect clearances, and pathways/travel/access to the final equipment installation locations. Submission of equipment shop drawing will be deemed evidence of compliance with this requirement. If no shop drawing is submitted, contractor shall be fully responsible for a complete installation and assumes all related costs that affects the contractor and other trades.

K. To aid in the preparation of submittals or shop drawings, the engineer can provide the electronic files for use by the contractor. The electronic files will be provided upon execution of the engineer’s electronic file release contract prepared specifically for this project. The electronic files will be released in the format used by the architect and engineer to design the project. If this file format is not compatible with the contractor’s needs, additional charges for providing the changes to the requested file format may be necessary at $150/hr. billable to the contractor.

1.05 SITE INSPECTION

A. Visit site, inspect and become aware of all conditions which may affect the work. Investigate utilities, protection requirements for adjacent facilities, storage locations, and access to the construction area.
B. Submission of bid will be deemed evidence of having complied with this request. Contractor may not request additional costs for existing conditions which were evident from inspection of the site.

1.06 SUBSTITUTIONS

A. Material and equipment specified shall be deemed as that which the bidder's quotation represents the contractor.
B. Once bids are accepted only that material and equipment listed in the specifications or added by addenda shall be acceptable. Substitution information for inclusion in an addenda must be received by the A\E at least 10 days prior to bid opening. If acceptable, an addenda will be issued which will add the additional acceptable manufacturers or materials and be available for all contractors to consider. It shall be a basic premise that a contractor is a lowest bidder because he utilized substituted materials or equipment as opposed to specified materials or equipment.
C. If the contractor submits alternate equipment, manufacturers, systems, methods, or materials, not specifically identified in the specifications, additional review and investigation time may be required by the engineer. If the engineer determines additional review time is required because of the substitution, then this will be a billable service by the engineer at the rate of $150.00/hr. for such services. Also, billable will be any redesign time and revisions to drawings should they be necessary for incorporation into the work. Services will be billable to the contractor making such substitutions and will be payable prior to approval or rejection.
D. Contractor and manufacturers shall be responsible for all physical characteristics of the equipment and field verify with final locations, coordinate with floor plans, confirm service access, clearances, confirm equipment arrangements, electrical disconnect clearances, and pathways/travel/access to the final equipment installation locations. Submission of equipment shop drawing will be deemed evidence of compliance with this requirement. If no shop drawing is submitted, contractor shall be fully responsible for a complete installation and assumes all related costs that affects the contractor and other trades.

1.07 DRAWINGS AND SPECIFICATIONS

A. The drawings are generally diagrammatic and necessary field coordination and adjustment must be provided by the contractor prior to installation. Such deviations to the work to allow for coordination shall be kept to a minimum and any such deviations shall be at no extra cost.
B. When a conflict or contradiction exists either between drawings and specs or between specs or between different drawings or details, the more stringent shall apply.
C. Drawings and specifications are intended to be taken as a whole and each is to supplement the other. It is not intended that all work must be both shown on drawings and specified in the specifications.
D. An item shown on the drawings and not indicated in the specifications is to be understood to be required for the project. An item specified and not shown on the drawings is to be understood to be required for the project.
E. The architects or engineer's interpretation of the documents shall be binding upon the contractor. If a question arises, the contractor shall ask for an interpretation prior to bidding and an answer shall be issued as an addendum to all bidders.
F. If a question arises after bidding the A/E interpretation shall govern.

1.08 MEASUREMENTS

A. Before ordering materials or commencing with any work, the contractor shall verify all measurements at the building. Coordination of equipment, materials, spaces, and dimensions are the responsibility of the contractor.

1.09 PROGRESS SCHEDULE

A. Provide a project schedule which shall show start, sequence of each type of work, milestone schedule, and completion of each type of work, with overall completion date.

1.10 COST SCHEDULE

A. Provide a detailed cost breakdown indicating labor and material amounts for various types of work.
B. AIA forms are required for this submission.

1.11 COMPLETION

A. The contractor shall deliver to the owner, with his request for final payment, copies of all manufacturer's guarantees, equipment instructional manuals, a complete set of all final shop drawings, catalog cuts, service contracts, and other items as may be required elsewhere in the documents.

1.12 OFFICE

A. The contractor shall set up his job office (desk) where directed by the owner.

1.13 STORAGE

A. Material shall be stored only where directed by the owner.

1.14 SANITARY

A. The contractor will at his own expense, provide and maintain in a sanitary condition, a portable chemical toilet.
B. Toilet will be located where directed by the owner.

PART 2 - PRODUCTS

2.01 GENERAL

A. All material shall be new and of present day manufacture.
B. All material and equipment shall be in conformance with accepted trade standards.
C. Whenever equipment or material is referred to in the singular, such as "the fan", it shall be deemed to apply to as many such items as may be necessary to complete the installation.
D. The word “provide” means “furnish and install complete, tested, and adjusted as necessary with all

accessories, covers, escutcheons". The word "piping" means pipe, fitting, controls, valves and hangers as required for a complete system.

2.02 OPERATING INSTRUCTIONS AND MANUALS

A. Properly and fully instruct owner's personnel in the operation and maintenance of all systems and equipment.
B. Insure that the owner's personnel are familiar with all operations to carry on required activities.
C. Such instruction shall be for each item of equipment and each system as a whole.
D. Manual shall include all instructions on operation, maintenance, repair parts list, lubrication requirements, brochures, catalogue cuts, wiring diagrams, control sequences, service requirements, piping diagrams, names, and addresses of vendors, suppliers and emergency contacts. Three manuals shall be provided.
E. Provide to the owner any special tools necessary to operate any of the equipment.

PART 3 - EXECUTION

3.01 PROTECTION

A. Plug or cap open ends of piping systems and conduit.
B. Stored materials shall be covered to prevent damage by inclement weather, sun, dust, or moisture.
C. Protect all installed work until accepted in place by the owner. Cover plumbing fixtures.
D. Do not install plates, polished metal escutcheons, and other finished devices until masonry, tile, and painting operations are complete or protect otherwise.
E. Protect all existing or new work from operations which may cause damage such as hauling, welding, soldering, painting, insulating, and covering.

3.02 WORKMANSHIP

A. Install all work neat, trim, and plumb with building lines.
B. Install work in spaces allocated.
C. Cutting and patching shall be performed by skilled tradesmen normally employed for the work involved.

3.03 FASTENERS, HANGERS, AND SUPPORTS

A. Furnish and install all hangers and supports required to suspend, mount, or hang the work.
B. Furnish and install all miscellaneous steel angles, channels, beams, clips, brackets, and anchors to hang or support the work. Provide submissions for review.
C. Install concrete inserts before concrete is poured.
D. Drilled inserts shall not be loaded to more than 1/4 rated capacity with a minimum of 200 lbs.
E. Powder driven fasteners shall not be allowed for piping larger than 2", or for equipment. When used they shall not be loaded more than 1/8 rated capacity with a minimum of 200 lbs.
F. All hangers, miscellaneous steel, braces, and supports shall be galvanized, cadmium plated, or painted with corrosion resistant primer and finish coat of epoxy enamel.
G. Piping shall be supported from adjustable clevis type hangers with insulation pipe saddles at not

more than 8 foot centers up to 1 1/4" dia. and 10 foot centers above 1 1/4" dia. Piping shall not support other piping.

H. Support vertical piping at floor levels. Piping shall have split rings.

I. Provide and install lintels where required for mechanical work and not indicated on architectural or structural drawings.

J. Furnish steel framing for roof openings and floor openings. Submit details for review.

3.04 SLEEVES

A. All piping passing through floors or walls shall have sleeves unless holes are cored. Sleeves shall be 16 gage galvanized steel in non-bearing walls, 10 gage galvanized steel for bearing walls, and schedule 40 galvanized pipe in floors. Sleeves shall accommodate insulation. This shall not apply to sprinkler piping.

B. Sleeves passing through foundation walls not exposed to interior spaces or sleeves passing through slab on grade may be schedule 40 PVC.

C. Wall sleeves shall finish flush with wall.

D. Floor sleeves shall extend 1 inch above floor.

E. Sleeves in walls between interior spaces and unexcavated, exterior, crawl, or backfilled spaces shall be made watertight with "Link-Seal" modular wall and casing seal. Casing shall be schedule 40 galvanized pipe with anchor flange.

3.05 PLATES

A. Furnish and install chrome plated plates wherever piping passes into finished areas.

B. Plates shall be securely fastened to piping or building construction.

C. Floor plates shall cover one inch floor extension.

3.06 OFFSETS, TRANSITIONS, MODIFICATIONS

A. Furnish and install all offsets necessary to install the work and to provide clearance for the other trades.

B. Maintain adequate headroom and clearance as directed by the A/E.

C. Ductwork transitions necessary to accommodate available space or clearance requirements shall be contract requirements.

D. Incidental modifications necessary to the installation of the systems shall be made as necessary and at the direction of the A/E.

E. Rises and drops of piping systems shall be provided as required and where directed to allow for clearances to other construction. Drains shall be installed at no additional cost to the owner. The contractor shall allow for such occurrences in his bid.

F. Piping and equipment shall be so arranged as to not pass in front of windows, doors, access panels, access doors, coil removal or filter removal space or service clearance areas. Do not install within 3'-0" clearance of electrical panel fronts.

3.07 RECESSES

A. Furnish information to the general contractor as to sizes and locations of recesses required to install panels, boxes, grilles, and other equipment or devices which are to be recessed into walls.

B. Make offsets or modifications as required to suit final locations.

3.08 LABELING

A. All equipment shall be provided with permanent black laminated white core labels with 3/8" letters.

3.09 ACCESS

A. Locate all equipment, valves, devices, and controllers which may need service in accessible places.
B. Where access is not available; access panels shall be provided. Furnish prime painted steel access doors to the General Contractor for installation.
C. Access doors shall be 16 gauge frames and 22 gauge steel door. Access doors in fire rated walls shall have a "B" label for 1 ½ hours.
D. Maintain clearances for tube removal, coil pulls, and filter removal.

3.10 UTILITIES

A. Do not interrupt any utility or service without adequate previous notice and scheduling with the owner.
B. Refer to Division 1 for requirements for providing temporary utilities.

3.11 CUTTING AND PATCHING EXTERIOR SERVICES

A. This contractor shall be responsible for returning disturbed areas to original condition where excavation for utilities has been required.
B. Cut and patch paved areas to match original surfaces.
C. Properly tamp backfill before finishing surfaces.
D. Concrete pavements and curbs shall be formed and poured to match adjacent areas.
E. Grass areas shall be sodded and maintained until established growth is achieved.

3.12 GUARANTEE

A. All work shall be guaranteed to be free from defects for a period of one year of operation from date of acceptance by the owner unless otherwise specified. Material and labor for first year warranty is to be provided.
B. Guarantee shall be extended for all non-operational periods due to failure within the guarantee period.
C. Compressor system components shall be provided with a 5 year factory warranty. Material only for years 2 through 5 is required.

3.13 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Deliver material and equipment in manufacturer’s original cartons or on skids.
B. Store material in dry enclosures or under protective coverings out of way of work progress.
C. Handle so as to prevent damage to product or any surrounding material.

3.14 MANUFACTURERS’ NAMES

A. Manufacturers’ names are included herein to establish those suppliers who may provide products for this project subject to the requirements of the specifications. Although a manufacturer’s name may appear as an acceptable supplier it is not understood that a standard product is acceptable. Products must also meet the technical, performance, and physical requirements of the project as well as being named in the specification. Any deviations from this must be acknowledged at bid time

by the supplier and he shall be solely responsible for any and all costs associated with the application of his product in the project.

B. A design cannot be prepared which accommodates the installation of all suppliers and is not intended to do so. If certain modifications must be made to accommodate one particular supplier's equipment it shall be considered the contractor's responsibility to arrange for such accommodations and be financially responsible for same.

3.15 AS-BUILT DRAWINGS

A. At the completion of the work the contractor shall furnish a reproducible as-built drawings to the A/E for approval. The drawings shall indicate all work installed and its actual size and location. If acceptable, the A/E will submit the as-built drawings to the owner as record drawings. If not acceptable, the A/E will return the drawing to the contractor to make corrections as required. The contractor will resubmit for approval.

B. The as-built drawings shall indicate measured dimensions of underground lines and other concealed work.

C. To aid in the preparation of as-built drawings, the engineer can provide the electronic files for use by the contractor. The electronic files will be provided upon execution of the engineer's electronic file release contract prepared specifically for this project. The electronic files will be released in the format used by the architect and engineer to design the project. If this file format is not compatible with the contractor's needs, additional charges for providing the changes to the requested file format may be necessary at $150/hr. billable to the contractor.

3.16 PENETRATION SEALING

A. All penetrations of Natatorium walls, fire walls, smoke walls, and floors by pipes or wiring shall be sealed to prevent the flow of gasses or smoke.

B. The sealant shall be foamed in place between the penetrant and the adjacent floor or wall with DOW Corning RTV foam or equivalent by 3M, Hilti, or Chase foam.

C. The installation shall meet the approval of the authority having jurisdiction.

D. Penetrations through rated surfaces shall have a UL rating equivalent to the adjacent surfaces.

3.17 INVERTS AND ELEVATIONS

A. Indicated inverts and elevations of existing utilities are approximate and based on the best information available.

B. Upon of award of contract, contractor shall verify in the field all such information and report any discrepancies before proceeding with work. Contractor shall be responsible for extra work caused by his failure to verify inverts and elevations.

3.18 CONNECTIONS TO EQUIPMENT FURNISHED BY OTHERS

A. Furnish and install final connections to equipment furnished in other parts of the specification or furnished by the owner. Provide drainage connections, vent connections, water connections, fuel gas connections, gas connections to the fixtures or equipment. Plumbing connections shall include valved supplies and trapped waste connections.

3.19 CONNECTIONS TO EXISTING SYSTEMS

A. The contractor shall be responsible for connecting new systems to existing systems.

B. Arrange for outages with the owner.
C. Provide new valves at connections to existing systems.
D. Contractor shall place existing systems back into operation.
E. Contractor shall repair and replace any insulation damaged or removed during connection procedures.

3.20 COORDINATION DRAWINGS

A. Provide 3/8" = 1'-0" scale drawings showing all coordinated ductwork, piping, conduit, and equipment of all trades.
B. The sheet metal shop drawings may be used as the basis of these drawings.
C. Show ductwork, walls, beams, steel, drainage piping, domestic water piping, HVAC piping, sprinkler piping, light fixtures, electrical conduit, and equipment.
D. Contact other disciplines and obtain information to identify fully coordinated systems.
E. Submit for review and approval to the A/E.
F. Provide all dimensional data and necessary clearances to other trades for installation of fixtures and equipment within casework and counter tops.
G. Work shall not proceed until coordination is completed and all conflicts, issues, sequences etc., are resolved.

H. Unit shall be operated to determine acoustic acceptability.

3.21 WELDING

A. All electric power for arc welding shall be supplied by the contractor performing the work.

3.22 VEHICLES

A. Vehicle access to the site will be as directed by the owner.

3.23 RUBBISH DISPOSAL

A. Burning of debris on the site shall not be permitted. All debris, refuse, and waste shall be removed from the premises at regular intervals. No accumulation shall be permitted.

3.24 PROTECTION

A. Maintain all public walks and access ways.
B. Erect and maintain barricades, warning signs, and other protective means as may be directed by the owner for protection of all persons and property from injury or damage.

3.25 SCAFFOLDING

A. The contractor shall at his own expense, install, operate, protect, and maintain temporary services such as scaffolding, material hoists, access walks, etc., as may be required.

3.26 UTILITIES (Applies only to existing facilities)

A. The contractor may use the existing water and electric power for temporary construction needs.
B. The owner will direct where these services may be tapped.

C. Those services that are used during construction, but are to remain, shall be refurbished to as new condition before turning back to the owner.

3.27 CLEANUP

A. Remove all visible temporary tags or labels as well as any protective coverings and wrappings from fixtures and equipment.
B. Remove all spots, stains, soil, paint, spackle, and other foreign matter from all finished work.
C. Clean and polish all plumbing fixtures.
D. Remove all trash and debris from the premises.

3.28 MOUNTING HEIGHTS

A. Contractor to coordinate all mounting heights with all trades and architect prior to rough-in.

3.29 WORK COMPLETION

A. The contractor shall promptly correct work rejected by the engineer failing to conform to the requirements of the contract documents, whether discovered before or after substantial completion and whether or not fabricated, installed or completed. Costs of correcting such rejected work, including additional testing and inspections and compensation for the engineer's services and expenses made necessary thereby, shall be at the contractor's expense.

3.30 REQUEST FOR INFORMATION (RFI) REQUIREMENTS

A. All RFI's shall include the following information based on AIA Document G716:
   1 To, From, Project Name, Issue Date, RFI number in sequential order with all other trades, Requested Reply Date.
   2 Provide a description with specification and/or drawing references.
   3 Provide the senders recommendation including cost and/or schedule considerations.
   4 Provide receiver's reply space.
   5 Note an RFI reply is not an authorization to proceed with the work involving additional cost/time.

3.31 SHOP DRAWING REQUIREMENTS

A. The following is a list of required shop drawings for the project. Not all items may be identified, and it is the responsibility of the contractor to submit additional shop drawings where indicated in the specifications.

PLUMBING	**DATE REC'D**	**ACTION**	**DATE REC'D**	**ACTION**
COORDINATION DRAWINGS				
VALVES				
PIPING/FITTINGS/LABELING				
FIXTURES/TRIM/CARRIERS				

PLUMBING	**DATE REC'D**	**ACTION**	**DATE REC'D**	**ACTION**
GAS PRESSURE REGULATORS				
AS-BUILT DRAWINGS/CAD DISK				
WARRANTIES AND GUARANTEES				
OPERATIONS AND MAINTENANCE MANUALS				
INSTRUCTIONS				
TESTS/CERTIFICATIONS				
EMERGENCY AND MANUFACTURER CONTACTS				

END OF SECTION

SECTION 22 17 00 - GAS PIPING SYSTEMS

PART 1 - GENERAL

1.01 REFERENCE

A. Refer to section 22 05 00 for requirements which are applicable to this section.
B. Refer to International Mechanical Code.
C. Refer to requirements of the local gas company.
D. Refer to NFPA Pamphlet No. 54.
E. Where the contract documents are more stringent but not in conflict with the applicable codes, the more stringent requirement shall be followed.
F. Refer to International Fuel Gas Code

1.02 WORK INCLUDED

A. Provide all labor, material, equipment, and supervision necessary to install a complete natural gas piping system with all devices, appurtenances and accessories to complete the work.
B. Provide gas cocks on each side of gas meter and pressure regulator. Install gas meter, pressure regulator, and relief valve in accordance with the requirements of the gas company.
C. Extend service from termination point of the gas company to the building.
D. Provide gas cocks on all branch lines to equipment and appliances to allow for servicing.
E. Provide separate gas pressure regulators on each piece of equipment and appliance to regulate line pressure down to appliance/equipment usage pressure.
F. Arrange for service and meter installation with utility supplier.
G. Contractor shall paint all exterior piping exposed to the outdoors with one coat of primer and two coats of enamel paint. Finish to be selected by architect, and/or as required by the utility company.
H. Furnish and install gas booster system, piping, appurtenances, and controls. Gas booster system installation to be in accordance with PGW requirements.

1.03 MATERIAL REQUIREMENTS

A. Steel pipe schedule 40: ASTM A53 and A106, Interior piping.
B. Plastic pipe schedule 40: ASTM D2513 and D2517, Exterior underground piping.
C. Corrugated stainless steel tubing and fittings when approved by Gas Company.

1.04 PRESSURE REQUIREMENTS

A. Service pressure from main to meter/regulator:
High pressure from Gas Company.
B. Pressure Regulator:
High Pressure to #/square inches or inches water column.
C. Relief Valve:
To relieve full connected load + 25% at a pressure of psig.

PART 2 - PRODUCTS

2.01 VALVES

A. Valves 2 inch and smaller shall be conventional port, three piece body, blow-out proof stem, chrome ball and Teflon seals, 600 PSI rated and UL listed. Model # T-595-Y-UL as manufactured by NIBCO.
B. Valves over 2 inch shall be Figure 143 with flanged ends as manufactured by Rockwell-Nordstrom.

2.02 ISOLATION FITTINGS

A. Insulated dielectric unions to prevent the flow of electricity between adjacent sections of piping. Unions shall have the same pressure and temperature ratings of the installed systems.
B. Fittings shall be screwed union type up to 2 inch and flanged type above 2 inch. Flanged type shall have isolating gaskets and isolated bolt holes.
C. Manufacturer; Epco Sales Inc., Central Plastics. UL listed for gas piping service.

2.03 UNIONS

A. All equipment, control valves, and regulators shall be provided with union connections up to 2 inch and flanged connections above 2 inch.
B. Unions and flanges shall have pressure and temperature ratings equivalent to the fittings in the adjacent piping system. Screwed unions shall be bronze to bronze seat.
C. Unions shall be placed between the appliance and its shutoff valve.

2.04 SCREWED PIPE FITTINGS

A. Pipe joints made on screwed pipe shall be sealed with Teflon ribbon wrapped on the threads before assembly.
B. Usage shall be in conformance with the manufacturer’s instructions.

2.05 PRESSURE REGULATOR - SERVICE

A. In accordance with utility company requirements.

2.06 PRESSURE REGULATOR - EQUIPMENT/APPLIANCES

A. Individual appliance gas pressure regulators shall be provided for each individual appliance to reduce pressure from line pressure to appliance pressure.
B. Pressure regulators shall be UL listed for gas service.
C. Pressure regulators shall be accessible and protected from physical damage.
D. Exterior regulators shall be approved for outdoor applications.
E. The vent from vented regulators shall be extended to the exterior of the building. Vents shall not terminate near windows or door openings, air intakes, areaways or other confined areas where gas may accumulate or cause gas to re-enter building spaces.

2.07 RELIEF VALVE

A. Install on the low pressure side of each pressure regulator.

B. Relieve to exterior atmosphere.

PART 3 - EXECUTION

3.01 PIPING SYSTEMS

A. Branch connections shall be made to the top of horizontal lines. All piping shall be arranged to drain to a drainable low point. The low point shall be provided with a nipple and cap for the removal of moisture.
B. Piping shall run square with building lines.
C. Necessary drains, offsets, rises, vents, and drips shall be provided for as part of the contracted work. Where any such rise or drip is necessary the contractor shall install same as part of the work and as directed by the engineer. The drawings are diagrammatic in nature and due to the small scale, it is not possible to show all necessary drains, vents, offsets and rises which may be required to properly execute the work and such items shall be provided as needed. Drips shall be accessible.
D. Running or close nipples are not allowed.
E. Furnish and install dielectric pipe couplings between sections of ferrous and nonferrous piping systems and between copper or brass equipment and ferrous piping systems.
F. Steel piping shall be supported from adjustable clevis type piping up to 1". Over 1" to be on 10'-0" centers. Refer to manufacturer for piping other than steel.
G. Piping above roof shall be cleaned, primed, and provided with 2 coats of epoxy enamel.
H. Furnish and install an appliance pressure regulator on all equipment unless otherwise indicated.
I. Piping shall not be installed underground beneath buildings.
J. Piping shall be capped immediately after installation.
K. Valves shall not be concealed above ceilings.

3.02 PIPING IDENTIFICATION

A. Provide stencils or snap-on labels to identify gas piping systems.
B. Labels shall indicate "GAS" and the direction of flow.
C. Labels shall be required where piping enters and leaves mechanical rooms, at inlets and outlets of equipment, at 50 foot intervals where exposed.

3.03 WELDING

A. All concealed black steel piping shall be fusion welded.
B. Welding shall be performed in conformance with the ASME Boiler and Pressure Vessel Code Section IX.
C. Elbows, tees, and branch connections shall be made with welding fittings ANSI B16.9.
D. Furnish welder test certificates for review. Certificates of successful welder qualification by the following organizations shall be acceptable;
   ASME Boiler and Pressure Vessel Code
   ANSI Code for Pressure Piping
   National Certified Pipe Welding Bureau
   Military Specification MIL-STD-248.
E. Weld-o-lets and Thread-o-lets are allowed but shall be a maximum of one size smaller than line size, i.e., a maximum of a 3 inch weld-o-let on a 4 inch pipe.

3.04 VALVES

A. Valves shall be installed with their stems above the horizontal.
B. Valves shall be installed on the connections to all equipment and control valves to allow for isolation for repair.
C. Valves shall not be installed above ceilings.
D. An emergency shut off valve to shut off the entire system shall be provided, accessible from outside the building.
E. Minimum depth of bury: 18".
F. Connections between plastic and steel piping shall only be made outside, underground, with approved fittings.
G. Piping through foundation walls shall be encased in an approved vented sleeve. The annular space shall be sealed to prevent the leakage of gas into the structure.
H. TESTING
I. The gas system shall be tested in accordance with the local gas company and NFPA Pamphlet No. 54.
J. Provide a report of the test procedure utilized indicating test pressure and duration, date, and signatures of witnesses which shall include the owner, Gas Company official, and representative of the A/E.
K. Sections of piping which will be concealed shall be tested prior to concealment.
L. Test pressure shall be 1.5 times the system working pressure but not less than 3 psi. There shall be no loss in pressure for a ten minute period. Repair any leaks and retest.

END OF SECTION

DIVISION 23 - HVAC

SECTION 23 05 00 - STANDARD CONDITIONS FOR HVAC

PART 1 - GENERAL

1.01 REFERENCE

A. Requirements established within the portions of this project manual titled Division 1, General Requirements are collectively applicable to the work of this section.
B. Instructions to Bidders, Special Conditions and addenda as issued are part of this specification.
C. Mechanical, Plumbing, and HVAC drawings along with all other project drawings and specifications represent the work of this section.
D. Drawings, Contract, General Conditions and Supplementary Conditions form a part of this section, by reference thereto and shall have the same force and effect as if printed herewith in full. Failure to review these sections shall not relieve the Contractor of his responsibility to fully comply with the terms therein.

1.02 SCOPE

A. Provide all labor, material, equipment, and supervision necessary to disconnect and remove the existing heating and ventilation system in its entirety including, but not limited to; boilers, pumps, radiators, hot water supply and return piping, coils, ductwork, fans, baseboard radiation, unit ventilators, controls, supports, hangers, and all associated insulation, equipment pads, and accessories. Patch and repair openings in walls, floors, and ceilings, for piping and equipment that was removed. Pipe, conduit, ductwork, and wiring shall be cut back behind wall surfaces, above ceilings, and below floor levels so that a patch can be placed over the opening.
B. Provide labor, material, equipment, and supervision necessary to install complete operating mechanical systems as indicated on the drawings and specified herein, including all work at the site and within the proposed construction areas to accomplish the required work.
C. It shall be the contractor’s responsibility to coordinate his work and the work of his subcontractors to insure that all the work is covered. He shall designate who is responsible for various portions of work which may overlap so that there is complete coverage of all required work. It is the position of the owner and the A/E that all work is the responsibility of the mechanical contractor within this Division of the work.
D. Contractor shall provide all demolition necessary to remove and replace, repair, install new or modify existing work whether it be walls, floors, ceilings, structure, mechanical or electrical required to install his work. Contractor shall replace all work to leave in a finished condition.
E. All work shown on the drawings and not expressly mentioned in the specifications and all work specified but not shown on the drawings, but necessary for the proper execution of same shall be performed by the contractor. It is not the intent of the drawings and specifications to describe every feature and detail of the work.
F. No additions to the contract amount will be approved for any materials, equipment, or labor to perform additional work unless it can be clearly shown to be beyond the scope and intent of the drawings and specifications.

G. HVAC contractor's scope of work shall include but not be limited to the following:
1. Demolition of existing work for new work.
2. New Variable Refrigerant Flow Systems.
3. New DX-Gas Rooftop Units
4. New DX-Gas Energy Recovery Units
5. New Exhaust fans
6. New electric heaters.
7. Air distribution system, associated ductwork, devices, equipment, and insulation.
8. Condensate drainage system (air conditioner units). Condensate pumps.
9. Roof penetrations for mechanical work and all associated roof work.
10. Exhaust systems.
11. Test Balance & Adjust.
12. Repair existing areas affected by the new construction. Patch, repair and finish to match existing.
13. Building automation system and automatic temperature controls.
14. All other work identified in Division 23 and/or on the mechanical drawings except that identified as plumbing or fire protection work.
15. Contractor shall not utilize new HVAC equipment for temporary heating, cooling, and dehumidification purposes. Temporary HVAC is to be provided as described under the architect's general conditions. Contractor is to protect all HVAC equipment during construction and cover all ductwork openings.
16. Provide third party certification of all packaged systems by a Nationally Recognized Testing Laboratory (NRTL) in accordance with OSHA Federal Regulations 29CFR1910.303 and .399 as well as Pamphlet #70 and National Electrical Code Article 90-7.
17. Fire stopping of penetrations. (See Section 23 05 50)

1.03 REGULATIONS, CODES, AND STANDARDS

A. Work shall be performed in accordance with the latest adopted codes, amendments, regulations, and ordinances of the authorities having jurisdiction. Observe all safety regulations including the requirements of OSHA.
B. Obtain and pay for all permits, connection charges, inspections, and certificates required to complete the work.
C. Latest editions of any referenced standards shall govern.
D. Contractor shall arrange and pay for all tests and inspections specified herein or required by above agencies and furnish required certificate of inspection to owner.
E. Where the contract documents are more stringent but not in conflict with the applicable codes, the more stringent requirements shall be followed.

1.04 SUBMISSIONS

A. The procedure for submissions of shop drawings shall be as specified in Division 1, or as a minimum, as indicated below.
B. Furnish submissions of shop drawings and samples of materials and equipment as indicated in these sections, on the drawings, or as directed by the A\E. Submissions will be made in a timely fashion such that adequate time exists to review the drawings, or material, and arrive at the site in accordance with the project schedule.
C. Submissions will not be accepted with work defined as "By Others". Identify contractor by name and with his approval so indicated. Submissions are required prior to purchasing, fabrication, or installation of any material or equipment. Submissions shall be reviewed and certified by the

submitting contractor that they are in accordance with the project documents.

D. When requested by the engineer, shop drawings shall be required to be submitted to designated agencies for review and approval prior to submission to the engineer.

E. Contractor shall arrange and pay for all tests and inspections specified herein or required by above agencies and furnish required certificate of inspection to owner.

F. Contractor to forward a copy of submittals which have electrical requirements to the Electrical Contractor (EC) for coordination of voltage, amperage, and phase. Response to be received from EC prior to ordering of equipment by mechanical contractor.

G. Submissions shall include warrantees by the manufacturer for equipment being provided. Submissions for commonly related items such as fixtures, trim, carriers, drains shall be combined in a single brochure with all items being furnished clearly identified.

H. Shop drawings and submittals shall be checked and stamped by the contractor before submitting. They shall conform to measurements made at the site, the contract requirements, and coordinated with all other trades.

I. Specific models in catalog sheets must be identified as well as all options, voltages, phases, etc. identified so as to be clear on what is being provided.

J. Contractor and manufacturers shall be responsible for all physical characteristics of the equipment and field verify with final locations, coordinate with floor plans, confirm service access, clearances, confirm equipment arrangements, electrical disconnect clearances, and pathways/travel/access to the final equipment installation locations. Submission of equipment shop drawing will be deemed evidence of compliance with this requirement. If no shop drawing is submitted, contractor shall be fully responsible for a complete installation and assumes all related costs that affects the contractor and other trades.

1.05 SITE INSPECTION

A. Visit site, inspect, and become aware of all conditions which may affect the work. Investigate utilities, protection requirements for adjacent facilities, storage locations, and access to the construction area.

B. Submission of bid will be deemed evidence of having complied with this request. Contractor may not request additional costs for existing conditions which were evident from inspection of the site.

1.06 SUBSTITUTIONS

A. Material and equipment specified shall be deemed as that which the bidder’s quotation represents.

B. Once bids are accepted only that material and equipment listed in the specifications or added by addenda shall be acceptable. Substitution information for inclusion in an addenda must be received by the A\E at least 10 days prior to bid opening. If acceptable, an addenda will be issued which will add the additional acceptable manufacturers or materials and be available for all contractors to consider. It shall be a basic premise that a contractor is a lowest bidder because he utilized substituted materials or equipment as opposed to specified materials or equipment.

C. If the contractor submits alternate equipment, manufacturers, systems, methods, or materials, not specifically identified in the specifications, additional review and investigation time may be required by the engineer. If the engineer determines additional review time is required because of the substitution, then this will be a billable service by the engineer at the rate of $150.00/hr. for such services. Also billable will be any redesign time and revisions to drawings should they be necessary for incorporation into the work. Services will be billable to the contractor making such substitutions and will be payable prior to approval or rejection.

D. If the contractor elects to submit alternate equipment, manufacturers, systems, methods, or materials, not specifically identified in the drawings and specifications, it is the contractor’s

responsibility to coordinate the work with other trades and pay for any associated costs with the substitution or change.

E. Contractor and manufacturers shall be responsible for all physical characteristics of the equipment and field verify with final locations, coordinate with floor plans, confirm service access, clearances, confirm equipment arrangements, electrical disconnect clearances, and pathways/travel/access to the final equipment installation locations. Submission of equipment shop drawing will be deemed evidence of compliance with this requirement. If no shop drawing is submitted, contractor shall be fully responsible for a complete installation and assumes all related costs that affects the contractor and other trades.

1.07 DRAWINGS AND SPECIFICATIONS

A. The drawings are generally diagrammatic and necessary field coordination and adjustment must be provided by the contractor prior to installation. Such deviations to the work to allow for coordination shall be kept to a minimum and any such deviations shall be at no extra cost.

B. When a conflict or contradiction exists either between drawings and specs or between specs or between different drawings or details, the more stringent shall apply.

C. Drawings and specifications are intended to be taken as a whole and each is to supplement the other. It is not intended that all work must be both shown on drawings and specified in the specifications.

D. An item shown on the drawings and not indicated in the specifications is to be understood to be required for the project. An item specified and not shown on the drawings is to be understood to be required for the project.

E. The architects or engineer’s interpretation of the documents shall be binding upon the contractor. If a question arises, the contractor shall ask for an interpretation prior to bidding and an answer shall be issued as an addendum to all bidders.

F. If a question arises after bidding the A/E interpretation shall govern.

1.08 MEASUREMENTS

A. Before ordering materials or commencing with any work, the contractor shall verify all measurements at the building. Coordination of equipment, materials, spaces, and dimensions are the responsibility of the contractor.

1.09 PROGRESS SCHEDULE

A. Provide a project schedule which shall show start, sequence of each type of work, milestone schedule, and completion of each type of work, with overall completion date.

1.10 COST SCHEDULE

A. Provide a detailed cost breakdown indicating labor and material amounts for various types of work.

B. AIA forms are required for this submission.

1.11 COMPLETION

A. The contractor shall deliver to the owner, with his request for final payment, copies of all manufacturer's guarantees, equipment instructional manuals, a complete set of all final shop drawings, catalog cuts, service contracts, and other items as may be required elsewhere in the documents.

1.12 OFFICE

A. The contractor shall set up his job office (desk) where directed by the owner.

1.13 STORAGE

A. Material shall be stored only where directed by the owner.

1.14 SANITARY

A. The contractor will at his own expense, provide and maintain in a sanitary condition, a portable chemical toilet.
B. Toilet will be located where directed by the owner.

PART 2 - PRODUCTS

2.01 GENERAL

A. All material shall be new and of present day manufacturer.
B. All material and equipment shall be in conformance with accepted trade standards.
C. Whenever equipment or material is referred to in the singular, such as "the fan", it shall be deemed to apply to as many such items as may be necessary to complete the installation.
D. The word “provide” means “furnish and install complete, tested, and adjusted as necessary with all accessories, covers, escutcheons”. The word “piping” means pipe, fitting, controls, valves, and hangers as required for a complete system.

2.02 MOTORS

A. Incorporate latest IEEE and NEMA standards.
B. All copper windings with ball bearings.
C. Indoors; drip proof, 40 degree C rise.
D. Outdoors; totally enclosed 55 degree C rise.
E. Motors over 10 HP to be high efficiency with PF in excess of 0.9.

2.03 MOTOR STARTERS AND CONTACTORS

A. Fractional with horsepower up to ½ HP; electrical contract.
B. Polyphase and single phase above ½ HP: this contract.
C. Electrical contractor shall install all starters except for those provided as an integral part of equipment.
D. Polyphase starters shall be magnetic combination type, across-the-line electrically operated, electrically held, three pole assemblies, with arc extinguishing characteristics, silver to silver renewable contacts, 3 pole thermal bi-metallic, red run pilot light, individual phase protection, with overload heaters matched to motors installed and with 4 auxiliary contact, Hand-off-Auto switch, and control transformer.
E. For single phase motors above ½ HP provide magnetic combination single phase motor starters with

overloads, non-fusible disconnect switch, red run pilot light, integral 120 volt control transformer with dual primary fusing auxiliary contacts.

F. Starters shall be as manufactured by G. E., Siemens, Square "D", Cerus or Cutler-Hammer.

2.04 EQUIPMENT START UP

A. Verify that equipment is operating within warranty requirements.
B. Advise owner and A/E at least two days prior.
C. Verify proper operation. Obtain signed statement by manufacturer or his representative that equipment is operating within warranty requirements. Submit statement to A/E.

2.05 LUBRICATION

A. Lubricate all equipment in accordance with manufacturer’s instructions.
B. Lubricate prior to start up.
C. Provide one year’s supply of lubricants to the owner.

2.06 OPERATING INSTRUCTIONS AND MANUALS

A. Properly and fully instruct owner’s personnel in the operation and maintenance of all systems and equipment.
B. Insure that the owner's personnel are familiar with all operations to carry on required activities.
C. Such instruction shall be for each item of equipment and each System as a whole.
D. Manual shall include all instructions on operation, maintenance, repair parts list, lubrication requirements, brochures, catalogue cuts, wiring diagrams, control sequences, service requirements, piping diagrams, names, and addresses of vendors, suppliers, and emergency contacts. Three manuals shall be provided.
E. Provide to the owner any special tools necessary to operate any of the equipment.

2.07 DRAIN PANS

A. Provide auxiliary galvanized steel condensate drain pan with 1" MPT drain connection for all interior fan coil units, cooling coils, heat pumps, and any other cooling equipment requiring condensate removal. Drain to suitable discharge point acceptable to owner and A/E. Drain lines shall be separate and independent of A/C unit drain system unless provided with interlocked water sensing switch.
B. All water heaters mounted above the floor shall be provided with drain pans. Drain to suitable discharge point acceptable to owner and A/E. To be visible outfall.
C. Drains shall slope down in direction of flow at 1" per 10 feet.

PART 3 - EXECUTION

3.01 PROTECTION

A. Cover duct openings during construction.
B. Plug or cap open ends of piping systems and conduit.
C. Stored materials shall be covered to prevent damage by inclement weather, sun, dust, or moisture.

D. Protect all installed work until accepted in place by the owner. Cover plumbing fixtures and lighting fixtures.
E. Do not install plates, polished metal escutcheons, thermostats, and other finished devices until masonry, tile, and painting operations are complete or protect otherwise.
F. Protect all existing or new work from operations which may cause damage such as hauling, welding, soldering, painting, insulating, and covering.

3.02 WORKMANSHIP

A. Install all work neat, trim, and plumb with building lines.
B. Install work in spaces allocated.
C. Cutting and patching shall be performed by skilled tradesmen normally employed for the work involved.

3.03 EXCAVATION, SHORING, PUMPING, BACKFILLING

A. Perform all excavation required to install the work. Deposit excavated material so as not to create a slide hazard.
B. No work shall be placed on rock. Cushion with 6 " layer of crushed stone.
C. Protect tree roots with burlap covering and maintain moist until backfilled.
D. Base estimates on excavation which will include earth, sand, clay, rubbish, debris, and all other materials up to one cubic yard in size. Boulders or rock larger than one cubic yard which need to be broken up with pneumatic equipment or explosives will be separately negotiated at the time of discovery with the owner and A/E. Do not proceed with rock excavation until an agreement is reached.
E. Maintain excavations free of water.
F. Shore excavations to prevent cave-in in accordance with OSHA regulations and to prevent strains on work put in place until ready to receive backfill.
G. Backfill with clean material and pneumatically tamp in 8" layers. Remove excess material, including rock, from site or as directed by the A/E.
H. Backfill piping trenches within 18" of footings, columns, piers, or grade beams, with concrete. Protect piping from direct contact and adherence to concrete.
I. Return to original condition any areas disturbed for excavation.

3.04 FASTENERS, HANGERS, AND SUPPORTS

A. Furnish and install all hangers and supports required to suspend, mount, or hang the work.
B. Furnish and install all miscellaneous steel angles, channels, beams, clips, brackets, and anchors to hang or support the work. Provide submissions for review.
C. Install concrete inserts before concrete is poured.
D. Drilled inserts shall not be loaded to more than 1/4 rated capacity with a minimum of 200 lbs.
E. Powder driven fasteners shall not be allowed for piping larger than 2", or for equipment. When used they shall not be loaded more than 1/8 rated capacity with a minimum of 200 lbs.
F. All hangers, miscellaneous steel, braces, and supports shall be galvanized, cadmium plated, or painted with corrosion resistant primer and finish coat of epoxy enamel.
G. Piping shall be supported from adjustable clevis type hangers with insulation pipe saddles as indicated in the piping system specification sections. Piping shall not support other piping.
H. Support vertical piping and ductwork at floor levels. Piping shall have split rings. Ductwork shall have 1 1/2" angle iron frames.
I. Provide and install lintels where required for mechanical work and not indicated on architectural or

structural drawings.

J. Furnish steel framing for roof openings and floor openings. Submit details for review.

3.05 SLEEVES

A. All piping passing through floors or walls shall have sleeves unless holes are cored. Sleeves shall be 16 gage galvanized steel in non-bearing walls, 10 gage galvanized steel for bearing walls, and schedule 40 galvanized pipe in floors. Sleeves shall accommodate insulation. This shall not apply to sprinkler piping.
B. Sleeves passing through foundation walls not exposed to interior spaces or sleeves passing through slab on grade may be schedule 40 PVC.
C. Wall sleeves shall finish flush with wall.
D. Floor sleeves shall extend 1 inch above floor.
E. Sleeves in walls between interior spaces and unexcavated, exterior, crawl, or backfilled spaces shall be made watertight with "Link-Seal" modular wall and casing seal. Casing shall be schedule 40 galvanized pipe with anchor flange.

3.06 PLATES

A. Furnish and install chrome plated plates wherever piping passes into finished areas.
B. Plates shall be securely fastened to piping or building construction.
C. Floor plates shall cover one inch floor extension.

3.07 OFFSETS, TRANSITIONS, MODIFICATIONS

A. Furnish and install all offsets necessary to install the work and to provide clearance for the other trades.
B. Maintain adequate headroom and clearance as directed by the A/E.
C. Ductwork transitions necessary to accommodate available space or clearance requirements shall be contract requirements.
D. Incidental modifications necessary to the installation of the systems shall be made as necessary and at the direction of the A/E.
E. Rises and drops of piping systems shall be provided as required and where directed to allow for clearances to other construction. Drains shall be installed at no additional cost to the owner. The contractor shall allow for such occurrences in his bid.
F. Ductwork, piping, conduit, and equipment shall be so arranged as to not pass in front of windows, doors, access panels, access doors, coil removal or filter removal space or service clearance areas. Do not install within 3'-0" clearance of electrical panel fronts.

3.08 RECESSES

A. Furnish information to the general contractor as to sizes and locations of recesses required to install panels, boxes, grilles, and other equipment or devices which are to be recessed into walls.
B. Make offsets or modifications as required to suit final locations.

3.09 EQUIPMENT SETTING

A. Furnish and install as a minimum, a 4" thick concrete pad beneath all floor mounted equipment in mechanical rooms, boiler rooms, or equipment rooms, or outside on grade. This shall not apply to residential installations of water heaters and air handling units or furnaces unless detailed on

drawings or specified elsewhere.

B. Furnish and install as a minimum, spring vibration isolators under any equipment 5 HP and over and rubber-in-shear vibration isolation under all equipment less than 5 HP. This shall apply to residential installations.
C. Reinforce concrete with No. 4 rods 12" on centers both ways.
D. Pad to have 3/4" dowels into concrete at 1 per 4 square feet.

3.10 LABELING

A. All equipment, panels, controls, safety switches, and devices shall be provided with permanent black laminated white core labels with 3/8" letters.
B. This shall also apply to all controllers, remote start/stop push buttons, equipment cabinets, and where directed by the A/E.
C. This shall not apply to local room thermostats and light switches.

3.11 FLASHING AND COUNTERFLASHING

A. Piping and conduit through the roof shall be flashed by the General Contractor. This contractor shall furnish counterflashing.
B. Ductwork through the roof and roof mounted duct connected equipment shall be provided with prefabricated roof curbs. General contractor shall flash. This contractor shall counterflash.
C. Structural dunnage for roof mounted equipment shall be flashed and counterflashed. Prefabricated roof curbs may be utilized.

3.12 ACCESS

A. Locate all equipment, valves, devices, and controllers which may need service in accessible places.
B. Where access is not available; access panels shall be provided. Furnish prime painted steel access doors to the General Contractor for installation.
C. Access doors shall be 16 gauge frames and 22 gauge steel door. Access doors in fire rated walls shall have a "B" label for 1 ½ hours.
D. Maintain clearances for tube removal, coil pulls, and filter removal.

3.13 WIRING

A. Power wiring shall be provided by the Division 26 Electrical Contractor. This contractor shall furnish all 3 phase starters, pushbuttons, and controllers necessary to operate the equipment. The Electrical Contractor shall store and install the electrical devices and furnish and install the power wiring.
B. Control wiring shall be furnished and installed under Division 23 portion of the work. Wiring for controls is control wiring whether it is line voltage or low voltage.
C. All wiring shall be in accordance with the NEC.
D. Pushbuttons shall be maintain-contact type.
E. Refer to the electrical specifications for wiring methods.
F. Plenum rated cable is required for control wiring.

3.14 UTILITIES

A. Do not interrupt any utility or service without adequate previous notice and scheduling with the owner.
B. Refer to Division 1 for requirements for providing temporary utilities.

3.15 CUTTING AND PATCHING EXTERIOR SERVICES

A. This contractor shall be responsible for returning disturbed areas to original condition where excavation for utilities has been required.
B. Cut and patch paved areas to match original surfaces.
C. Properly tamp backfill before finishing surfaces.
D. Concrete pavements and curbs shall be formed and poured to match adjacent areas.
E. Grass areas shall be sodded and maintained until established growth is achieved.

3.16 GUARANTEE

A. All work shall be guaranteed to be free from defects for a period of one year of operation from date of acceptance by the owner unless otherwise specified. Material and labor for first year warranty is to be provided.
B. Guarantee shall be extended for all non-operational periods due to failure within the guarantee period.
C. Compressors and refrigeration system components shall be provided with a 5 year factory warranty. Material only for years 2 through 5 is required.

3.17 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Deliver material and equipment in manufacturer's original cartons or on skids.
B. Store material in dry enclosures or under protective coverings out of way of work progress.
C. Handle so as to prevent damage to product or any surrounding material.

3.18 MANUFACTURERS' NAMES

A. Manufacturers' names are included herein to establish those suppliers who may provide products for this project subject to the requirements of the specifications. Although a manufacturer's name may appear as an acceptable supplier it is not understood that a standard product is acceptable. Products must also meet the technical, performance, and physical requirements of the project as well as being named in the specification. Any deviations from this must be acknowledged at bid time by the supplier and he shall be solely responsible for any and all costs associated with the application of his product in the project.
B. A design cannot be prepared which accommodates the installation of all suppliers and is not intended to do so. If certain modifications must be made to accommodate one particular supplier's equipment it shall be considered the contractor's responsibility to arrange for such accommodations and be financially responsible for same.

3.19 AS-BUILT DRAWINGS

A. At the completion of the work the contractor shall furnish a reproducible as-built drawings to the A/E for approval. The drawings shall indicate all work installed and its actual size and location. If acceptable, the A/E will submit the as-built drawings to the owner as record drawings. If not acceptable, the A/E will return the drawing to the contractor to make corrections as required. The contractor will resubmit for approval.
B. The as-built drawings shall indicate measured dimensions of underground lines and other concealed work.

3.20 PENETRATION SEALING

A. All penetrations of Natatorium walls, fire walls, smoke walls, and floors by ducts, pipes, conduit, or wiring shall be sealed to prevent the flow of gasses or smoke.
B. The sealant shall be foamed in place between the penetrant and the adjacent floor or wall with DOW Corning RTV foam or equivalent by 3M, Hilti, or Chase foam.
C. The installation shall meet the approval of the authority having jurisdiction.
D. Penetrations through rated surfaces shall have a UL rating equivalent to the adjacent surfaces.
E. All other penetrations of walls either above ceilings or exposed shall be closely sealed around the penetration with caulking or packing to prevent flow of air or sound through the wall.

3.21 CUTTING AND PATCHING INTERIOR SURFACES

A. Respective contractor shall install all hangers, supports, pipe sleeves in floors, walls, partitions, ceilings, and roof slabs as construction progresses to permit their work to be built into place and to eliminate unnecessary cutting of construction work.
B. All cutting of concrete, or other material for the passage of piping and ductwork through floors, walls, partitions, and ceiling shall be done by the respective contractor where necessary to install his work. Respective contractor will close all such openings around piping, ductwork, and conduit with materials equivalent to that removed. All exposed surfaces shall be left in suitable condition for refinishing without further work.
C. Contractor shall patch and repair any existing openings created by the demolition work in floors, walls, partitions, and ceilings not being reused for the new construction.

3.22 INVERTS AND ELEVATIONS

A. Indicated inverts and elevations of existing utilities are approximate and based on the best information available.
B. Upon of award of contract, contractor shall verify in the field all such information and report any discrepancies before proceeding with work. Contractor shall be responsible for extra work caused by his failure to verify inverts and elevations.

3.23 CONNECTIONS TO EQUIPMENT FURNISHED BY OTHERS

A. Furnish and install final connections to equipment furnished in other parts of the specification or furnished by the owner. Provide drainage connections, vent connections, water connections, fuel gas connections, duct connections, gas connections to the fixtures or equipment. Plumbing connections shall include valved supplies and trapped waste connections.

3.24 CONNECTIONS TO EXISTING SYSTEMS

A. The contractor shall be responsible for connecting new systems to existing systems.
B. Arrange for outages with the owner.
C. Contractor shall shut down and drain existing systems.
D. Contractor shall cut in, weld, solder, or thread, and make connections compatible with existing systems.
E. Provide new valves at connections to existing systems.
F. Contractor shall refill existing and fill new systems.
G. Contractor shall purge air from systems, both new and existing.
H. Contractor shall place existing systems back into operation.

I. Contractor shall repair and replace any insulation damaged or removed during connection procedures.

3.25 COORDINATION DRAWINGS

A. Provide drawings showing all coordinated ductwork, piping, conduit, and equipment of all trades.
B. The sheet metal shop drawings may be used as the basis of these drawings.
C. Show ductwork, walls, beams, steel, drainage piping, domestic water piping, HVAC piping, sprinkler piping, light fixtures, electrical conduit, and equipment.
D. Contact other disciplines and obtain information to identify fully coordinated systems.
E. Submit for review and approval to the A/E.
F. Provide all dimensional data and necessary clearances to other trades for installation of fixtures and equipment within casework and counter tops.
G. Work shall not proceed until coordination is completed and all conflicts, issues, sequences etc., are resolved.

3.26 WELDING

A. All electric power for arc welding shall be supplied by the contractor performing the work.

3.27 VEHICLES

A. Vehicle access to the site will be as directed by the owner.

3.28 RUBBISH DISPOSAL

A. Burning of debris on the site shall not be permitted. All debris, refuse, and waste shall be removed from the premises at regular intervals. No accumulation shall be permitted.

3.29 PROTECTION

A. Maintain all public walks and access ways.
B. Erect and maintain barricades, warning signs, and other protective means as may be directed by the owner for protection of all persons and property from injury or damage.

3.30 SCAFFOLDING

A. The contractor shall at his own expense, install, operate, protect, and maintain temporary services such as scaffolding, material hoists, access walks, etc., as may be required.

3.31 UTILITIES (Applies only to existing facilities)

A. The contractor may use the existing water and electric power for temporary construction needs.
B. The owner will direct where these services may be tapped.
C. Those services that are used during construction, but are to remain, shall be refurbished to as new condition before turning back to the owner.

3.32 CLEANUP

A. Remove all visible temporary tags or labels as well as any protective coverings and wrappings from

fixtures and equipment.

B. Remove all spots, stains, soil, paint, spackle, and other foreign matter from all finished work.

C. Clean and polish all plumbing fixtures.

D. Remove all trash and debris from the premises.

3.33 MOUNTING HEIGHTS

A. Contractor to coordinate all mounting heights with all trades and architect prior to rough-in.

B. Maximum thermostat mounting height (top of thermostat) in accordance with ADA.
   1. Side reach: 48" A.F.F.
   2. Forward reach: 48" A.F.F.

3.34 WORK COMPLETION

A. The contractor shall promptly correct work rejected by the engineer failing to conform to the requirements of the contract documents, whether discovered before or after substantial completion and whether or not fabricated, installed or completed. Costs of correcting such rejected work, including additional testing and inspections and compensation for the engineer's services and expenses made necessary thereby, shall be at the contractor's expense.

3.35 REQUEST FOR INFORMATION (RFI) REQUIREMENTS

A. All RFI's shall include the following information based on AIA Document G716:
   1. To, From, Project Name, Issue Date, RFI number in sequential order with all other trades, Requested Reply Date.
   2. Provide a description with specification and/or drawing references.
   3. Provide the senders recommendation including cost and/or schedule considerations.
   4. Provide receiver's reply space.
   5. Note an RFI reply is not an authorization to proceed with the work involving additional cost/time.

3.36 SHOP DRAWING REQUIREMENTS

A. The following is a list of required shop drawings for the project. Not all items may be identified, and it is the responsibility of the contractor to submit additional shop drawings where indicated in the specifications.

HVAC	**DATE REC'D**	**ACTION**	**DATE REC'D**	**ACTION**
COORDINATION DRAWINGS				
REFRIGERANT PIPING				
VIBRATION ISOLATION				
INSULATION A. Piping B. Ductwork C. Equipment				

HVAC	DATE REC'D	ACTION	DATE REC'D	ACTION
SHEET METAL DRAWINGS				
UNIT HEATERS (ELECTRIC)				
CONVECTORS (ELECTRIC)				
FANS (SUPPLY, EXHAUST, GREASE, INTERIOR)				
HEAT PUMPS				
ROOFTOP UNITS				
SPLIT SYSTEMS				
ENERGY RECOVERY UNITS				
VRF SYSTEMS				
ENERGY RECOVERY UNIT				
FIRE DAMPERS DAMPERS				
VOLUME DAMPERS				
SMOKE DAMPERS				
GRILLES, REGISTERS, DIFFUSERS				
LOUVERS/ROOF CAPS				
EQUIPMENT CURBS				
AUTOMATIC TEMPERATURE CONTROL A. DEVICES B. WIRING DIAGRAMS C. SEQUENCES				
TEST, BALANCE AND ADJUST REPORT				
AS-BUILT DRAWINGS				
WARRANTIES AND GUARANTEES				
OPERATIONS AND MAINTENANCE MANUALS				
INSTRUCTIONS				
EMERGENCY AND MANUFACTURER CONTACTS				
CONDENSATE PUMPS				

HVAC	DATE REC'D	ACTION	DATE REC'D	ACTION

END OF SECTION

SECTION 23 05 13 - COMMON MOTOR REQUIREMENTS FOR HVAC EQUIPMENT

PART 1 - GENERAL

1.01 SUMMARY

A. Section includes general requirements for single-phase and polyphase, general-purpose, horizontal, small, and medium, squirrel-cage induction motors for use on ac power systems up to 600 V and installed at equipment manufacturer's factory or shipped separately by equipment manufacturer for field installation.

1.02 COORDINATION

A. Coordinate features of motors, installed units, and accessory devices to be compatible with the following:
   1. Motor controllers.
   2. Torque, speed, and horsepower requirements of the load.
   3. Ratings and characteristics of supply circuit and required control sequence.
   4. Ambient and environmental conditions of installation location.

1.03 SUBMITTALS

A. Shop drawing submittals for motorized equipment shall include, but not limited to, the following information on motors provided with equipment.
   1. Manufacturer’s name and cutsheets.
   2. Motor type.
   3. Horsepower.
   4. Voltage/Phase/Hertz.
   5. RPM.
   6. Service factor.
   7. Insulation class.
   8. NEC code number.
   9. Motor efficiency and testing method and results.

PART 2 - PRODUCTS

2.01 GENERAL MOTOR REQUIREMENTS

A. Comply with NEMA MG 1 unless otherwise indicated.
B. All materials and equipment furnished shall be installed as per manufacturer’s requirements and conform to the requirements of Division 26.

2.02 MOTOR CHARACTERISTICS

A. Duty: Continuous duty at ambient temperature of 40 deg. C and at altitude of 3300 feet above sea level.
B. Capacity and Torque Characteristics: Sufficient to start, accelerate, and operate connected loads at designated speeds, at installed altitude and environment, with indicated operating sequence, and without exceeding nameplate ratings or considering service factor.
C. Incorporate latest IEEE and NEMA standards.
D. All copper windings with ball bearings.
E. Indoors; drip proof, 40 degree C rise.
F. Outdoors; totally enclosed 55 degree C rise.
G. Motors over 10 HP to be high efficiency with PF in excess of 0.9.

2.03 POLYPHASE MOTORS

A. Description: NEMA MG 1, Design B, medium induction motor.
B. Efficiency: Energy efficient, as defined in NEMA MG 1.
C. Service Factor: 1.15.
D. Multispeed Motors: Variable torque.
    1. For motors with 2:1 speed ratio, consequent pole, single winding.
    2. For motors with other than 2:1 speed ratio, separate winding for each speed.
E. Rotor: Random-wound, squirrel cage.
F. Bearings: Regreasable, shielded, antifriction ball bearings suitable for radial and thrust loading.
G. Temperature Rise: Match insulation rating.
H. Insulation: Class F.
I. Code Letter Designation:
    1. Motors 15 HP and Larger: NEMA starting Code F or Code G.
    2. Motors Smaller than 15 HP: Manufacturer's standard starting characteristic.
J. Enclosure Material: Cast iron for motor frame sizes 324T and larger; rolled steel for motor frame sizes smaller than 324T.

2.04 POLYPHASE MOTORS WITH ADDITIONAL REQUIREMENTS

A. Motors Used with Reduced-Voltage and Multispeed Controllers: Match wiring connection requirements for controller with required motor leads. Provide terminals in motor terminal box, suited to control method.
B. Motors Used with Variable Frequency Controllers: Ratings, characteristics, and features coordinated with and approved by controller manufacturer.
    1. Windings: Copper magnet wire with moisture-resistant insulation varnish, designed and tested to resist transient spikes, high frequencies, and short time rise pulses produced by pulse-width modulated inverters.
    2. Energy- and Premium-Efficient Motors: Class B temperature rise; Class F insulation.
    3. Inverter-Duty Motors: Class F temperature rise; Class H insulation.
    4. Thermal Protection: Comply with NEMA MG 1 requirements for thermally protected motors.

2.05 SINGLE-PHASE MOTORS

A. Motors larger than 1/20 hp. shall be one of the following, to suit starting torque and requirements of specific motor application:
    1. Permanent-split capacitor.
    2. Split phase.
    3. Capacitor start, inductor run.

4. Capacitor start, capacitor run.

B. Multispeed Motors: Variable-torque, permanent-split-capacitor type.

C. Bearings: Prelubricated, antifriction ball bearings or sleeve bearings suitable for radial and thrust loading.

D. Motors 1/20 HP and Smaller: Shaded-pole type.

E. Thermal Protection: Internal protection to automatically open power supply circuit to motor when winding temperature exceeds a safe value calibrated to temperature rating of motor insulation. Thermal-protection device shall automatically reset when motor temperature returns to normal range.

2.06 MOTOR STARTERS

A. Fractional with horsepower up to ½ HP; electrical contract.

B. Polyphase and single phase above ½ HP: this contract.

C. Electrical contractor shall install all starters except for those provided as an integral part of equipment.

D. Polyphase starters shall be magnetic combination type, across-the-line electrically operated, electrically held, three pole assemblies, with arc extinguishing characteristics, silver to silver renewable contacts, 3 pole thermal bi-metallic, red run pilot light, individual phase protection, with overload heaters matched to motors installed and with 4 auxiliary contact, Hand-off-Auto switch, and control transformer.

E. For single phase motors above ½ HP provide magnetic combination single phase motor starters with overloads, non-fusible disconnect switch, red run pilot light, integral 120 volt control transformer with dual primary fusing auxiliary contacts.

F. Starters shall be as manufactured by G. E., Siemens, Square "D", Cerus or Cutler-Hammer.

PART 3 - EXECUTION

3.01 GENERAL:

A. Motors shall be leveled, set in true angular and concentric alignment with driven equipment, and bolted firmly to motor base, if not mounted on equipment. Motors's factory-mounted on equipment shall be checked for alignment to driven equipment and mounting bolts shall be checked to ensure bolts are tightly fastened.

B. Coordination: The Mechanical Contractor shall have the responsibility to provide adequate rough-in information to the Electrical Contractor. Any costs, such as patching and refinishing of walls, resulting from inadequate information shall be the responsibility of the Mechanical Contractor.

C. For variable frequency drives, refer to Specification 23 09 93.

END OF SECTION

SECTION 23 05 29 - HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:
   1. Metal pipe hangers and supports.
   2. Trapeze pipe hangers.
   3. Thermal-hanger shield inserts.
   4. Fastener systems.
   5. Equipment supports.

1.02 PERFORMANCE REQUIREMENTS

A. Delegated Design: Design trapeze pipe hangers and equipment supports, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
B. Structural Performance: Hangers and supports for HVAC piping and equipment shall withstand the effects of gravity loads and stresses within limits and under conditions indicated according to ASCE/SEI 7.
   1. Design supports for multiple pipes capable of supporting combined weight of supported systems, system contents, and test water.
   2. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.
   3. Design seismic-restraint hangers and supports for piping and equipment [and obtain approval from authorities having jurisdiction].

1.03 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.
B. Shop Drawings: Signed and sealed by a qualified professional engineer. Show fabrication and installation details and include calculations for the following: include Product Data for components:
   1. Trapeze pipe hangers.
   2. Equipment supports.
C. Delegated-Design Submittal: For trapeze hangers indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.04 INFORMATIONAL SUBMITTALS

A. Welding certificates.

1.05 QUALITY ASSURANCE

A. Structural Steel Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

B. Pipe Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.

PART 2 - PRODUCTS

2.01 METAL PIPE HANGERS AND SUPPORTS

A. Carbon-Steel Pipe Hangers and Supports:
   1. Description: MSS SP-58, Types 1 through 58, factory-fabricated components.
   2. Galvanized Metallic Coatings: Pregalvanized or hot dipped.
   3. Nonmetallic Coatings: Plastic coating, jacket, or liner.
   4. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion to support bearing surface of piping.
   5. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel.

B. Stainless-Steel Pipe Hangers and Supports:
   1. Description: MSS SP-58, Types 1 through 58, factory-fabricated components.
   2. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion to support bearing surface of piping.
   3. Hanger Rods: Continuous-thread rod, nuts, and washer made of stainless steel.

C. Copper Pipe Hangers:
   1. Description: MSS SP-58, Types 1 through 58, copper-coated-steel, factory-fabricated components.

D. Hanger Rods: Continuous-thread rod, nuts, and washer made of stainless steel.

2.02 TRAPEZE PIPE HANGERS

A. Description: MSS SP-69, Type 59, shop or field fabricated pipe-support assembly made from structural carbon-steel shapes with MSS SP-58 carbon-steel hanger rods, nuts, saddles, and U-bolts.

2.03 THERMAL-HANGER SHIELD INSERTS

A. Insulation-Insert Material for Cold Piping: ASTM C 552, Type II cellular glass with 100-psig minimum compressive strength and vapor barrier.

B. Insulation-Insert Material for Hot Piping: ASTM C 552, Type II cellular glass with 100-psig minimum compressive strength.

C. For Trapeze or Clamped Systems: Insert and shield shall cover entire circumference of pipe.

D. For Clevis or Band Hangers: Insert and shield shall cover lower 180 degrees of pipe.

E. Insert Length: Extend 2 inches beyond sheet metal shield for piping operating below ambient air temperature.

2.04 FASTENER SYSTEMS

A. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

B. Mechanical-Expansion Anchors: Insert wedge type, stainless steel anchors, for use in hardened

portland cement concrete; with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

2.05 EQUIPMENT SUPPORTS

A. Description: Welded, shop- or field-fabricated equipment support made from structural carbon-steel shapes.

2.06 MISCELLANEOUS MATERIALS

A. Structural Steel: ASTM A 36/A 36M, carbon-steel plates, shapes, and bars; black and galvanized.
B. Grout: ASTM C 1107, factory mixed and -packaged, dry, hydraulic-cement, nonshrink and nonmetallic grout; suitable for interior and exterior applications.
   1. Properties: Nonstaining, noncorrosive, and nongaseous.
   2. Design Mix: 5000-psi, 28-day compressive strength.

PART 3 - EXECUTION

3.01 HANGER AND SUPPORT INSTALLATION

A. Metal Pipe-Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Install hangers, supports, clamps, and attachments as required to properly support piping from the building structure.
B. Metal Trapeze Pipe-Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Arrange for grouping of parallel runs of horizontal piping, and support together on field-fabricated trapeze pipe hangers.
   1. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size or install intermediate supports for smaller diameter pipes as specified for individual pipe hangers.
   2. Field fabricate from ASTM A 36/A 36M, carbon-steel shapes selected for loads being supported. Weld steel according to AWS D1.1/D1.1M.
C. Thermal-Hanger Shield Installation: Install in pipe hanger or shield for insulated piping.
D. Fastener System Installation:
   1. Install powder-actuated fasteners for use in lightweight concrete or concrete slabs less than 4 inches thick in concrete after concrete is placed and completely cured. Use operators that are licensed by powder-actuated tool manufacturer. Install fasteners according to powder-actuated tool manufacturer's operating manual.
   2. Install mechanical-expansion anchors in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.
E. Install hangers and supports complete with necessary attachments, inserts, bolts, rods, nuts, washers, and other accessories.
F. Equipment Support Installation: Fabricate from welded-structural-steel shapes.
G. Install hangers and supports to allow controlled thermal and seismic movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.
H. Install lateral bracing with pipe hangers and supports to prevent swaying.
I. Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads, including valves, flanges, and strainers, NPS 2-1/2-inch and larger and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten

inserts to forms and install reinforcing bars through openings at top of inserts.

J. Load Distribution: Install hangers and supports so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.

K. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and to not exceed maximum pipe deflections allowed by ASME B31.9 for building services piping.

L. Insulated Piping:
   1. Attach clamps and spacers to piping.
      a. Piping Operating above Ambient Air Temperature: Clamp may project through insulation.
      b. Piping Operating below Ambient Air Temperature: Use thermal-hanger shield insert with clamp sized to match OD of insert.
      c. Do not exceed pipe stress limits allowed by ASME B31.9 for building services piping.
   2. Install MSS SP-58, Type 39, protection saddles if insulation without vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation.
      a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4-inch and larger if pipe is installed on rollers.
   3. Install MSS SP-58, Type 40, protective shields on cold piping with vapor barrier. Shields shall span an arc of 180 degrees.
      a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4-inch and larger if pipe is installed on rollers.
   4. Shield Dimensions for Pipe: Not less than the following:
      a. NPS ¼-inch to NPS 2 ½ -inch: 12 inches long and 0.048 inch thick.
      b. NPS 4-inch: 12 inches long and 0.06 inch thick.
      c. NPS 5-inch and NPS 6-inch: 18 inches long and 0.06 inch thick.
      d. NPS 8-inch to NPS 14-inch: 24 inches long and 0.075 inch thick.
      e. e. NPS 16-inch to NPS 24-inch: 24 inches long and 0.105 inch thick.
   5. Pipes NPS 8-inch and Larger: Include wood or reinforced calcium-silicate-insulation inserts of length at least as long as protective shield.
   6. Thermal-Hanger Shields: Install with insulation same thickness as piping insulation.

3.02 EQUIPMENT SUPPORTS

A. Fabricate structural-steel stands to suspend equipment from structure overhead or to support equipment above floor.

B. Grouting: Place grout under supports for equipment and make bearing surface smooth.

C. Provide lateral bracing, to prevent swaying, for equipment supports.

3.03 METAL FABRICATIONS

A. Cut, drill, and fit miscellaneous metal fabrications for trapeze pipe hangers and equipment supports.

B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.

C. Field Welding: Comply with AWS D1.1/D1.1M procedures for shielded, metal arc welding; appearance and quality of welds; and methods used in correcting welding work; and with the following:
   1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
   2. Obtain fusion without undercut or overlap.
   3. Remove welding flux immediately.
   4. Finish welds at exposed connections so no roughness shows after finishing and so contours

of welded surfaces match adjacent contours.

3.04 ADJUSTING

A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.
B. Trim excess length of continuous thread hanger and support rods to 1 ½ inches.

3.05 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 a minimum dry film thickness of 2.0 mils.
B. Touchup: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal are specified in Section 099113 "Exterior Painting" Section 099123 "Interior Painting" and Section 099600 "High Performance Coatings."
C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

3.06 HANGER AND SUPPORT SCHEDULE

A. Specific hanger and support requirements are in Sections specifying piping systems and equipment.
B. Comply with MSS SP-69 for pipe-hanger selections and applications that are not specified in piping system Sections.
C. Use hangers and supports with galvanized metallic coatings for piping and equipment that will not have field-applied finish.
D. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.
E. Use carbon-steel pipe hangers and supports and metal trapeze pipe hangers and attachments for general service applications.
F. Use copper-plated pipe hangers and copper attachments for copper piping and tubing.
G. Use padded hangers for piping that is subject to scratching.
H. Use thermal-hanger shield inserts for insulated piping and tubing.
I. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
   1. Adjustable, Steel Clevis Hangers (MSS Type 1): For suspension of noninsulated or insulated, stationary pipes NPS 1/2-inch to NPS 30-inch.
   2. Yoke-Type Pipe Clamps (MSS Type 2): For suspension of up to 1050 deg. F, pipes NPS 4-inch to NPS 24-inch, requiring up to 4 inches of insulation.
   3. Carbon- or Alloy-Steel, Double-Bolt Pipe Clamps (MSS Type 3): For suspension of pipes NPS 3/4-inch to NPS 36-inch, requiring clamp flexibility and up to 4 inches of insulation.
   4. Adjustable, Steel Band Hangers (MSS Type 7): For suspension of noninsulated, stationary pipes NPS 1/2-inch to NPS 8-inch.
   5. U-Bolts (MSS Type 24): For support of heavy pipes NPS 1/2-inch to NPS 30-inch.
   6. Pipe Saddle Supports (MSS Type 36): For support of pipes NPS 4-inch to NPS 36-inch, with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate.
   7. Pipe Stanchion Saddles (MSS Type 37): For support of pipes NPS 4-inch to NPS 36-inch, with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate, and with U-bolt to retain pipe.

8. Single-Pipe Rolls (MSS Type 41): For suspension of pipes NPS 1-inch to NPS 30-inch, from two rods if longitudinal movement caused by expansion and contraction might occur.
9. Complete Pipe Rolls (MSS Type 44): For support of pipes NPS 2-inch to NPS 42-inch if longitudinal movement caused by expansion and contraction might occur but vertical adjustment is not necessary.

J. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers NPS ¾-inch to NPS 24-inch.
2. Carbon or Alloy Steel Riser Clamps (MSS Type 42): For support of pipe risers NPS ¾-inch to NPS 24-inch if longer ends are required for riser clamps.

K. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1 Steel Turnbuckles (MSS Type 13): For adjustment up to 6 inches for heavy loads.
2 Steel Clevises (MSS Type 14): For 120 to 450 deg. F piping installations.

L. Building Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel or Malleable Concrete Inserts (MSS Type 18): For upper attachment to suspend pipe hangers from concrete ceiling.
2. Top-Beam C-Clamps (MSS Type 19): For use under roof installations with bar-joist construction, to attach to top flange of structural shape.
3. Side-Beam or Channel Clamps (MSS Type 20): For attaching to bottom flange of beams, channels, or angles.
4. Center-Beam Clamps (MSS Type 21): For attaching to center of bottom flange of beams.
5. Welded Beam Attachments (MSS Type 22): For attaching to bottom of beams if loads are considerable and rod sizes are large.
6. C-Clamps (MSS Type 23): For structural shapes.
7. Welded-Steel Brackets: For support of pipes from below, or for suspending from above by using clip and rod. Use one of the following for indicated loads:
   a. Light (MSS Type 31): 750 lb.
   b. Medium (MSS Type 32): 1500 lb.
   c. Heavy (MSS Type 33): 3000 lb.
8. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.
9. Plate Lugs (MSS Type 57): For attaching to steel beams if flexibility at beam is required.

M. Saddles and Shields: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel-Pipe-Covering Protection Saddles (MSS Type 39): To fill interior voids with insulation that matches adjoining insulation.
2. Protection Shields (MSS Type 40): Of length recommended in writing by manufacturer to prevent crushing insulation.
3. Thermal-Hanger Shield Inserts: For supporting insulated pipe.

N. Spring Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Spring Cushions (MSS Type 48): For light loads if vertical movement does not exceed 1 ¼ inches.
2. Spring-Cushion Roll Hangers (MSS Type 49): For equipping Type 41, roll hanger with springs.
3. Variable-Spring Base Supports (MSS Type 52): Preset to indicated load and limit variability factor to 25 percent to allow expansion and contraction of piping system from base support.

O. Comply with MSS SP-69 for trapeze pipe-hanger selections and applications that are not specified in

piping system Sections.

P. Use mechanical-expansion anchors instead of building attachments where required in concrete construction.

END OF SECTION

SECTION 23 05 48.13 - VIBRATION CONTROLS FOR HVAC

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:
1. Elastomeric isolation pads.
2. Restrained elastomeric isolation mounts.
3. Housed-spring isolators.
4. Housed-restrained-spring isolators.
5. Pipe-riser resilient supports.
6. Resilient pipe guides.
7. Elastomeric hangers.
8. Spring hangers.

1.02 ACTION SUBMITTALS

A. Product Data: For each type of product.
B. Delegated-Design Submittal: For each vibration isolation device.
1. Include design calculations for selecting vibration isolators.

PART 2 - PRODUCTS

2.01 ELASTOMERIC ISOLATION PADS

A. Elastomeric Isolation Pads:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. Kinetics Noise Control, Inc.
b. Mason Industries, Inc.
2. Fabrication: Single or multiple layers of sufficient durometer stiffness for uniform loading over pad area.
3. Size: Factory or field cut to match requirements of supported equipment.
4. Pad Material: Oil and water resistant with elastomeric properties.
5. Surface Pattern: Waffle pattern.
6. Infused nonwoven cotton or synthetic fibers.
7. Load-bearing metal plates adhered to pads.
8. Application: Floor mounted furnaces and A/C units of 2000 CFM or less. Roof mounted condensing units up to 5 tons shall be mounted on curbs with neoprene pads. See spring mounts for over 5 tons.

2.02 PIPE-RISER RESILIENT SUPPORT

A. Description: All-directional, acoustical pipe anchor consisting of two steel tubes separated by a minimum 1/2-inch-thick neoprene.
   1. Vertical-Limit Stops: Steel and neoprene vertical-limit stops arranged to prevent vertical travel in both directions.
   2. Maximum Load Per Support: 500 psig on isolation material providing equal isolation in all directions.

2.03 RESILIENT PIPE GUIDES

A. Description: Telescopic arrangement of two steel tubes or post and sleeve arrangement separated by a minimum 1/2-inch-thick neoprene.
   1. Factory-Set Height Guide with Shear Pin: Shear pin shall be removable and reinsertable to allow for selection of pipe movement. Guides shall be capable of motion to meet location requirements.

2.04 SPRING HANGERS

A. Combination Coil-Spring and Elastomeric-Insert Hanger with Spring and Insert in Compression:.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Kinetics Noise Control, Inc.
      b. Mason Industries, Inc.
   2. Frame: Steel, fabricated for connection to threaded hanger rods and to allow for a maximum of 30 degrees of angular hanger-rod misalignment without binding or reducing isolation efficiency.
   3. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
   4. Minimum Additional Travel: 50 percent of the required deflection at rated load.
   5. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
   6. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
   7. Elastomeric Element: Molded, oil-resistant rubber or neoprene. Steel-washer-reinforced cup to support spring and bushing projecting through bottom of frame.
   8. Adjustable Vertical Stop: Steel washer with neoprene washer "up-stop" on lower threaded rod.
   9. Self-centering hanger rod cap to ensure concentricity between hanger rod and support spring coil.
   10. Application: Below 5 ton horizontal suspended heat pumps and fan/coil units, in-line exhaust fans.

2.05 PRE-COMPRESSED SPRING AND NEOPRENE HANGERS

A. Vibration hangers shall be spring and neoprene as described above, but they shall be pre-compressed 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.

B. Hangers shall be type PC3ON as manufactured by Mason Industries, Inc. or equivalent by Vibration Eliminator Company or Amber Booth.
C. Application: Horizontal fan/coil units above 5 ton capacity.

2.06 DUCT HANGERS

A. Vibration hangers shall contain a steel spring located in a neoprene cup manufactured with a grommet to prevent a short circuiting of the hanger rod. The cup shall contain a steel washer designed to properly distribute the load on the neoprene and prevent its extrusion. Spring diameters and hanger box lower hole sizes shall be large enough to permit the hanger rod to swing through a 30 degree 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. Hangers shall be provided with an eye bolt on the spring end and provision to attach the housing to the flat iron duct straps. Submittals shall include a scale drawing of the hanger showing the 30 degree capability.
B. Hangers shall be type W30 as manufactured by Mason Industries, Inc. or equivalent by Vibration Eliminator Company or Amber Booth.
C. Application: Ductwork in mechanical rooms below occupied spaces.

2.07 EQUIPMENT FRAME BASES

A. Vibration isolator manufacturer shall furnish integral structural steel bases. Bases shall be rectangular in shape for all equipment other than centrifugal refrigeration machines and pump bases which may be "T" or "L" shaped. Pump bases for split case pumps shall include supports for suction and discharge base ells. All perimeter members shall be beams with a minimum depth equal to 1/10th of the longest dimension of the base. Beam depth need not exceed 14" provided that the deflection and misalignment is kept within acceptable limits as determined by the manufacturer. Height saving brackets shall be employed in all mounting locations to provide a base clearance of one inch.
B. Bases shall be type WF as manufactured by Mason Industries, Inc. or equivalent by Vibration Eliminator Company or Amber Booth.
C. Application: Special use where structural rigidity required between components.

2.08 EQUIPMENT RAIL BASES

A. Vibration isolator manufacturer shall provide steel members welded to height saving brackets to cradle machines having legs or bases that do not require a complete supplementary rigid to prevent strains in the equipment.
B. Inverted saddles shall be type ICS as manufactured by Mason Industries, Inc. or equivalent by Vibration Eliminator Company or Amber Booth.
C. Application: Base mounted HVAC units.

2.09 ROOF CURB BASES

A. Curb mounted rooftop equipment shall be mounted on vibration isolation bases that fit over the roof curb and under the isolated equipment. The extruded aluminum top members shall overlap the bottom member to provide water runoff independent of the seal. The aluminum member shall house cadmium plated springs having a 1 inch, 2 inch minimum deflection with 50% addition travel to solid. Spring diameters shall be no less than 0.8 of the spring height at rated load. Wind resistance shall be provided by means of resilient snubbers in the corners with a minimum clearance of 1/4" so as

not to interfere with the spring action except in high winds. The weather seal shall consist of continuous closed cell sponge materials both above and below the base and a waterproof flexible duct like connection joining the outside perimeter of the aluminum members. Foam or other contact like seals are unacceptable at the spring cavity closure. Caulking shall be kept to a minimum.

A. HUSHCORE Base System Model HIR-2. Curb mounted rooftop equipment shall be mounted on vibration isolation bases that fit over the roof curb and under the isolated equipment. The structural isolation rail curbs shall bear directly on the RTU factory curb which must be flashed and waterproofed into the roof's membrane waterproofing system. The installation shall be capable of being re-flashed without lifting the unit. Equipment manufacturer's base factory curbs shall be coordinated with the HIR rail curbs. Curb rail sides and ends shall be manufactured from minimum 14 ga. G90 galvanized sheet metal (expanded metal or painted steel is not acceptable), reinforced and cross braced as required. All springs shall provide a minimum of 85% vibration isolation efficiency. All springs shall be adjustable for leveling. Spring assemblies shall contain restraints and snubbers to resist wind and seismic forces. Seismic performance criteria shall be as shown or indicated on the drawings, schedules or in the vibration control specification. The factory curb shall accept standard 2" roof insulation supplied and installed by the roofing contractor. A resilient weather seal shall be incorporated into the rail curb design between the isolated top frame and the base curb assembly. Wood nailer and flashing shall be provided and rail curbs shall be manufactured to NRCA standards. Curb rail height shall be 13 ½" high minimum in addition to the base factory curb height or as shown on the drawings. Curbs shall be shipped pre-assembled. Knocked down kits are not acceptable. All non-galvanized materials shall be prime paint finished. All duct supports, bracing, flashing and safing as required. Unless otherwise recommended by the RTU manufacturer, all curbs shall be full perimeter type.

B. HUSHCORE® DECK™ System In-Curb Multi-Layer Acoustical Treatment

1. HUSHCORE® DECK™ system shall be multiple layers installed to meet the following acoustical performance. Materials shall meet Class "A" for flammability as per ASTM E-84 test procedures.

HUSHCORE In-Curb Composite - (Transmission Loss) in accordance with ASTM E-90-10																					
Freq. (Hz)	80	100	125	160	200	250	315	400	500	630	800	1K	1.25K	1.6K	2K	2.5K	3.15K	4K	5K	6.3K	8K	STC
Transmission Loss (dB)	18	23	34	36	43	45	51	55	57	60	60	62	64	67	66	66	71	74	76	78	81	57

2. Decking shall be maintained inside the curb to a clearance of ¼" maximum around all duct drops but may never contact the duct.
3. Total thickness shall not exceed 10" for all in-curb layers.
4. HUSH SEALANT™ HSAC-100 shall be used in the following areas.
   a. Around the entire curb interior perimeter
   b. Around duct drop penetrations of the decking
   c. Sealant shall be an acoustical grade, non-hardening formulation.

C. Curb mounted bases shall be type CMAB as manufactured by Mason Industries or equivalent by Vibration Eliminator Company, Amber Booth, Thi-Curb, Custom Curb or R.P.S.

D. Application: Roof mounted DX-Gas units and Energy Recovery Units.

PART 3 - EXECUTION

3.01 VIBRATION CONTROL DEVICE INSTALLATION

A. Coordinate the location of embedded connection hardware with supported equipment attachment and mounting points and with requirements for concrete reinforcement and formwork specified in Architectural specification sections.
B. Installation of vibration isolators must not cause any change of position of equipment, piping, or ductwork resulting in stresses or misalignment.
C. Select the appropriate base to match the equipment being provided. Base shall meet the exact dimensional and weight requirements at all points of the curb. Install as recommended by the vibration isolator manufacturer.

END OF SECTION

SECTION 23 05 50 - FIRE STOPPING

PART 1 - GENERAL

1.01 SUMMARY

A. Refer to Section 23 05 00 for requirements which are applicable to this section.
B. Refer to International Building Codes.
C. Section includes.
   1. Through penetration firestops and smoke-stops for all fire rated bearing and non-bearing wall and floor assemblies, both blank (empty) and those accommodating penetrating items such as cables, conduits, pipes, ducts, etc.

1.02 REFERENCES

A. American Society for Testing and Materials Standards (ASTM):
   1. ASTM E84: Standard Test Method for Surface Burning Characteristics of Building Materials.
   2. ASTM E814: Standard Test method for Fire Tests of Through-Penetration Firestops.
B. Underwriters Laboratories, Inc.:
   1. UL 723 Surface Burning Characteristics of Building Materials
   2. UL 1479 Fire Tests of Through-Penetration Firestops.
C. UL Fire Resistance Directory:
   1. Through Penetration Firestop Devices (XHJI)
   2. Fire Resistive Ratings (BXUV)
   3. Through Penetration Firestop Systems (XHEZ)
   4. Fill, Void, or Cavity Material (XHHW)

1.03 DEFINITIONS

A. FIRESTOPPING: The use of a material or combination of materials in a fire rated structure (wall or floor) where it has been breached, so as to restore the integrity of the fire rating on that wall or floor.
B. SYSTEM: The use of a specific firestop material or combination of materials in conjunction with a specific wall or floor construction type and a specific penetrant(s), constitutes a “System.”
C. BARRIER: Any bearing or non-bearing wall or floor that has an hourly fire and smoke rating.
D. THROUGH-PENETRATION: Any penetration of a fire rated wall or floor that completely breaches the barrier.
E. MEMBRANE-PENETRATION: Any penetration in a fire rated wall that breaches only one side of the barrier.
F. CONSTRUCTION GAPS: any gap, joint, or opening, whether static or dynamic, where the top of a wall may meet a floor; wall to wall applications; edge to edge floor configurations; floor to exterior wall; or any linear breach in a rated barrier. Where movement is required, the firestopping system must comply with UL2079 for dynamic joints.

1.04 SUBMITTALS

NOTE: A “Certificate of Conformance,” from the manufacturers listed in Section “2.02 Acceptable Manufacturers,” is required with the “Submittal Package” to ensure that the material selected

meets all of the criteria of this specification as set forth in Section “1.05 Quality Assurance.”

A. Submit manufacturer’s product literature for each type of firestop material to be installed. Literature shall indicate product characteristics, typical uses, performance and imitation criteria, and test data. Submittal should be in compliance with Section 23 05 00.
B. Material Safety Data Sheets (MSDS): Submit MSDS for each firestop product.
C. UL Tested Systems: Submit drawings showing typical installation details for the methods of installation. Indicate which firestop materials will be used and thickness for different hourly ratings.
D. Engineering Judgments: Submit manufacturer’s drawings for all non-standard applications where no UL rested system exists. All drawings must indicate the “Tested” UL system upon which the judgment is based so as to assess the relevance of the judgment to some known performance.
E. Submit manufacturer’s installation procedures for each type of product.
F. Approved Applicator: Submit document from manufacturer wherein manufacturer recognizes the installer as qualified or submit a list of past projects to demonstrate capability to perform intended work.
G. Upon completion, installer shall provide written certification that materials were installed in accordance with the manufacturer’s installation instructions and details.

1.05 QUALITY ASSURANCE

A. Firestopping systems (materials and design):
    1. Shall conform to both Flame (F) and Temperature (T) ratings as required by local building codes and as tested by nationally accepted test agencies per ASTM E814 or UL 1479 fire tests in a configuration that is representative of field conditions.
    2. The F rating must be minimum of one (1) hour but not less than the fire resistance rating of the assembly being penetrated. T rating when required by code authority shall be based on measurement of the temperature rise on penetrating item(s). The fire test shall be conducted with a minimum positive pressure differential of 0.01 inches of water column joints, must be tested to UL 2079 with movement capabilities equal to those of the anticipated conditions.
B. Firestopping materials and systems must be capable of closing or filling through openings created by 1) the burning or melting of combustible pipes, cable jacketing, or pipe insulation materials, or 2) deflection of sheet metal due to thermal expansion (electrical & mechanical duct work).
C. Firestopping material shall be asbestos and lead free and shall not incorporate nor require the use of hazardous solvents.
D. Firestopping sealants must be flexible, allowing for normal pipe movement.
E. Firestopping materials shall not shrink upon drying as evidenced by cracking or pulling back from contact surfaces.
F. Firestopping materials shall be moisture resistant, and may not dissolve in water after curing.
G. All firestopping materials shall be manufactured by one manufacturer (to the maximum extent possible).
H. Installation of firestopping systems shall be performed by a contractor (or contractors) trained or approved by the firestop manufacturer.
I. Material used shall be in accordance with the manufacturer’s written installation instructions.

1.06 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Deliver material in the manufacturer’s original, unopened containers or packages with the manufacturer’s name, product identification, lot number, UL label and mixing and installation instructions as applicable.

B. Store materials in the original, unopened containers or packages and under conditions recommended by the manufacturer.
C. All firestop materials will be installed prior to expiration of shelf life.

1.07 PROJECT CONDITIONS

A. Conform to manufacturer's printed instructions for installation and when applicable, curing in accordance with temperature and humidity. Conform to ventilation and safety requirements.
B. Verify the condition of the substrates before starting work.
C. Weather Conditions: Do not proceed with installation of firestop materials when temperatures fall outside the manufacturer's suggested limits.
D. Care should be taken to ensure that firestopping materials are installed so as not to contaminate adjacent surfaces.

1.08 SEQUENCING

A. Schedule firestopping after installation of penetrants but prior to concealing the openings.
B. Firestopping shall precede gypsum board finishing.

1.09 PROTECTION

A. Where firestopping is installed at locations which will remain exposed in the completed work, provide protection as necessary to prevent damage to adjacent surfaces and finishes, and protect as necessary against damage from other construction activities.

PART 2 - PRODUCTS

2.01 GENERAL

A. Firestopping materials and systems shall meet the requirements specified herein.
B. Architect must approve in writing any alternates to the materials and system specified herein.
C. All firestop products and systems shall be designed and installed so that the basic sealing system will allow the full restoration of the thermal and fire resistance properties of the barrier being penetrated with minimal repair if penetrants are subsequently removed.
D. For applications where combustible penetrants are involved, i.e., insulated, and plastic pipe, a suitable intumescent material must be used.

2.02 ACCEPTABLE MANUFACTURERS

NOTE: Inclusion of materials in this specification does not indicate that the listed products have been evaluated for conformance to this specification. Therefore, the user/contractor must certify in the submittal package, with a "Certificate of Conformance" from the manufacturers listed below, that the material selected meets all of the criteria set forth in Section "1.05 Quality Assurance" of this specification.

A. Specified Technologies, Inc./GE Pensil® (STI), Somerville, NJ 08876, Phone: (800) 992-1180.
B. 3M Fire Protection Products, St. Paul, MN

2.03 MATERIALS

A. Intumescent Firestop Sealants and Caulks:
   1. STI SpecSeal SSS100
   2. 3M Fire Barrier Caulk CP25WB+
B. Latex Firestop Sealant
   1. STI SpecSeal LC150 Sealant
C. Elastomeric Water-Based Sealant
   1. STI SpecSeal ES100 Elastomeric Sealant
D. Silicone Firestop Sealants and Caulks:
   1. STI SpecSeal Pensil 300\
   2. 3M Fire Barrier Silicone Sealants
E. Firestop Putty:
   1. STI SpecSeal Firestop Putty Bars and Pads
   2. 3M Fire Barrier Moldable Putty
F. Firestop Collars:
   1. STI Spec Seal Firestop Collars
   2. 3M Fire Barrier PPD's.
G. Wrap Strips:
   1. SpecSeal Wrap Strip
   2. 3M Fire Barrier FS195 Wrap Strip.
H. 2-Part Silicone Firestop Foam:
   1. STI SpecSeal Pensil 200
   2. 3M Fire Barrier 2001 Silicone Foam.
I. Firestop Mortar:
   1. STI SpecSeal Mortar.
J. Firestop Pillows:
   1. STI SpecSeal Pillows
K. Elastomeric Spray:
   1. STI SpecSeal AS Elastomeric Spray
L. Composite Board:
   1. 3M Barrier Sheet Material
M. Accessories:

2.04 Forming/Damming Materials: Mineral fiberboard or other type as per manufacturer recommendation.

PART 3 - CONDITIONS REQUIRING FIRESTOPPING

A. General:
B. Provide firestopping for conditions specified whether or not firestopping is indicated, and if indicated, whether such material is designed as insulation, safing, or otherwise.
C. Through-Penetrations:
D. Firestopping shall be installed in all open penetrations and in the annular space in all penetrations in any bearing or non-bearing fire-rated barrier.

E. Membrane-Penetrations:
F. Where required by code, all membrane-penetrations in rated walls shall be protected with firestopping products that meet the requirements of third party time/temperature testing.
G. Construction Joints/Gaps:
H. Fire Stopping shall be provided:
   1. Between the edges of floor slabs and exterior walls.
   2. Between the tops of walls and the underside of floors
   3. In the control joint in masonry walls and floors
   4. In expansion joints.
I. Smoke-Stopping:

3.02 As required by the other Sections, Smoke-Stops shall be provided for Through-Penetrations, Membrane-) Penetrations, and Construction Gaps with a material approved and tested for such application.

3.03 EXAMINATION

A. Examine the areas and conditions where firestops are to be installed and notify the architect of conditions detrimental to the proper and timely completion of the work. Do not proceed with work until unsatisfactory conditions have been corrected by the contractor in a manner acceptable to the architect and in accordance with Section 01039.
B. Verify that environmental conditions are safe and suitable for installation of firestop products.
C. Verify that all pipe, conduit, cable, and other items which penetrate fire-rated construction have been permanently installed prior to installation of firestops.

3.04 INSTALLATION

A. General:
   1. Installation of firestops shall be performed by an applicator/installer qualified and trained by the manufacturer. Installation shall be performed in strict accordance with manufacturer's detailed installation procedures.
   2. Apply firestops in accordance with fire test reports, fire resistance requirements, acceptable sample installations, and manufacturer's recommendations.
   3. Unless specified and approved, all insulation used in conjunction with through-penetrants shall remain intact and undamaged and may not be removed.
   4. Seal holes and penetrations to ensure an effective smoke seal.
   5. In areas of high traffic, protect firestopping materials from damage. If the opening is large, install firestopping materials capable of supporting the weight of a human.
   6. Insulation types specified in other sections shall not be installed in lieu of firestopping material specified herein.
   7. All combustible penetrants (e.g., Non-metallic pipes or insulated metallic pipes) shall be fire stopped using products and systems tested in a configuration representative of the field condition.
B. Dam Construction: When required to properly contain firestopping materials within openings damming or packing materials may be utilized. Combustible damming material must be removed after appropriate curing. Non-combustible damming materials may be left as a permanent component of the firestop system.

3.05 FIELD QUALITY CONTROL

A. Prepare and install firestopping systems in accordance with manufacturer's printed instructions and recommendations.
B. Follow safety procedures recommended in the Material Safety Data Sheets.
C. Finish surfaces of firestopping which are to remain exposed in the completed work to a uniform and level condition.
D. All areas of work must be accessible until inspection by the applicable Code Authorities.
E. Correct unacceptable firestops and provide additional inspection to verify compliance with this specification.

3.06 CLEANING

A. Remove spilled and excess materials adjacent to firestopping without damaging adjacent surfaces.
B. Leave finished work in neat, clean condition with no evidence of spill overs or damage to adjacent surfaces.

END OF SECTION

SECTION 23 05 53 - IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:
1. Equipment labels.
2. Warning signs and labels.
3. Pipe labels.
4. Duct labels.

1.02 ACTION SUBMITTALS

A. Product Data: For each type of product.

PART 2 - PRODUCTS

2.01 EQUIPMENT LABELS

A. Metal Labels for Equipment:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. Brady Corporation.
b. Brimar Industries, Inc.
c. Carlton Industries, LP.
d. Champion America.
e. Craftmark Pipe Markers.
f. emedco.
g. Kolbi Pipe Marker Co.
h. LEM Products Inc.
i. Marking Services, Inc.
j. Seton Identification Products.
2. Material and Thickness: Stainless steel, 0.025-inch minimum thickness, and having predrilled or stamped holes for attachment hardware.
3. Letter Color: Black.
4. Background Color: White.
5. Minimum Label Size: Length and width vary for required label content, but not less than 2 ½ by 3/4 inch.
6. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-quarters the size of principal lettering.
7. Fasteners: Stainless-steel self-tapping screws.

8. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

B. Plastic Labels for Equipment:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Brady Corporation.
      b. Brimar Industries, Inc.
      c. Carlton Industries, LP.
      d. Champion America.
      e. Craftmark Pipe Markers.
      f. emedco.
      g. Kolbi Pipe Marker Co.
      h. LEM Products Inc.
      i. Marking Services, Inc.
      j. Seton Identification Products.
   2. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving,1/8 inch thick, and having predrilled holes for attachment hardware.
   3. Letter Color: Black.
   4. Background Color: White.
   5. Maximum Temperature: Able to withstand temperatures up to 160 deg. F.
   6. Minimum Label Size: Length and width vary for required label content, but not less than 2 ½ by 3/4 inch.
   7. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-quarters the size of principal lettering.
   8. Fasteners: Stainless-steel self-tapping screws.
   9. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

C. Label Content: Include equipment's Drawing designation or unique equipment number, drawing numbers where equipment is indicated (plans, details, and schedules), and the Specification Section number and title where equipment is specified.

D. Equipment Label Schedule: For each item of equipment to be labeled, on 8 ½ by 11-inch bond paper. Tabulate equipment identification number, and identify Drawing numbers where equipment is indicated (plans, details, and schedules) and the Specification Section number and title where equipment is specified. Equipment schedule shall be included in operation and maintenance data.

2.02 WARNING SIGNS AND LABELS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Brady Corporation.
   2. Brimar Industries, Inc.
   3. Carlton Industries, LP.
   4. Champion America.
   5. Craftmark Pipe Markers.
   6. emedco.
   7. LEM Products Inc.
   8. Marking Services Inc.
   9. National Marker Company.
   10. Seton Identification Products.
   11. Stranco, Inc.

B. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch thick,

and having predrilled holes for attachment hardware.

C. Letter Color: Black.
D. Background Color: White
E. Maximum Temperature: Able to withstand temperatures up to 160 deg. F.
F. Minimum Label Size: Length and width vary for required label content, but not less than 2 ½ by 3/4 inch.
G. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-quarters the size of principal lettering.
H. Fasteners: Stainless-steel self-tapping screws.
I. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
J. Label Content: Include caution and warning information plus emergency notification instructions.

2.03 PIPE LABELS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Actioncraft Products, Inc.; a division of Industrial Test Equipment Co., Inc.
   2. Brady Corporation.
   3. Brimar Industries, Inc.
   4. Carlton Industries, LP.
   5. Champion America.
   6. Craftmark Pipe Markers.
   7. emedco.
   8. Kolbi Pipe Marker Co.
   9. LEM Products Inc.
   10. Marking Services Inc.
   11. Seton Identification Products.
B. General Requirements for Manufactured Pipe Labels: Preprinted, color-coded, with lettering indicating service, and showing flow direction according to ASME A13.1.
C. Pretensioned Pipe Labels: Precoiled, semirigid plastic formed to partially cover circumference of pipe and to attach to pipe without fasteners or adhesive.
D. Self-Adhesive Pipe Labels: Printed plastic with contact-type, permanent-adhesive backing.
E. Pipe Label Contents: Include identification of piping service using same designations or abbreviations as used on Drawings; also include pipe size and an arrow indicating flow direction.
   1. Flow-Direction Arrows: Integral with piping system service lettering to accommodate both directions or as separate unit on each pipe label to indicate flow direction.
   2. Lettering Size: Size letters according to ASME A13.1 for piping. At least 1/2 inch for viewing distances up to 72 inches and proportionately larger lettering for greater viewing distances.

2.04 DUCT LABELS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Brady Corporation.
   2. Brimar Industries, Inc.
   3. Carlton Industries, LP.
   4. Champion America.
   5. Craftmark Pipe Markers.
   6. emedco.
   7. Kolbi Pipe Marker Co.
   8. LEM Products Inc.

9. Marking Services Inc.
10. Seton Identification Products.

B. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch thick, and having predrilled holes for attachment hardware.
C. Letter Color: Black.
D. Background Color: White.
E. Maximum Temperature: Able to withstand temperatures up to 160 deg. F.
F. Minimum Label Size: Length and width vary for required label content, but not less than 2 ½ by 3/4 inch.
G. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-quarters the size of principal lettering.
H. Fasteners: Stainless-steel self-tapping screws.
I. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
J. Duct Label Contents: Include identification of duct service using same designations or abbreviations as used on Drawings; also include duct size and an arrow indicating flow direction.
    1. Flow-Direction Arrows: Integral with duct system service lettering to accommodate both directions or as separate unit on each duct label to indicate flow direction.

PART 3 - EXECUTION

3.01 PREPARATION

A. Clean piping and equipment surfaces of substances that could impair bond of identification devices, including dirt, oil, grease, release agents, and incompatible primers, paints, and encapsulants.

3.02 EQUIPMENT LABEL INSTALLATION

A. Install or permanently fasten labels on each major item of mechanical equipment.
B. Locate equipment labels where accessible and visible.

3.03 PIPE LABEL INSTALLATION

A. Piping Color-Coding: Painting of piping is specified in Section 099123 "Interior Painting." Section 099600 "High-Performance Coatings."
B. Pipe Label Locations: Locate pipe labels where piping is exposed or above accessible ceilings in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior exposed locations as follows:
    1. Near each valve and control device.
    2. Near each branch connection, excluding short takeoffs for fixtures and terminal units. Where flow pattern is not obvious, mark each pipe at branch.
    3. Near penetrations and on both sides of through walls, floors, ceilings, and inaccessible enclosures.
    4. At access doors, manholes, and similar access points that permit view of concealed piping.
    5. Near major equipment items and other points of origination and termination.
    6. Spaced at maximum intervals of 50 feet along each run. Reduce intervals to 25 feet areas of congested piping and equipment.

C. Pipe Label Color Schedule:
   1. Refrigerant Piping: Black letters on a safety-orange background.

3.04 DUCT LABEL INSTALLATION

A. Install plastic-laminated self-adhesive duct labels with permanent adhesive on air ducts in the following color codes:
   1. Blue: For cold-air supply ducts.
   2. Yellow: For hot-air supply ducts.
   3. Green: For exhaust, outside, relief, return, and mixed-air ducts.

B. Locate labels near points where ducts enter into and exit from concealed spaces and at maximum intervals of 50 feet in each space where ducts are exposed or concealed by removable ceiling system.

END OF SECTION

SECTION 23 05 93 - TESTING, ADJUSTING, AND BALANCING FOR HVAC

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:
   1. Balancing Air Systems:
      a. Constant-volume air systems.

1.02 DEFINITIONS

A. AABC: Associated Air Balance Council.
B. NEBB: National Environmental Balancing Bureau.
C. TAB: Testing, adjusting, and balancing.
D. TABB: Testing, Adjusting, and Balancing Bureau.
E. TAB Specialist: An independent entity meeting qualifications to perform TAB work.
F. TDH: Total dynamic head.

1.03 ACTION SUBMITTALS

1.04 INFORMATIONAL SUBMITTALS

A. Certified TAB reports.

1.05 QUALITY ASSURANCE

A. TAB Specialists Qualifications: Certified by AABC or NEBB.
   1. TAB Field Supervisor: Employee of the TAB specialist and certified by AABC or NEBB.
   2. TAB Technician: Employee of the TAB specialist and certified by AABC or NEBB as a TAB technician.
B. Instrumentation Type, Quantity, Accuracy, and Calibration: Comply with requirements in ASHRAE 111, Section 4, "Instrumentation."
C. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 7.2.2 - "Air Balancing."
D. ASHRAE/IESNA Compliance: Applicable requirements in ASHRAE/IESNA 90.1, Section 6.7.2.3 - "System Balancing."

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION

3.01 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 installed systems for 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 applicable for intended purpose and 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 and underfloor air plenums used for supply, return, or relief air to verify that they 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 verify that bearings are greased, belts are aligned and tight, filters are clean, and equipment with functioning controls is ready for operation.

J. Examine terminal units, such as variable-air-volume boxes, and verify that they are accessible and their controls are connected and functioning.

K. Examine strainers. Verify that startup screens have been replaced by permanent screens with indicated perforations.

L. Examine control valves for proper installation for their intended function of throttling, diverting, or mixing fluid flows.

M. Examine heat-transfer coils for correct piping connections and for clean and straight fins.

N. Examine system pumps to ensure absence of entrained air in the suction piping.

O. Examine operating safety interlocks and controls on HVAC equipment.

P. 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.

3.02 PREPARATION

A. Prepare a TAB plan that includes strategies and step-by-step procedures for balancing the systems.

B. Perform system-readiness checks of HVAC systems and equipment to verify system readiness for TAB work. Include, at a minimum, the following:
   1. Airside:
      a. Duct systems are complete with terminals installed.
      b. Volume, smoke, and fire dampers are open and functional.
      c. Clean filters are installed.
      d. Fans are operating, free of vibration, and rotating in correct direction.
      e. Variable-frequency controllers' startup is complete, and safeties are verified.
      f. Automatic temperature-control systems are operational.

g. Ceilings are installed.
h. Windows and doors are installed.
i. Suitable access to balancing devices and equipment is provided.

2. Hydronics:
   a. Verify leakage and pressure tests on water distribution systems have been satisfactorily completed.
   b. Piping is complete with terminals installed.
   c. Water treatment is complete.
   d. Systems are flushed, filled, and air purged.
   e. Strainers are pulled and cleaned.
   f. Control valves are functioning per the sequence of operation.
   g. Shutoff and balance valves have been verified to be 100 percent open.
   h. Pumps are started, and proper rotation is verified.
   i. Pump gage connections are installed directly at pump inlet and outlet flanges or in discharge and suction pipe prior to valves or strainers.
   j. Variable-frequency controllers' startup is complete and safeties are verified.
   k. Suitable access to balancing devices and equipment is provided.

3.03 GENERAL PROCEDURES FOR TESTING AND BALANCING

A. Perform testing and balancing procedures on each system according to the procedures contained in AABC's "National Standards for Total System Balance" ASHRAE 111, NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems" or SMACNA's "HVAC Systems - Testing, Adjusting, and Balancing" and in this Section.

B. Cut insulation, ducts, pipes, and equipment cabinets for installation of test probes to the minimum extent necessary for TAB procedures.
   1. After testing and balancing, patch probe holes in ducts with same material and thickness as used to construct ducts.
   2. After testing and balancing, install test ports and duct access doors that comply with requirements in Section 233300 "Air Duct Accessories."
   3. Install and join new insulation that matches removed materials. Restore insulation, coverings, vapor barrier, and finish according to Section 230713 "Duct Insulation," Section 230716 "HVAC Equipment Insulation," and Section 230719 "HVAC Piping Insulation."

C. Mark equipment and balancing devices, including damper-control positions, valve position indicators, fan-speed-control levers, and similar controls and devices, with paint or other suitable, permanent identification material to show final settings.

D. Take and report testing and balancing measurements in inch-pound (IP) units.

3.04 GENERAL PROCEDURES FOR BALANCING AIR SYSTEMS

A. Prepare test reports for both fans and outlets. Obtain manufacturer's outlet factors and recommended testing procedures. Cross-check the summation of required outlet volumes with required fan volumes.

B. Prepare schematic diagrams of systems' "as-built" duct layouts.

C. For variable-air-volume systems, develop a plan to simulate diversity.

D. Determine the best locations in main and branch ducts for accurate duct-airflow measurements.

E. Check airflow patterns from the outdoor-air louvers and dampers and the return- and exhaust-air dampers through the supply-fan discharge and mixing dampers.

F. Locate start-stop and disconnect switches, electrical interlocks, and motor starters.

G. Verify that motor starters are equipped with properly sized thermal protection.

H. Check dampers for proper position to achieve desired airflow path.
I. Check for airflow blockages.
J. Check condensate drains for proper connections and functioning.
K. Check for proper sealing of air-handling-unit components.
L. Verify that air duct system is sealed as specified in Section 233113 "Metal Ducts."
M. The contractor shall allow for (2) passes for each heating and cooling season.
N. Allow for one sheave change for 50% of the HVAC systems to be tested and adjusted. Replacement sheave shall be furnished and installed by the mechanical contractor. Sheave shall be adjusted by the TBA contractor.

3.05 PROCEDURES FOR CONSTANT-VOLUME AIR SYSTEMS

A. Adjust fans to deliver total indicated airflows within the maximum allowable fan speed listed by fan manufacturer.
   1. Measure total airflow.
      a. Set outside-air, return-air, and relief-air dampers for proper position that simulates minimum outdoor-air conditions.
      b. Where duct conditions allow, measure airflow by Pitot-tube traverse. If necessary, perform multiple Pitot-tube traverses to obtain total airflow.
      c. Where duct conditions are not suitable for Pitot-tube traverse measurements, a coil traverse may be acceptable.
      d. If a reliable Pitot-tube traverse or coil traverse is not possible, measure airflow at terminals and calculate the total airflow.
   2. Measure fan static pressures as follows:
      a. Measure static pressure directly at the fan outlet or through the flexible connection.
      b. Measure static pressure directly at the fan inlet or through the flexible connection.
      c. Measure static pressure across each component that makes up the air-handling system.
      d. Report artificial loading of filters at the time static pressures are measured.
   3. Review Record Documents to determine variations in design static pressures versus actual static pressures. Calculate actual system-effect factors. Recommend adjustments to accommodate actual conditions.
   4. Obtain approval from Owner and Construction Manager for adjustment of fan speed higher or lower than indicated speed. Comply with requirements in HVAC Sections for air-handling units for adjustment of fans, belts, and pulley sizes to achieve indicated air-handling-unit performance.
   5. Do not make fan-speed adjustments that result in motor overload. Consult equipment manufacturers about fan-speed safety factors. Modulate dampers and measure fan-motor amperage to ensure that no overload occurs. Measure amperage in full-cooling, full-heating, economizer, and any other operating mode to determine the maximum required brake horsepower.
B. Adjust volume dampers for main duct, submain ducts, and major branch ducts to indicated airflows.
   1. Measure airflow of submain and branch ducts.
   2. Adjust submain and branch duct volume dampers for specified airflow.
   3. Re-measure each submain and branch duct after all have been adjusted.
C. Adjust air inlets and outlets for each space to indicated airflows.
   1. Set airflow patterns of adjustable outlets for proper distribution without drafts.
   2. Measure inlets and outlets airflow.
   3. Adjust each inlet and outlet for specified airflow.
   4. Re-measure each inlet and outlet after they have been adjusted.

3.06 ENERGY RECOVERY UNIT TEST

A. Tests shall substantiate:
   1. CFM of supply and exhaust.
   2. Winter BTU exchange, sensible and latent grains.
   3. Summer BTU exchange, sensible and latent grains.
   4. Quantitative CFM of cross flow from higher pressure to lower pressure side of wheel. Percent of total flow.

B. Compare measured values to required values and tabulate.

3.07 DUCTWORK LEAKAGE TESTING

A. Installed ductwork shall be tested prior to installation of access doors, take-offs, etc.

B. All leak testing shall be witnessed by the engineer or representative of the engineer. The contractor shall give the engineer 72 hours' notice prior to testing. Any testing not witnessed by the engineer or his/her representative shall be considered invalid and will be redone.

C. The testing shall be performed as follows:
   1. Perform testing in accordance with HVAC Air Duct Leakage Test Manual.
   2. Use a certified orifice tube for measuring the leakage.
   3. Determine section of system to be tested and blank off.
   4. Determine the percentage of the system being tested.
   5. Using that percentage, determine the allowable leakage (cfm) for that section being tested.
   6. Pressurize to operating pressure and repair any significant or audible leaks.
   7. Repressurize the measure leakage.
   8. Repeat steps 6 and 7 until the leakage measured is less than the allowable defined in step 5.

   NOTE: It is recommended that the first 100'-300' of ductwork installed be tested to insure the quality of the workmanship at an early stage.

3.08 SMOKE EVACUATION SYSTEMS/STAIR PRESSURIZATION SYSTEMS

A. Provide all required measurements in the Commissioning Specification Section.

3.09 TOLERANCES

A. Set HVAC system's airflow rates and water flow rates within the following tolerances:
   1. Supply, Return, and Exhaust Fans and Equipment with Fans: Plus or minus 10 percent.
   2. Air Outlets and Inlets: Plus or minus 10 percent.
   3. Heating-Water Flow Rate: Plus or minus 10 percent.
   4. Cooling-Water Flow Rate: Plus or minus 10 percent.

B. Maintaining pressure relationships as designed shall have priority over the tolerances specified above.

3.10 FINAL REPORT

A. General: Prepare a certified written report; tabulate and divide the report into separate sections for tested systems and balanced systems.
   1. Include a certification sheet at the front of the report's binder, signed and sealed by the

certified testing and balancing engineer.
2. Include a list of instruments used for procedures, along with proof of calibration.
3. Certify validity and accuracy of field data.

B. Final Report Contents: In addition to certified field-report data, include the following:
1. Fan curves.
2. Manufacturers' test data.
3. Field test reports prepared by system and equipment installers.
4. Other information relative to equipment performance; do not include Shop Drawings and Product Data.

C. General Report Data: In addition to form titles and entries, include the following data:
1. Title page.
2. Name and address of the TAB specialist.
3. Project name.
4. Project location.
5. Architect's name and address.
6. Engineer's name and address.
7. Contractor's name and address.
8. Report date.
9. Signature of TAB supervisor who certifies the report.
10. Table of Contents with the total number of pages defined for each section of the report. Number each page in the report.
11. Summary of contents including the following:
    a. Indicated versus final performance.
    b. Notable characteristics of systems.
    c. Description of system operation sequence if it varies from the Contract Documents.
12. Nomenclature sheets for each item of equipment.
13. Data for terminal units, including manufacturer's name, type, size, and fittings.
14. Notes to explain why certain final data in the body of reports vary from indicated values.
15. Test conditions for fans and pump performance forms including the following:
    a. Settings for outdoor-, return-, and exhaust-air dampers.
    b. Conditions of filters.
    c. Cooling coil, wet- and dry-bulb conditions.
    d. Face and bypass damper settings at coils.
    e. Fan drive settings including settings and percentage of maximum pitch diameter.
    f. Inlet vane settings for variable-air-volume systems.
    g. Settings for supply-air, static-pressure controller.
    h. Other system operating conditions that affect performance.

D. System Diagrams: Include schematic layouts of air and hydronic distribution systems. Present each system with single-line diagram and include the following:
1. Quantities of outdoor, supply, return, and exhaust airflows.
2. Duct, outlet, and inlet sizes.
3. Terminal units.
4. Balancing stations.
5. Position of balancing devices.

E. Air-Handling-Unit Test Reports: For air-handling units with coils, include the following:
1. Unit Data:
    a. Unit identification.
    b. Location.
    c. Make and type.
    d. Model number and unit size.

e. Manufacturer's serial number.
f. Unit arrangement and class.
g. Discharge arrangement.
h. Sheave make, size in inches, and bore.
i. Center-to-center dimensions of sheave and amount of adjustments in inches.
j. Number, type, and size of filters.

2. Motor Data:
a. Motor make, and frame type and size.
b. Horsepower and rpm.
c. Volts, phase, and hertz.
d. Full-load amperage and service factor.
e. Sheave make, size in inches, and bore.
f. Center-to-center dimensions of sheave and amount of adjustments in inches.

3. Test Data (Indicated and Actual Values):
a. Total airflow rate in cfm.
b. Total system static pressure in inches wg.
c. Fan rpm.
d. Discharge static pressure in inches wg.
e. Filter static-pressure differential in inches wg.
f. Outdoor airflow in cfm.
g. Return airflow in cfm.
h. Outdoor-air damper position.
i. Return-air damper position.

F. Air-Terminal-Device Reports:
1. Unit Data:
a. System and air-handling unit identification.
b. Location and zone.
c. Apparatus used for test.
d. Area served.
e. Make.
f. Number from system diagram.
g. Type and model number.
h. Size.
i. Effective area in sq. ft.

2. Test Data (Indicated and Actual Values):
a. Airflow rate in cfm.
b. Air velocity in fpm.
c. Preliminary airflow rate as needed in cfm.
d. Preliminary velocity as needed in fpm.
e. Final airflow rate in cfm.
f. Final velocity in fpm.
g. Space temperature in deg. F.

G. Instrument Calibration Reports:
1. Report Data:
a. Instrument type and make.
b. Serial number.
c. Application.
d. Dates of use.
e. Dates of calibration.

3.11 VERIFICATION OF TAB REPORT

A. The TAB specialist's test and balance engineer shall conduct the inspection in the presence of Construction Manager.
B. Construction Manager shall randomly select measurements, documented in the final report, to be rechecked. Rechecking shall be limited to either 10 percent of the total measurements recorded or the extent of measurements that can be accomplished in a normal 8-hour business day.
C. If rechecks yield measurements that differ from the measurements documented in the final report by more than the tolerances allowed, the measurements shall be noted as "FAILED."
D. If the number of "FAILED" measurements is greater than 10 percent of the total measurements checked during the final inspection, the testing and balancing shall be considered incomplete and shall be rejected.
E. If TAB work fails, proceed as follows:
    1. TAB specialists shall recheck all measurements and make adjustments. Revise the final report and balancing device settings to include all changes; resubmit the final report and request a second final inspection.
    2. If the second final inspection also fails, Owner may contract the services of another TAB specialist to complete TAB work according to the Contract Documents and deduct the cost of the services from the original TAB specialist's final payment.
    3. If the second verification also fails, Owner may contact AABC Headquarters regarding the AABC National Performance Guaranty.
F. Prepare test and inspection reports.

3.12 ADDITIONAL TESTS

A. Within 90 days of completing TAB, perform additional TAB to verify that balanced conditions are being maintained throughout and to correct unusual conditions.
B. Seasonal Periods: If initial TAB procedures were not performed during near-peak summer and winter conditions, perform additional TAB during near-peak summer and winter conditions.

END OF SECTION

SECTION 23 07 13 - DUCT INSULATION

PART 1 - GENERAL

1.01 SUMMARY

A. Section includes insulating the following duct services:
   1. Indoor, concealed supply and outdoor air.
   2. Indoor, exposed supply and outdoor air.
   3. Indoor, concealed return located in unconditioned space.
   4. Indoor, exposed return located in unconditioned space.
   5. Outdoor, concealed supply and return.
   6. Outdoor, exposed supply and return.

B. Related Sections:
   1. Section 230716 "HVAC Equipment Insulation."
   2. Section 230719 "HVAC Piping Insulation."
   3. Section 233113 "Metal Ducts" for duct liners.

C. Insulation to be in accordance with ASHRAE 90.1-2016.

1.02 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

B. Sustainable Design Submittals:
   1. For each type of insulation product indicated, include thermal conductivity, water-vapor permeability for closed cell insulations, thickness, applicable ASTM standard specification, and jackets (both factory- and field-applied, if any). For each type of vapor retarder or jacket specified, include water vapor permeability, required thickness, and applicable ASTM standard specification.
   2. Product Data: For adhesives, indicating VOC content.
   3. Laboratory Test Reports: For adhesives, indicating compliance with requirements for low-emitting materials.
   4. Product Data: For coatings, indicating VOC content.
   5. Laboratory Test Reports: For coatings, indicating compliance with requirements for low-emitting materials.
   6. Product Data: For sealants, indicating VOC content.
   7. Laboratory Test Reports: For sealants, indicating compliance with requirements for low-emitting materials.

C. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
   1. Detail application of protective shields, saddles, and inserts at hangers for each type of insulation and hanger.
   2. Detail insulation application at elbows, fittings, dampers, specialties, and flanges for each type of insulation.
   3. Detail application of field-applied jackets.
   4. Detail application at linkages of control devices.

1.03 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

1.04 QUALITY ASSURANCE

A. Install insulation in accordance with the manufacturer's instructions.

Material Certifications: Manufacturers can provide information regarding material and testing certifications from a qualified testing agency acceptable to authorities having jurisdiction (AHJ). The AHJ can use this information for indicating, interpreting, and certifying test results for compliance of insulation materials, sealers, attachments, cements, and jackets, with requirements indicated. (Many companies published compliance data on public data sheets while also offering technical resources for additional information. The wording was adjusted to reflect this.)

B. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products according to ASTM E 84, by a testing agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing agency. Suggestion: or proper documentation indicating compliance. (Some fabricated materials used by the industry do not come directly from the manufacturer, so this documentation can be provided in those cases).
   1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.

PART 2 - PRODUCTS

2.01 INSULATION MATERIALS

A. Comply with requirements in "Duct Insulation Schedule, General," "Indoor Duct and Plenum Insulation Schedule," and "Aboveground, Outdoor Duct and Plenum Insulation Schedule" articles for where insulating materials shall be applied.
B. Products shall not contain asbestos, lead, mercury, or mercury compounds.
C. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871. Products that come in contact with austenitic stainless steel operating at temperatures between 140°F and 250°F shall have a leachable chloride content in accordance with the limits set by ASTM C795 (Standard Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel).
D. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795. See above.
E. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.
F. Mineral-Fiber Blanket Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 553, Type II and ASTM C 1290, [Type I] Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. CertainTeed Corporation.
      b. Johns Manville; a Berkshire Hathaway company.
      c. Knauf Insulation.
      d. Manson Insulation Inc.

e. Owens Corning.

G. Mineral-Fiber Board Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 612, Type IA, or Type IB. For duct and plenum applications, provide insulation with factory applied ASJ. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. CertainTeed Corporation.
   b. Johns Manville; a Berkshire Hathaway company.
   c. Knauf Insulation.
   d. Manson Insulation Inc.
   e. Owens Corning.

2.02 FIRE-RATED INSULATION SYSTEMS

A. Fire-Rated Blanket: High-temperature, flexible, blanket insulation with FSK jacket that is tested and certified to provide a 2-hour fire rating by an NRTL acceptable to authorities having jurisdiction.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. 3M.
   b. CertainTeed Corporation.

2.03 ADHESIVES

A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated unless otherwise indicated.

B. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Childers Brand; H. B. Fuller Construction Products.
   b. Eagle Bridges - Marathon Industries.
   c. Foster Brand; H. B. Fuller Construction Products.
   d. Mon-Eco Industries, Inc.
2. Fiberglass adhesive shall have a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
3. Adhesive shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

C. ASJ Adhesive, and FSK Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Childers Brand; H. B. Fuller Construction Products.
   b. Eagle Bridges - Marathon Industries.
   c. Foster Brand; H. B. Fuller Construction Products.
   d. Mon-Eco Industries, Inc.
2. Adhesive shall have a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
3. Adhesive shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile

Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

D. PVC Jacket Adhesive: Compatible with PVC jacket.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Dow Corning Corporation.
      b. Johns Manville; a Berkshire Hathaway company.
      c. P.I.C. Plastics, Inc.
      d. Speedline Corporation.
   2. Adhesive shall have a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
   3. Adhesive shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

2.04 MASTICS

A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-PRF-19565C, Type II.
   1. VOC Content: 420 g/L or less.
   2. Low-Emitting Materials: Mastic coatings shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

B. Vapor-Barrier Mastic: Water based; suitable for indoor use on below ambient services.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Foster Brand; H. B. Fuller Construction Products.
      b. Knauf Insulation.
      c. Vimasco Corporation.
   2. Water-Vapor Permeance: ASTM E 96/E 96M, Procedure B, 0.013 perm at 43-mil dry film thickness.
   3. Service Temperature Range: Minus 20 to plus 180 deg. F.
   4. Solids Content: ASTM D 1644, 58 percent by volume and 70 percent by weight.
   5. Color: White.

2.05 SEALANTS

A. FSK and Metal Jacket Flashing Sealants:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Childers Brand; H. B. Fuller Construction Products.
      b. Eagle Bridges - Marathon Industries.
      c. Foster Brand; H. B. Fuller Construction Products.
      d. Mon-Eco Industries, Inc.
   2. Materials shall be compatible with insulation materials, jackets, and substrates.
   3. Fire- and water-resistant, flexible, elastomeric sealant.
   4. Service Temperature Range: Minus 40 to plus 250° F.
   5. Color: Aluminum.
   6. Sealant shall have a VOC content of 420 g/L or less.
   7. Sealant shall comply with the testing and product requirements of the California Department

of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

B. ASJ Flashing Sealants, and Vinyl and PVC Jacket Flashing Sealants:
   1. Manufacturers: Subject to compliance with requirements, provide products by the following:
      a. Childers Brand; H. B. Fuller Construction Products.
   2. Materials shall be compatible with insulation materials, jackets, and substrates.
   3. Fire- and water-resistant, flexible, elastomeric sealant.
   4. Service Temperature Range: Minus 40 to plus 250° F.
   5. Color: White.
   6. Sealant shall have a VOC content of 420 g/L or less.
   7. Sealant shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

2.06 FACTORY-APPLIED JACKETS

A. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:
   1. ASJ: White, kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C 1136, Type I.
   2. ASJ-SSL: ASJ with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C 1136, Type I.
   3. FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C 1136, Type II.
   4. FSP Jacket: Aluminum-foil, fiberglass-reinforced scrim with polyethylene backing; complying with ASTM C 1136, Type II.

B. Vinyl Jacket: White vinyl with a permeance of 1.3 perms when tested according to ASTM E 96/E 96M, Procedure A, and complying with NFPA 90A and NFPA 90B.

2.07 FIELD-APPLIED FABRIC-REINFORCING MESH

A. Woven Polyester Fabric: Approximately 1 oz./sq. yd. with a thread count of 10 strands by 10 strands/sq. in., in a Leno weave, for ducts.
   1. Manufacturers: Subject to compliance with requirements, provide products by the following:
      a. Childers Brand; H. B. Fuller Construction Products.

2.08 FIELD-APPLIED JACKETS

A. Field-applied jackets shall comply with ASTM C 921, Type I, unless otherwise indicated.

B. FSK Jacket: Aluminum-foil-face, fiberglass-reinforced scrim with kraft-paper backing.

C. 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. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Johns Manville; a Berkshire Hathaway company.
      b. P.I.C. Plastics, Inc.
      c. Proto Corporation.
      d. Speedline Corporation.
   2. Adhesive: As recommended by jacket material manufacturer.

3. Color: White

D. Aluminum Jacket: Comply with ASTM B 209 (ASTM B 209M), Alloy 3003, 3005, 3105, or 5005, Temper H-14.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Childers Brand; H. B. Fuller Construction Products.
      b. ITW Insulation Systems; Illinois Tool Works, Inc. Johns Manville
      c. RPR Products, Inc.
   2. [Sheet and roll stock ready for shop or field sizing] [Factory cut and rolled to size].
   3. Finish and thickness are indicated in field-applied jacket schedules.
   4. Moisture Barrier for Indoor Applications: 1-mil-thick, heat-bonded polyethylene and kraft paper.
   5. Moisture Barrier for Outdoor Applications: 2.5-mil- thick polysurlyn.

E. Self-Adhesive Outdoor Jacket: 6014-mil-thick, laminated vapor barrier and waterproofing membrane for installation over insulation located aboveground outdoors; consisting of a rubberized bituminous resin on a cross laminated polyethylene film covered with aluminum-foil facing.
   1. Manufacturers: Subject to compliance with requirements, provide products by the following:
      a. Polyguard Products, Inc.
      b. VentureClad by 3M

2.09 TAPES

A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Avery Dennison Corporation, Specialty Tapes Division.
      b. Compac Corporation.
      c. Ideal Tape Co., Inc., an American Biltrite Company.
      d. Knauf Insulation.
      e. Venture Tape.
   2. Width: 3 inches
   3. Thickness: 11.5 mils.
   4. Adhesion: 90 ounces’ force/inch in width.
   5. Elongation: 2 percent.
   6. Tensile Strength: 40 lbf/inch in width.
   7. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.

B. FSK Tape: Foil-face, vapor-retarder tape matching factory-applied jacket with acrylic adhesive; complying with ASTM C 1136.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Avery Dennison Corporation, Specialty Tapes Division.
      b. Compac Corporation.
      c. Ideal Tape Co., Inc., an American Biltrite Company.
      d. Knauf Insulation.
      e. Venture Tape.
   2. Width: 3 inches.
   3. Thickness: 6.5 mils.
   4. Adhesion: 90 ounces’ force/inch in width.
   5. Elongation: 2 percent.

6. Tensile Strength: 40 lbf/inch in width.
7. FSK Tape Disks and Squares: Precut disks or squares of FSK tape.

C. Aluminum-Foil Tape: Vapor-retarder tape with acrylic adhesive.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. Avery Dennison Corporation, Specialty Tapes Division.
b. Compac Corporation.
c. Ideal Tape Co., Inc., an American Biltrite Company.
d. Knauf Insulation.
e. Venture Tape.
2. Width: 2 inches.
3. Thickness: 3.7 mils.
4. Adhesion: 100 ounces' force/inch in width.
5. Elongation: 5 percent.
6. Tensile Strength: 34 lbf/inch in width.

2.10 SECUREMENTS

A. Aluminum Bands: ASTM B 209 (ASTM B 209M), Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch thick, 1/2 inch wide with wing seal.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. ITW Insulation Systems; Illinois Tool Works, Inc.
b. RPR Products, Inc.

B. Insulation Pins and Hangers:
1. Metal, Adhesively Attached, Perforated-Base Insulation Hangers: Baseplate welded to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:
a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1) AGM Industries, Inc.
2) Gemco.
3) Hardcast, Inc.
4) Midwest Fasteners, Inc.
5) Nelson Stud Welding.
b. Baseplate: Perforated, galvanized carbon-steel sheet, 0.030 inch thick by 2 inches square.
c. Spindle: Aluminum, fully annealed, 0.106-inch-diameter shank, length to suit depth of insulation indicated.
d. Adhesive: Recommended by hanger manufacturer. Product with demonstrated capability to bond insulation hanger securely to substrates indicated without damaging insulation, hangers, and substrates.
2. Nonmetal, Adhesively Attached, Perforated-Base Insulation Hangers: Baseplate fastened to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:
a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1) Gemco.

2) Midwest Fasteners, Inc.

b. Baseplate: Perforated, nylon sheet, 0.030 inch thick by 1 ½ inches in diameter.

c. Spindle: Nylon, 0.106-inch-diameter shank, length to suit depth of insulation indicated, up to 2 ½ inches.

d. Adhesive: Recommended by hanger manufacturer. Product with demonstrated capability to bond insulation hanger securely to substrates indicated without damaging insulation, hangers, and substrates.

3. Self-Sticking-Base Insulation Hangers: Baseplate welded to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:

a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1) AGM Industries, Inc.
2) Gemco.
3) Hardcast, Inc.
4) Midwest Fasteners, Inc.

b. Baseplate: Galvanized carbon-steel sheet, 0.030 inch thick by 2 inches square.

c. Spindle: Aluminum, fully annealed, 0.106-inch-diameter shank, length to suit depth of insulation indicated.

d. Adhesive-backed base with a peel-off protective cover.

4. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch-thick, aluminum sheet, with beveled edge sized as required to hold insulation securely in place but not less than 1 ½ inches in diameter.

a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1) AGM Industries, Inc.
2) Gemco.
3) Hardcast, Inc.
4) Midwest Fasteners, Inc.
5) Nelson Stud Welding.

b. Protect ends with capped self-locking washers incorporating a spring steel insert to ensure permanent retention of cap in exposed locations.

c. Nonmetal Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch- thick nylon sheet, with beveled edge sized as required to hold insulation securely in place but not less than 1 ½ inches in diameter.

d. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1) Gemco.
2) Midwest Fasteners, Inc.

C. Staples: Outward-clinching insulation staples, nominal 3/4-inch- wide, stainless steel or Monel.

D. Wire: 0.062-inch soft-annealed, galvanized steel.

1. Manufacturers: Subject to compliance with requirements, provide products by the following:

a. C & F Wire.

2.11 CORNER ANGLES

A. PVC Corner Angles: 30 mils thick, minimum 1 by 1 inch, PVC according to ASTM D 1784, Class 16354-C. White or color-coded to match adjacent surface.

B. Aluminum Corner Angles: 0.040 inch thick, minimum 1 by 1 inch, aluminum according to ASTM B 209 (ASTM B 209M), Alloy 3003, 3005, 3105, or 5005; Temper H-14.

PART 3 - EXECUTION

3.01 PREPARATION

A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.

3.02 GENERAL INSTALLATION REQUIREMENTS

A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of ducts and fittings.
B. Install insulation materials, vapor barriers or retarders, jackets, and thicknesses required for each item of duct system as specified in insulation system schedules.
C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.
D. Install insulation with longitudinal seams at top and bottom of horizontal runs.
E. Install multiple layers of insulation with longitudinal and end seams staggered.
F. Keep insulation materials dry during storage, application, and finishing.
G. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.
H. Install insulation with least number of joints practical.
I. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.
    1. Install insulation continuously through hangers and around anchor attachments.
    2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.
    3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
J. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.
K. Install insulation with factory-applied jackets as follows:
    1. Draw jacket tight and smooth.
    2. Cover circumferential joints with 3-inch-wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches o.c.
    3. Overlap jacket longitudinal seams at least 1 ½ inches. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 2 inches o.c.
        a. For below ambient services, apply vapor-barrier mastic over staples.
    4. Cover joints and seams with tape, according to insulation material manufacturer's written instructions, to maintain vapor seal.
    5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to duct flanges and fittings.
L. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal

thickness.

M. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.

N. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.

3.03 PENETRATIONS

A. Insulation Installation at Roof Penetrations: Install insulation continuously through roof penetrations.
   1. Seal penetrations with flashing sealant.
   2. For applications requiring only indoor insulation, terminate insulation above roof surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
   3. Extend jacket of outdoor insulation outside roof flashing at least 2 inches below top of roof flashing.
   4. Seal jacket to roof flashing with flashing sealant.

B. Insulation Installation at Aboveground Exterior Wall Penetrations: Install insulation continuously through wall penetrations.
   1. Seal penetrations with flashing sealant.
   2. For applications requiring only indoor insulation, terminate insulation inside wall surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
   3. Extend jacket of outdoor insulation outside wall flashing and overlap wall flashing at least 2 inches.
   4. Seal jacket to wall flashing with flashing sealant.

C. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.

D. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Terminate insulation at fire damper sleeves for fire-rated wall and partition penetrations. Externally insulate damper sleeves to match adjacent insulation and overlap duct insulation at least 2 inches.
   1. Comply with requirements in Section 078413 "Penetration Firestopping" for firestopping and fire-resistive joint sealers.

E. Insulation Installation at Floor Penetrations:
   1. Duct: For penetrations through fire-rated assemblies, terminate insulation at fire damper sleeves and externally insulate damper sleeve beyond floor to match adjacent duct insulation. Overlap damper sleeve and duct insulation at least 2 inches.
   2. Seal penetrations through fire-rated assemblies. Comply with requirements in Section 078413 "Penetration Firestopping."

3.04 INSTALLATION OF MINERAL-FIBER INSULATION

A. Blanket Insulation Installation on Ducts and Plenums: Secure with adhesive and insulation pins.
   1. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for 100 percent coverage of duct and plenum surfaces.
   2. Apply adhesive to entire circumference of ducts and to all surfaces of fittings and transitions.
   3. Install either capacitor-discharge-weld pins and speed washers or cupped-head, capacitor-discharge-weld pins on sides and bottom of horizontal ducts and sides of vertical ducts as

follows:

a. On duct sides with dimensions 18 inches and smaller, place pins along longitudinal centerline of duct. Space 3 inches' maximum from insulation end joints, and 16 inches o.c.
b. On duct sides with dimensions larger than 18 inches, place pins 16 inches o.c. each way, and 3 inches' maximum from insulation joints. Install additional pins to hold insulation tightly against surface at cross bracing.
c. Pins may be omitted from top surface of horizontal, rectangular ducts and plenums.
d. Do not over compress insulation during installation.
e. Impale insulation over pins and attach speed washers.
f. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.

4. For ducts and plenums with surface temperatures below ambient, install a continuous unbroken vapor barrier. Create a facing lap for longitudinal seams and end joints with insulation by removing 2 inches from one edge and one end of insulation segment. Secure laps to adjacent insulation section with 1/2-inch outward-clinching staples, 1 inch o.c. Install vapor barrier consisting of factory or field-applied jacket, adhesive, vapor-barrier mastic, and sealant at joints, seams, and protrusions.
   a. Repair punctures, tears, and penetrations with tape or mastic to maintain vapor-barrier seal.
   b. Install vapor stops for ductwork and plenums operating below 50 deg. F at 18-foot intervals. Vapor stops shall consist of vapor-barrier mastic applied in a Z-shaped pattern over insulation face, along butt end of insulation, and over the surface. Cover insulation face and surface to be insulated a width equal to two times the insulation thickness, but not less than 3 inches.
5. Overlap unfaced blankets a minimum of 2 inches on longitudinal seams and end joints. At end joints, secure with steel bands spaced a maximum of 18 inches o.c.
6. Install insulation on rectangular duct elbows and transitions with a full insulation section for each surface. Install insulation on round and flat-oval duct elbows with individually mitered gores cut to fit the elbow.
7. Insulate duct stiffeners, hangers, and flanges that protrude beyond insulation surface with 6-inch-wide strips of same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with pins spaced 6 inches o.c.

B. Board Insulation Installation on Ducts and Plenums: Secure with adhesive, tape, or and insulation pins. Follow manufacturer's installation instructions.
1. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for 100 percent coverage of duct and plenum surfaces.
2. Apply adhesive to entire circumference of ducts and to all surfaces of fittings and transitions.
3. Install either capacitor-discharge-weld pins and speed washers or cupped-head, capacitor-discharge-weld pins on sides and bottom of horizontal ducts and sides of vertical ducts as follows:
   a. On duct sides with dimensions 18 inches and smaller, place pins along longitudinal centerline of duct. Space 3 inches maximum from insulation end joints, and 16 inches o.c.
   b. On duct sides with dimensions larger than 18 inches, space pins 16 inches o.c. each way, and 3 inches maximum from insulation joints. Install additional pins to hold insulation tightly against surface at cross bracing.
   c. Pins may be omitted from top surface of horizontal, rectangular ducts and plenums.
   d. Do not over compress insulation during installation.

e. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.

4. For ducts and plenums with surface temperatures below ambient, install a continuous unbroken vapor barrier. Create a facing lap for longitudinal seams and end joints with insulation by removing 2 inches from one edge and one end of insulation segment. Secure laps to adjacent insulation section with 1/2-inch outward-clinching staples, 1-inch o.c. Install vapor barrier consisting of factory or field applied jacket, adhesive, vapor-barrier mastic, and sealant at joints, seams, and protrusions.
   a. Repair punctures, tears, and penetrations with tape or mastic to maintain vapor-barrier seal.
   b. Install vapor stops for ductwork and plenums operating below 50°F at 18-foot intervals. Vapor stops shall consist of vapor-barrier mastic applied in a Z-shaped pattern over insulation face, along butt end of insulation, and over the surface. Cover insulation face and surface to be insulated a width equal to two times the insulation thickness, but not less than 3 inches.
5. Install insulation on rectangular duct elbows and transitions with a full insulation section for each surface. Groove and score insulation to fit as closely as possible to outside and inside radius of elbows. Install insulation on round and flat-oval duct elbows with individually mitered gores cut to fit the elbow.
6. Insulate duct stiffeners, hangers, and flanges that protrude beyond insulation surface with 6-inch-wide strips of same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with pins spaced 6 inches o.c.

3.05 FIELD-APPLIED JACKET INSTALLATION

A. Where FSK jackets are indicated, install as follows:
   1. Draw jacket material smooth and tight.
   2. Install lap or joint strips with same material as jacket.
   3. Secure jacket to insulation with manufacturer's recommended adhesive.
   4. Install jacket with 1 ½ -inch laps at longitudinal seams and 3-inch- wide joint strips at end joints.
   5. Seal openings, punctures, and breaks in vapor-retarder jackets and exposed insulation with vapor-barrier mastic.

B. 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 manufacturer's 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.

C. Where metal jackets are indicated, install with 2-inch overlap at longitudinal seams and end joints. Overlap longitudinal seams arranged to shed water. Seal end joints with weatherproof sealant recommended by insulation manufacturer. Secure jacket with stainless-steel bands 12 inches o.c. and at end joints.

3.06 FIRE-RATED INSULATION SYSTEM INSTALLATION

A. Where fire-rated insulation system is indicated, secure system to ducts and duct hangers and supports to maintain a continuous fire rating.

B. Insulate duct access panels and doors to achieve same fire rating as duct.

C. Install firestopping at penetrations through fire-rated assemblies. Fire-stop systems are specified in

Section 078413 "Penetration Firestopping."

3.07 FINISHES

A. Insulation with ASJ or Other Paintable Jacket Material: Paint jacket with paint system identified below and as specified in Section 099113 "Exterior Painting" and Section 099123 "Interior Painting."
   1. Flat Acrylic Finish: Two finish coats over a primer that is compatible with jacket material and finish coat paint. Add fungicidal agent to render fabric mildew proof.
      a. Finish Coat Material: Interior, flat, latex-emulsion size.
B. Color: Final color as selected by Architect. Vary first and second coats to allow visual inspection of the completed Work.
C. Do not field paint aluminum or stainless-steel jackets.
D. Local building code and fire marshal shall approve before painting.

3.08 FIELD QUALITY CONTROL

A. Perform tests and inspections. Engage a qualified testing agency to perform tests and inspections.
B. Tests and Inspections:
   1. Inspect ductwork, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to one location(s) for each duct system defined in the "Duct Insulation Schedule, General" Article.
C. All insulation applications will be considered defective Work if sample inspection reveals noncompliance with requirements.

3.09 DUCT INSULATION SCHEDULE, GENERAL

A. Plenums and Ducts Requiring Insulation:
   1. Indoor, concealed supply, return and outdoor air.
   2. Indoor, exposed supply and outdoor air.
   3. Indoor, concealed return located in unconditioned space.
   4. Indoor, exposed return located in unconditioned space.
   5. Outdoor, concealed supply, return, locker room / shower exhaust.
   6. Outdoor, exposed supply, return, locker room / shower exhaust.
B. Items Not Insulated:
   1. Fibrous-glass ducts.
   2. Metal ducts with duct liner of sufficient thickness to comply with energy code and ASHRAE/IESNA 90.1.
   3. Factory-insulated flexible ducts.
   4. Factory-insulated plenums and casings.
   5. Flexible connectors.
   6. Vibration-control devices.
   7. Factory-insulated access panels and doors.

3.10 INDOOR DUCT AND PLENUM INSULATION SCHEDULE

A. Concealed, Supply-Air Duct and Plenum Insulation: Mineral-fiber blanket, 2 inches thick and 0.75-lb/cu. Ft. nominal density. “R” value of 4.2.
B. Concealed, Return-Air Duct and Plenum Insulation: Mineral-fiber blanket, 2 inches thick and 0.75-lb/cu. Ft nominal density. “R” value of 4.2.

C. Concealed, Outdoor-Air Duct and Plenum Insulation: Mineral-fiber blanket, 2 inches thick and 0.75-lb/cu. Ft nominal density. “R” value of 4.2.
D. Concealed, Exhaust-Air Duct and Plenum Insulation: Mineral-fiber blanket, 2 inches thick and 0.75-lb/cu. Ft. nominal density. “R” value of 4.2.
E. Exposed, Supply-Air Duct and Plenum Insulation: Mineral-fiber blanket, 2 inches thick and 3-lb/cu. ft. nominal density. “R” value of 4.2.
F. Exposed, Return-Air Duct and Plenum Insulation: Mineral-fiber blanket, 2 inches thick and 3-lb/cu. ft. nominal density. “R” value of 4.2.
G. Exposed, Outdoor-Air Duct and Plenum Insulation: Mineral-fiber blanket, 2 inches thick and 3-lb/cu. ft. nominal density. “R” value of 4.2.
H. Exposed, Exhaust-Air Duct and Plenum Insulation: Mineral-fiber blanket, 2 inches thick and 3-lb/cu. ft. nominal density. “R” value of 4.2.

3.11 ABOVEGROUND, OUTDOOR DUCT AND PLENUM INSULATION SCHEDULE

A. Insulation materials and thicknesses are identified below. If more than one material is listed for a duct system, selection from materials listed is Contractor's option.
   1. Concealed, Supply-Air Duct and Plenum Insulation: Mineral-fiber board 3 inches thick and 6-lb/cu. ft. nominal density. “R” value of 8.3.
   2. Concealed, Return-Air Duct and Plenum Insulation: Mineral-fiber board, 3 inches thick and 6-lb./cu. ft. nominal density. “R” value of 8.3.
   3. Concealed, Outdoor-Air Duct and Plenum Insulation: Mineral-fiber board, 3 inches thick and 6-lb/cu. ft. nominal density. “R” value of 8.3.
   4. Exposed, Supply-Air Duct and Plenum Insulation: Mineral-fiber board, 3 inches thick and 6-lb/cu. ft. nominal density. “R” value of 8.3.
   5. Exposed, Return-Air Duct and Plenum Insulation: Mineral-fiber board, 3 inches thick and 6-lb/cu. ft. nominal density. “R” value of 8.3.
   6. Concealed, locker room / shower exhaust Insulation: Mineral-fiber board, 3 inches thick and 6-lb/cu. ft. nominal density. “R” value of 8.3.
   7. Exposed, locker room / shower exhaust: Mineral-fiber board, 3 inches thick and 6-lb/cu. ft. nominal density. “R” value of 8.3.

3.12 INDOOR, FIELD-APPLIED JACKET SCHEDULE

A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.
B. If more than one material is listed, selection from materials listed is Contractor's option.
   1. Ducts and Plenums, Concealed:
      a. None.
   2. Ducts and Plenums, Exposed:
      a. Aluminum, Smooth: 0.020 inch thick.

3.13 OUTDOOR, FIELD-APPLIED JACKET SCHEDULE

A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.
B. If more than one material is listed, selection from materials listed is Contractor's option.
   1. Ducts and Plenums, Concealed:
      a. PVC: 20 mils thick.

2. Ducts and Plenums, Exposed, up to 48 Inches in Diameter or with Flat Surfaces up to 72 Inches.
   a. Aluminum, Smooth: 0.020 inch thick.

END OF SECTION

SECTION 23 07 19 - HVAC PIPING INSULATION

PART 1 - GENERAL

1.01 SUMMARY

A. Section includes insulating the following HVAC piping systems:
   1. Refrigerant suction and hot-gas piping, indoors and outdoors.

B. Related Sections:
   1. Section 230713 "Duct Insulation."
   2. Section 230716 "HVAC Equipment Insulation."
   3. Section 232113.13 "Underground Hydronic Piping" for loose-fill pipe insulation in underground piping outside the building.
   4. Section 336313 "Underground Steam and Condensate Distribution Piping" for loose-fill pipe insulation in underground piping outside the building.

1.02 ACTION SUBMITTALS

A. Product Data: For each type of insulation product indicated, include thermal conductivity, water-vapor permeability for closed cell insulations, thickness, applicable ASTM standard specification, and jackets (both factory- and field-applied, if any). For each type of vapor retarder or jacket specified, include water vapor permeability, required thickness, and applicable ASTM standard specification.

B. Sustainable Design Submittals:
   1. Product Data: For adhesives, indicating VOC content.
   2. Laboratory Test Reports: For adhesives, indicating compliance with requirements for low-emitting materials.
   3. Product Data: For coatings, indicating VOC content.
   4. Laboratory Test Reports: For coatings, indicating compliance with requirements for low-emitting materials.
   5. Product Data: For sealants, indicating VOC content.
   6. Laboratory Test Reports: For sealants, indicating compliance with requirements for low-emitting materials.

C. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
   1. Detail application of protective shields, saddles, and inserts at hangers for each type of insulation and hanger.
   2. Detail attachment and covering of heat tracing inside insulation.
   3. Detail insulation application at pipe expansion joints for each type of insulation.
   4. Detail insulation application at elbows, fittings, flanges, valves, and specialties for each type of insulation.
   5. Detail removable insulation at piping specialties.
   6. Detail application of field-applied jackets.
   7. Detail application at linkages of control devices.

1.03 INFORMATIONAL SUBMITTALS (Only as necessary)

A. Field quality-control reports.

1.04 QUALITY ASSURANCE

A. Material Certifications: Manufacturers can provide information regarding material and testing certifications from a qualified testing agency acceptable to authorities having jurisdiction (AHJ). The AHJ can use this information for indicating, interpreting, and certifying test results for compliance of insulation materials, sealers, attachments, cements, and jackets, with requirements indicated.
B. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products according to ASTM E 84, by a testing and inspecting agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing agency.
    1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
    2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.

PART 2 - PRODUCTS

2.01 INSULATION MATERIALS

A. Products shall not contain asbestos, lead, mercury, or mercury compounds.
B. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871. Products that come in contact with austenitic stainless steel operating at temperatures between 140°F and 250°F shall have a leachable chloride content in accordance with the limits set by ASTM C795 (Standard Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel).
C. Insulation materials for use on austenitic stainless steel operating at temperatures between 140°F and 250°F shall be qualified as acceptable according to ASTM C 795. (Same reasoning as above)
D. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.
E. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.
F. Cellular Glass: Inorganic, incombustible, foamed or cellulated glass with annealed, rigid, hermetically sealed cells. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
    1. Manufacturers: Subject to compliance with requirements, provide products by the following:
        a. Pittsburgh Corning Corporation.
    2. Block Insulation: ASTM C 552, Type I.
    3. Special-Shaped Insulation: ASTM C 552, Type III.
    4. Board Insulation: ASTM C 552, Type IV.
    5. Preformed Pipe Insulation without Jacket: Comply with ASTM C 552, Type II, Class 1.
    6. Preformed Pipe Insulation with Factory-Applied ASJ: Comply with ASTM C 552, Type II, Class 2.
    7. Factory fabricate shapes according to ASTM C 450 and ASTM C 585.
G. Flexible Elastomeric Insulation: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type I for tubular materials.
    1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
        a. Aeroflex USA, Inc.

b. Armacell LLC.
c. K-Flex USA.

H. Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 553, Type II and ASTM C 1290, Type I. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

I. Mineral-Fiber Blanket Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 1290, Type I.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. CertainTeed Corporation.
b. Johns Manville; a Berkshire Hathaway company.
c. Knauf Insulation.
d. Manson Insulation Inc.
e. Owens Corning.

J. Mineral-Fiber, Preformed Pipe Insulation:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. Johns Manville; a Berkshire Hathaway company.
b. Knauf Insulation.
c. Manson Insulation Inc.
d. Owens Corning.
2. Type I, 850 deg. F Materials: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 547, Type I, Grade A, with factory-applied ASJ. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
3. Type II, 1200 deg. F Materials: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 547, Type II, Grade A with factory-applied ASJ-SSL. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

K. Mineral-Fiber, Pipe Insulation Wicking System: Preformed pipe insulation complying with ASTM C 547, Type I, Grade A, with absorbent cloth factory-applied to the entire inside surface of preformed pipe insulation and extended through the longitudinal joint to outside surface of insulation under insulation jacket. Factory apply a white, polymer, vapor-retarder jacket with self-sealing adhesive tape seam and evaporation holes running continuously along the longitudinal seam, exposing the absorbent cloth.
1. Manufacturers: Subject to compliance with requirements, provide products by the following:
a. Owens Corning.

2.02 INSULATING CEMENTS

A. Mineral-Fiber, Hydraulic-Setting Insulating and Finishing Cement: Comply with ASTM C 449.
1. Manufacturers: Subject to compliance with requirements, provide products by the following:
a. Ramco Insulation, Inc.

2.03 ADHESIVES

A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated unless otherwise indicated.

B. Cellular-Glass Adhesive: Two-component, thermosetting urethane adhesive containing no flammable solvents, with a service temperature range of minus 100 to plus 200 deg. F.
1. Manufacturers: Subject to compliance with requirements, provide products by the following:
a. Foster Brand; H. B. Fuller Construction Products.

2. Adhesives shall have a VOC content of 50 g/L or less.
3. Adhesive shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

C. Flexible Elastomeric and Polyolefin Adhesive: Comply with MIL-A-24179A, Type II, Class I.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Aeroflex USA, Inc.
   b. Armacell LLC.
   c. Foster Brand; H. B. Fuller Construction Products.
   d. K-Flex USA.
2. Adhesives shall have a VOC content off 50 g/L or less.
3. Adhesive shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

D. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Childers Brand; H. B. Fuller Construction Products.
   b. Eagle Bridges - Marathon Industries.
   c. Foster Brand; H. B. Fuller Construction Products.
   d. Mon-Eco Industries, Inc.
2. Fiberglass adhesive shall have a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
3. Adhesive shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

E. ASJ Adhesive, and FSK and PVDC Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Childers Brand; H. B. Fuller Construction Products.
   b. Eagle Bridges - Marathon Industries.
   c. Foster Brand; H. B. Fuller Construction Products.
   d. Mon-Eco Industries, Inc.
2. Adhesive shall have a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
3. Adhesive shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

F. PVC Jacket Adhesive: Compatible with PVC jacket.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Dow Corning Corporation.
   b. Johns Manville; a Berkshire Hathaway company.
   c. P.I.C. Plastics, Inc.
   d. Speedline Corporation.
2. Adhesive shall have a VOC content of 80 g/L or less (if available) when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
3. Adhesive shall comply with the testing and product requirements of the California

Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

2.04 MASTICS

A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-PRF-19565C, Type II.
   1. VOC Content: 420 g/L or less.
   2. Low-Emitting Materials: Mastic coatings shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

B. Vapor-Barrier Mastic: Water based; suitable for indoor use on below-ambient services.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Foster Brand; H. B. Fuller Construction Products.
      b. Knauf Insulation.
      c. Vimasco Corporation.
   2. Water-Vapor Permeance: ASTM E 96/E 96M, Procedure B, 0.013 perm at 43-mil dry film thickness.
   3. Service Temperature Range: Minus 20 to plus 180 deg. F.
   4. Solids Content: ASTM D 1644, 58 percent by volume and 70 percent by weight.
   5. Color: White.

2.05 SEALANTS

A. Joint Sealants:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Childers Brand; H. B. Fuller Construction Products.
      b. Eagle Bridges - Marathon Industries.
      c. Foster Brand; H. B. Fuller Construction Products.
      d. Mon-Eco Industries, Inc.
      e. Pittsburgh Corning Corporation.
   2. Materials shall be compatible with insulation materials, jackets, and substrates.
   3. Permanently flexible, elastomeric sealant.
   4. Service Temperature Range: Minus 100 to plus 300 deg. F.
   5. Color: White or gray.
   6. Sealant shall have a VOC content of 420 g/L or less.
   7. Sealant shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

B. FSK and Metal Jacket Flashing Sealants:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Childers Brand; H. B. Fuller Construction Products.
      b. Eagle Bridges - Marathon Industries.
      c. Foster Brand; H. B. Fuller Construction Products.
      d. Mon-Eco Industries, Inc.
   2. Materials shall be compatible with insulation materials, jackets, and substrates.

3. Fire- and water-resistant, flexible, elastomeric sealant.
4. Service Temperature Range: Minus 40 to plus 250 deg. F.
5. Color: Aluminum.
6. Sealant shall have a VOC content of 420 g/L or less.
7. Sealant shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

C. ASJ Flashing Sealants, and Vinyl, PVDC, and PVC Jacket Flashing Sealants:
1. Manufacturers: Subject to compliance with requirements, provide products by the following:
   a. Childers Brand; H. B. Fuller Construction Products.
2. Materials shall be compatible with insulation materials, jackets, and substrates.
3. Fire- and water-resistant, flexible, elastomeric sealant.
4. Service Temperature Range: Minus 40 to plus 250 deg. F.
5. Color: White.
6. Sealant shall have a VOC content of 420 g/L or less.
7. Sealant shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

2.06 FACTORY-APPLIED JACKETS

A. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:
1. ASJ: White, kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C 1136, Type I.
2. ASJ-SSL: ASJ with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C 1136, Type I.
3. FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C 1136, Type II.
4. FSP Jacket: Aluminum-foil, fiberglass-reinforced scrim with polyethylene backing; complying with ASTM C 1136, Type II.
5. Vinyl Jacket: White vinyl with a permeance of 1.3 perms when tested according to ASTM E 96/E 96M, Procedure A.

2.07 FIELD-APPLIED FABRIC-REINFORCING MESH

A. Woven Polyester Fabric: Approximately 1 oz./sq. yd. with a thread count of 10 strands by 10 strands/sq. in., in a Leno weave, for pipe.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Foster Brand; H. B. Fuller Construction Products.
   b. Vimasco Corporation.

2.08 FIELD-APPLIED JACKETS

A. Field-applied jackets shall comply with ASTM C 921, Type I, unless otherwise indicated.
B. FSK Jacket: Aluminum-foil face, fiberglass-reinforced scrim with kraft-paper backing.
C. 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. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Johns Manville; a Berkshire Hathaway company.
   b. P.I.C. Plastics, Inc.
   c. Proto Corporation.
   d. Speedline Corporation.
2. Adhesive: As recommended by jacket material manufacturer.
3. Color: 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.

D. Aluminum Jacket: Comply with ASTM B 209, Alloy 3003, 3005, 3105, or 5005, Temper H-14.
1. Finish and thickness are indicated in field-applied jacket schedules.
2. Moisture Barrier for Indoor Applications: 3-mil-thick, heat-bonded polyethylene and kraft paper.
3. Moisture Barrier for Outdoor Applications: 3-mil-thick, heat-bonded polyethylene and kraft paper
4. Factory-Fabricated Fitting Covers:
   a. Same material, finish, and thickness as jacket.
   b. Preformed 2-piece or gore, 45 and 90-degree, short and long-radius elbows.
   c. Tee covers.
   d. Flange and union cover.
   e. End caps.
   f. Beveled collars.
   g. Valve covers.
   a Field fabricate fitting covers only if factory-fabricated fitting covers are not available.

E. Self-Adhesive Outdoor Jacket: 60-mil-thick, laminated vapor barrier and waterproofing membrane for installation over insulation located aboveground outdoors; consisting of a rubberized bituminous resin on a cross-laminated polyethylene film covered with white aluminum-foil facing.
1. Manufacturers: Subject to compliance with requirements, provide products by the following:
   a. Polyguard Products, Inc.

F. PVDC Jacket for Indoor Applications: 4-mil- thick, white PVDC biaxially oriented barrier film with a permeance at 0.02 perms when tested according to ASTM E 96/E 96M and with a flame-spread index of 5 and a smoke-developed index of 20 when tested according to ASTM E 84.
1. Manufacturers: Subject to compliance with requirements, provide products by the following:
   a. Johns Manville; Saranex 540CX Vapor Retarder Film.

G. PVDC Jacket for Outdoor Applications: 6-mil-thick, white PVDC biaxially oriented barrier film with a permeance at 0.01 perms when tested according to ASTM E 96/E 96M and with a flame-spread index of 5 and a smoke-developed index of 25 when tested according to ASTM E 84.
1. Manufacturers: Subject to compliance with requirements, provide products by the following:
   a. Johns Manville; Saranex 540CX Vapor Retarder Film.

H. PVDC-SSL Jacket: PVDC jacket with a self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip.
1. Manufacturers: Subject to compliance with requirements, provide products by the following:
   a. Johns Manville; Saranex 540CX Vapor Retarder Film or Saranex 560CX Vapor Retarder Film.

2.09 TAPES

A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Avery Dennison Corporation, Specialty Tapes Division.
      b. Compac Corporation.
      c. Ideal Tape Co., Inc., an American Biltrite Company.
      d. Knauf Insulation.
      e. Venture Tape.
   2. Width: 3 inches.
   3. Thickness: 11.5 mils.
   4. Adhesion: 90 ounces' force/inch in width.
   5. Elongation: 2 percent.
   6. Tensile Strength: 40 lbf/inch in width.
   7. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.

B. FSK Tape: Foil-face, vapor-retarder tape matching factory applied jacket with acrylic adhesive; complying with ASTM C 1136.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Avery Dennison Corporation, Specialty Tapes Division.
      b. Compac Corporation.
      c. Ideal Tape Co., Inc., an American Biltrite Company.
      d. Knauf Insulation.
      e. Venture Tape.
   2. Width: 3 inches.
   3. Thickness: 6.5 mils.
   4. Adhesion: 90 ounces' force/inch in width.
   5. Elongation: 2 percent.
   6. Tensile Strength: 40 lbf/inch in width.
   7. FSK Tape Disks and Squares: Precut disks or squares of FSK tape.

C. PVC Tape: White vapor-retarder tape matching field-applied PVC jacket with acrylic adhesive; suitable for indoor and outdoor applications.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Compac Corporation.
      b. Ideal Tape Co., Inc., an American Biltrite Company.
      c. Venture Tape.
      d. PVC Z-Tape, Z-Tape II, Johns Manville, a Berkshire-Hathaway Company
   2. Width: 2 inches.
   3. Thickness: 6 mils. (5-10 mil)
   4. Adhesion: 64 ounces' force/inch in width or (14-64 oz)
   5. Elongation: 150 -500 percent.
   6. Tensile Strength: 18 lbf/inch in width or (15-27 lbf/inch)

D. Aluminum-Foil Tape: Vapor-retarder tape with acrylic adhesive.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Avery Dennison Corporation, Specialty Tapes Division.
      b. Compac Corporation.
      c. Ideal Tape Co., Inc., an American Biltrite Company.
      d. Knauf Insulation.

e. Venture Tape.
2. Width: 2 inches.
3. Thickness: 3.7 mils.
4. Adhesion: 100 ounces' force/inch in width.
5. Elongation: 5 percent.
6. Tensile Strength: 34 lbf/inch in width.

E. PVDC Tape for Indoor Applications: White vapor-retarder PVDC tape with acrylic adhesive.
1. Manufacturers: Subject to compliance with requirements, provide products by the following:
a. ITW Insulation Systems; Illinois Tool Works, Inc.
2. Width: 3 inches.
3. Film Thickness: 4 mils.
4. Adhesive Thickness: 1.5 mils.
5. Elongation at Break: 145 percent.
6. Tensile Strength: 55 lbf/inch in width.

F. PVDC Tape for Outdoor Applications: White vapor-retarder PVDC tape with acrylic adhesive.
1. Manufacturers: Subject to compliance with requirements, provide products by the following:
a. PVDC Tape for Indoor and outdoor Applications: White vapor-retarder PVDC tape with acrylic adhesive. (Since PVDC is not suitable for being left exposed outdoors, it is not the thickness that determines what thickness should be used but, rather, the desired permeance which is largely a factor of the pipe temperature. I recommend making this section applicable to both indoor and outdoor applications of PVDC Tape since the same tapes can be used in either application.)
See Editing Instruction No. 1 in the Evaluations for cautions about naming manufacturers and products. See Division 01 Section "Product Requirements."
Products: Subject to compliance with requirements, [provide the following] [provide one of the following] [available products that may be incorporated into the Work include, but are not limited to, the following]:
Johns Manville; Saranex 520CX Vapor Retarder Tape or Saranex 560CX Vapor Retarder Tape.
2. Width: 3 inches.
3. Film Thickness: 6 mils.
4. Adhesive Thickness: 1.5 mils.
5. Elongation at Break: 145 percent.
6. Tensile Strength: 55 lbf/inch in width.

2.10 SECUREMENTS

A. Aluminum Bands: ASTM B 209 (ASTM B 209M), Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch thick, 1/2 inch wide with wing seal orclosed seal.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. Johns Manville
b. RPR Products, Inc.

B. Staples: Outward-clinching insulation staples, nominal 3/4-inch-wide, stainless steel, or Monel.

C. Wire: 0.080-inch nickel-copper alloy
1. Manufacturers: Subject to compliance with requirements, provide products by the following:
a. C & F Wire.

PART 3 - EXECUTION

3.01 PREPARATION

A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.
B. Coordinate insulation installation with the trade installing heat tracing. Comply with requirements for heat tracing that apply to insulation.
C. Mix insulating cements with clean potable water; if insulating cements are to be in contact with stainless-steel surfaces, use demineralized water.

3.02 GENERAL INSTALLATION REQUIREMENTS

A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of piping including fittings, valves, and specialties.
B. Install insulation materials, forms, vapor barriers or retarders, jackets, and thicknesses required for each item of pipe system as specified in insulation system schedules.
C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.
D. Install insulation with longitudinal seams at top and bottom of horizontal runs.
E. Install multiple layers of insulation with longitudinal and end seams staggered.
F. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.
G. Keep insulation materials dry during storage application and finishing.
H. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.
I. Install insulation with least number of joints practical.
J. Install outermost layer of insulation with longitudinal seams at the 3:00 and 9:00 positions of horizontal runs. (Longitudinal seams should be at the sides of horizontal pipe to avoid being stressed from pipe supports, being walked on, having things hung from the insulated pipe, etc. If there will be stresses applied to insulated pipe, it is most likely to be at the top or bottom of the pipe so you do not want to have the joints in the outermost layer at these locations). Check with manufacturer depending upon application.
K. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.
    1. Install insulation continuously through hangers and around anchor attachments.
    2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.
    3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
    4. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.
L. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.
M. Install insulation with factory-applied jackets as follows:
    1. Draw jacket tight and smooth.
    2. Cover circumferential joints with 3-inch-wide strips, of same material as insulation jacket.

Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches o.c.

3. Jackets without a self-sealing lap are typically stapled or taped. Jackets like an ASJ jacket that have a self-sealing Lap adhesive system are not usually stapled for indoor applications. For below ambient air systems, any penetrations made in the vapor-retarder jacket needs to be sealed with appropriate vapor-retarder tape or mastic.
4. Overlap jacket longitudinal seams at least 1 ½ inches. Install insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 2 inches o.c.
   a. For below-ambient services, apply vapor-barrier mastic over staples.
5. Cover joints and seams with tape, according to insulation material manufacturer's written instructions, to maintain vapor seal.
6. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to pipe flanges and fittings.

N. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.

O. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.

P. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.

Q. For above-ambient services, do not install insulation to the following:
1. Vibration-control devices.
2. Testing agency labels and stamps.
3. Nameplates and data plates.
4. Manholes.
5. Handholes.
6. Cleanouts.

3.03 PENETRATIONS

A. Insulation Installation at Roof Penetrations: Install insulation continuously through roof penetrations.
1. Seal penetrations with flashing sealant.
2. For applications requiring only indoor insulation, terminate insulation above roof surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
3. Extend jacket of outdoor insulation outside roof flashing at least 2 inches below top of roof flashing.
4. Seal jacket to roof flashing with flashing sealant.

B. Insulation Installation at Underground Exterior Wall Penetrations: Terminate insulation flush with sleeve seal. Seal terminations with flashing sealant.

C. Insulation Installation at Aboveground Exterior Wall Penetrations: Install insulation continuously through wall penetrations.
1. Seal penetrations with flashing sealant.
2. For applications requiring only indoor insulation, terminate insulation inside wall surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
3. Extend jacket of outdoor insulation outside wall flashing and overlap wall flashing at least 2

inches.

4. Seal jacket to wall flashing with flashing sealant.

D. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.

E. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Install insulation continuously through penetrations of fire-rated walls and partitions.
   1. Comply with requirements in Section 078413 "Penetration Firestopping" for firestopping and fire-resistive joint sealers.

F. Insulation Installation at Floor Penetrations:
   1. Pipe: Install insulation continuously through floor penetrations.
   2. Seal penetrations through fire-rated assemblies. Comply with requirements in Section 078413 "Penetration Firestopping."

3.04 GENERAL PIPE INSULATION INSTALLATION

A. Requirements in this article generally apply to all insulation materials except where more specific requirements are specified in various pipe insulation material installation articles.

B. Insulation Installation on Fittings, Valves, Strainers, Flanges, and Unions:
   1. Install insulation over fittings, valves, strainers, flanges, unions, and other specialties with continuous thermal and vapor-retarder integrity unless otherwise indicated.
   2. Insulate pipe elbows using preformed fitting insulation or mitered fittings made from same material and density as adjacent pipe insulation. Each piece shall be butted tightly against adjoining piece and bonded with adhesive. Fill joints, seams, voids, and irregular surfaces with insulating cement finished to a smooth, hard, and uniform contour that is uniform with adjoining pipe insulation.
   3. Insulate tee fittings with preformed fitting insulation or sectional pipe insulation of same material and thickness as used for adjacent pipe. Cut sectional pipe insulation to fit. Butt each section closely to the next and hold in place with tie wire. Bond pieces with adhesive.
   4. Insulate valves using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. For valves, insulate up to and including the bonnets, valve stuffing-box studs, bolts, and nuts. Fill joints, seams, and irregular surfaces with insulating cement.
   5. Insulate strainers using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Fill joints, seams, and irregular surfaces with insulating cement. Insulate strainers so strainer basket flange or plug can be easily removed and replaced without damaging the insulation and jacket. Provide a removable reusable insulation cover. For below-ambient services, provide a design that maintains vapor barrier.
   6. Insulate flanges and unions using a section of oversized preformed pipe insulation. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker.
   7. Cover segmented insulated surfaces with a layer of finishing cement and coat with a mastic. Install vapor-barrier mastic for below-ambient services and a breather mastic for above-ambient services. Reinforce the mastic with fabric-reinforcing mesh. Trowel the mastic to a smooth and well-shaped contour.
   8. For services not specified to receive a field-applied jacket except for flexible elastomeric and polyolefin, install fitted PVC cover over elbows, tees, strainers, valves, flanges, and unions. Terminate ends with PVC end caps. Tape PVC covers to adjoining insulation facing using

PVC tape.

9. Stencil or label the outside insulation jacket of each union with the word "union." Match size and color of pipe labels.

C. Insulate instrument connections for thermometers, pressure gages, pressure temperature taps, test connections, flow meters, sensors, switches, and transmitters on insulated pipes. Shape insulation at these connections by tapering it to and around the connection with insulating cement and finish with finishing cement, mastic, and flashing sealant.

D. Install removable insulation covers at locations indicated. Installation shall conform to the following:

1. Make removable flange and union insulation from sectional pipe insulation of same thickness as that on adjoining pipe. Install same insulation jacket as adjoining pipe insulation.
2. When flange and union covers are made from sectional pipe insulation, extend insulation from flanges or union long at least two times the insulation thickness over adjacent pipe insulation on each side of flange or union. Secure flange cover in place with stainless-steel or aluminum bands. Select band material compatible with insulation and jacket.
3. Construct removable valve insulation covers in same manner as for flanges, except divide the two-part section on the vertical center line of valve body.
4. When covers are made from block insulation, make two halves, each consisting of mitered blocks wired to stainless-steel fabric. Secure this wire frame, with its attached insulation, to flanges with tie wire. Extend insulation at least 2 inches over adjacent pipe insulation on each side of valve. Fill space between flange or union cover and pipe insulation with insulating cement. Finish cover assembly with insulating cement applied in two coats. After first coat is dry, apply and trowel second coat to a smooth finish.
5. Unless a PVC jacket is indicated in field-applied jacket schedules, finish exposed surfaces with a metal jacket.

3.05 INSTALLATION OF FLEXIBLE ELASTOMERIC INSULATION

A. Seal longitudinal seams and end joints with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

B. Insulation Installation on Pipe Flanges:

1. Install pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of sheet insulation of same thickness as pipe insulation.
4. Secure insulation to flanges and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install mitered sections of pipe insulation.
2. Secure insulation materials and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed valve covers manufactured of same material as pipe insulation when available.
2. When preformed valve covers are not available, install cut sections of pipe and sheet insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
3. Install insulation to flanges as specified for flange insulation application.
4. Secure insulation to valves and specialties and seal seams with manufacturer's

recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

3.06 INSTALLATION OF MINERAL-FIBER PREFORMED PIPE INSULATION

A. Insulation Installation on Straight Pipes and Tubes:
   1. Use the ASL-SSL pressure sensitive adhesive lap seal, and butt (circumferential) strips to seal the seams and joints respectively. Penetrations can be sealed with pressure-sensitive adhesive tape or vapor-retarder mastic. Follow manufacturer's instructions, which include sealing lap seal and butt strips having pressure-sensitive adhesive surfaces. When adhered, the lap and butt strips must be pressurized by rubbing firmly with a plastic squeegee or the back of a knife blade to ensure positive closure. For specific installations, secure each layer of Unfaced preformed pipe insulation to pipe with wire or bands and tighten bands without deforming insulation materials. Check with manufacturer for instructions.
   2. Secure each layer of preformed pipe insulation to pipe with wire or bands and tighten bands without deforming insulation materials.
   3. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
   4. For insulation with factory-applied jackets on above-ambient surfaces, secure laps with outward-clinched staples at 6 inches o.c.
   5. For insulation with factory-applied jackets on below-ambient surfaces, do not staple longitudinal tabs. Instead, secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant.
B. Insulation Installation on Pipe Flanges:
   1. Install preformed pipe insulation to outer diameter of pipe flange.
   2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
   3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with mineral-fiber blanket insulation.
   4. Install jacket material with manufacturer's recommended adhesive, overlap seams at least 1 inch, and seal joints with flashing sealant.
C. Insulation Installation on Pipe Fittings and Elbows:
   1. Install preformed sections of same material as straight segments of pipe insulation when available.
   2. When preformed insulation elbows and fittings are not available, install mitered sections of pipe insulation, to a thickness equal to adjoining pipe insulation. Secure insulation materials with wire or bands.
D. Insulation Installation on Valves and Pipe Specialties:
   1. Install preformed sections of same material as straight segments of pipe insulation when available.
   2. When preformed sections are not available, install mitered sections of pipe insulation to valve body.
   3. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
   4. Install insulation to flanges as specified for flange insulation application.

3.07 FIELD-APPLIED JACKET INSTALLATION

A. Where FSK jackets are indicated, install as follows:
   1. Draw jacket material smooth and tight.

2. Install lap or joint strips with same material as jacket.
3. Secure jacket to insulation with manufacturer's recommended adhesive.
4. Install jacket with 1 ½ -inch laps at longitudinal seams and 3-inch-wide joint strips at end joints.
5. Seal openings, punctures, and breaks in vapor-retarder jackets and exposed insulation with vapor-barrier mastic.

B. Where PVC jackets are indicated, install with 1-inch overlap at longitudinal seams and end joints; for horizontal applications. Seal with manufacturer's 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.

C. Where metal jackets are indicated, install with 2-inch (50-mm) overlap at longitudinal seams and end joints. On horizontal pipe, overlap longitudinal seams arranged to shed water and locate longitudinal seams at 3:00 or 9:00 position on pipe. Seal end joints with weatherproof sealant recommended by insulation manufacturer. On vertical pipe, overlap end joint seams arranged to shed water and locate longitudinal joints to face away from prevailing wind. Secure jacket with stainless-steel bands 12 inches (300 mm) o.c. and at end joints. Where PVDC jackets are indicated, install as follows: Apply wraps of filament tape at ends of each insulation section and on 12 inch centers to secure pipe insulation to pipe prior to installation of PVDC jacket.
Wrap factory-presized jackets around individual pipe insulation sections with one end overlapping the previously installed sheet. Install presized jacket with an approximate overlap at butt joint of 2 inches (50 mm) over the previous section. Adhere lap seal using adhesive or SSL, and then apply 1-1/4 circumferences of appropriate PVDC tape around overlapped butt joint.
Continuous jacket can be spiral-wrapped around a length of pipe insulation. Apply adhesive or PVDC tape at overlapped spiral edge. When electing to use adhesives, refer to manufacturer's written instructions for application of adhesives along this spiral edge to maintain a permanent bond.
Jacket can be wrapped in cigarette fashion along length of roll for insulation systems with an outer circumference of 33-1/2 inches (850 mm) or less. The 33-1/2-inch- (850-mm-) circumference limit allows for 2-inch- (50-mm-) overlap seal. Using the length of roll allows for longer sections of jacket to be installed at one time. Use adhesive on the lap seal. Visually inspect lap seal for "fishmouthing," and use PVDC tape along lap seal to secure joint.
Repair holes or tears in PVDC jacket by placing PVDC tape over the hole or tear and wrapping a minimum of 1-1/4 circumferences to avoid damage to tape edges.

D. Where PVDC jackets are indicated, install as follows:
1. Apply three separate wraps of filament tape per insulation section to secure pipe insulation to pipe prior to installation of PVDC jacket.
2. Wrap factory-presized jackets around individual pipe insulation sections with one end overlapping the previously installed sheet. Install presized jacket with an approximate overlap at butt joint of 2 inches over the previous section. Adhere lap seal using adhesive or SSL, and then apply 1-1/4 circumferences of appropriate PVDC tape around overlapped butt joint.
3. Continuous jacket can be spiral-wrapped around a length of pipe insulation. Apply adhesive or PVDC tape at overlapped spiral edge. When electing to use adhesives, refer to manufacturer's written instructions for application of adhesives along this spiral edge to maintain a permanent bond.
4. Jacket can be wrapped in cigarette fashion along length of roll for insulation systems with an outer circumference of 33 ½ - inches or less. The 33 ½ -inch-circumference limit allows for 2-inch- overlap seal. Using the length of roll allows for longer sections of jacket to be installed at one time. Use adhesive on the lap seal. Visually inspect lap seal for "fishmouthing," and use PVDC tape along lap seal to secure joint.
5. Repair holes or tears in PVDC jacket by placing PVDC tape over the hole or tear and

wrapping a minimum of 1-1/4 circumferences to avoid damage to tape edges.

3.08 FINISHES

A. Pipe Insulation with ASJ or Other Paintable Jacket Material: Paint jacket with paint system identified below and as specified in Section 099113 "Exterior Painting" and Section 099123 "Interior Painting."
   1. Flat Acrylic Finish: Two finish coats over a primer that is compatible with jacket material and finish coat paint. Add fungicidal agent to render fabric mildew proof.
      a. Finish Coat Material: Interior, flat, latex-emulsion size.
B. Flexible Elastomeric Thermal Insulation: After adhesive has fully cured, apply two coats of insulation manufacturer's recommended protective coating.
C. Color: Final color as selected by Architect. Vary first and second coats to allow visual inspection of the completed Work.
D. Do not field paint aluminum or stainless-steel jackets.

3.09 FIELD QUALITY CONTROL

A. Perform tests and inspections.
B. Tests and Inspections:

   Testing Agency: Engage a qualified testing agency to perform tests and inspections.
   1. Inspect pipe, fittings, strainers, and valves, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to three locations of straight pipe, three locations of threaded fittings, three locations of welded fittings, two locations of threaded strainers, two locations of welded strainers, three locations of threaded valves, and three locations of flanged valves for each pipe service defined in the "Piping Insulation Schedule, General" Article.
C. All insulation applications will be considered defective Work if sample inspection reveals noncompliance with requirements.

3.10 PIPING INSULATION SCHEDULE, GENERAL

A. Acceptable preformed pipe and tubular insulation materials and thicknesses are identified for each piping system and pipe size range. If more than one material is listed for a piping system, selection from materials listed is Contractor's option.
B. Items Not Insulated: Unless otherwise indicated, do not install insulation on the following:
   1. Drainage piping located in crawl spaces.
   2. Underground piping.
   3. Chrome-plated pipes and fittings unless there is a potential for personnel injury.
   4. Geothermal heat pump supply and return piping.

3.11 INDOOR PIPING INSULATION SCHEDULE

A. Refrigerant Suction and Hot-Gas Piping: Flexible elastomeric 1 inch thick
B. Refrigerant Suction and Hot-Gas Flexible Tubing: Flexible elastomeric, 1 inch thick.
C. Condensate Piping: Mineral-fiber, preformed pipe insulation, 1 inch thick.

3.12 OUTDOOR, ABOVEGROUND PIPING INSULATION SCHEDULE

A. Refrigerant Suction and Hot-Gas Piping: Insulation shall be one of the following:

1. Cellular Glass: 2 inches thick.
2. Flexible Elastomeric: 2 inches thick.
3. Mineral-Fiber, Preformed Pipe Insulation, Type I: 2 inches thick.

B. Refrigerant Suction and Hot-Gas Flexible Tubing: Insulation shall be:
1. Flexible Elastomeric: 2 inches thick.

3.13 INDOOR, FIELD-APPLIED JACKET SCHEDULE

A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.
B. If more than one material is listed, selection from materials listed is Contractor's option.
C. Piping, Concealed:
1. None.
D. Piping, Exposed:

1. Aluminum, Smooth: 0.016 inch hick.

3.14 OUTDOOR, FIELD-APPLIED JACKET SCHEDULE

A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.
B. If more than one material is listed, selection from materials listed is Contractor's option.
C. Piping, Concealed:
1. None.
D. Piping, Exposed:
1. PVC: 20 mils thick.

END OF SECTION

SECTION 23 09 33 – BUILDING AUTOMATION SYSTEM – HONEYWELL N4 (JAVA BASED)

PART 1 - GENERAL

1.01 OWNERS REQUIREMENTS

A. No additional software shall be required to operate, program, or troubleshoot equipment.
B. All thermostats shall be 24 hr./7 day programmable type, auto changeover type. a +/- 3 degree adjustment by the occupant from the Building Automation System (BAS) setpoint. Thermostats shall not have occupancy override unless otherwise noted in the specifications. Provide locking covers (clear plastic, hinged type).
C. Samples (snapshots) of the graphics shall be included in the Automatic Temperature Control (ATC) submittal.
D. All building alarms must be sent to the local/main building alarm page accessed from the main site plan. Generic alarms are not acceptable and must indicate the reason the alarm has been generated. ATC contractor to coordinate with owner and develop alarm categories (critical, non-critical, maintenance, etc.) and identify which category equipment, systems, components, etc. shall be placed. ATC contractor to coordinate owner's notification requirements (local, remote, personnel, emails, texts, etc.). An alarm shall be sent to the main alarm page whenever a controller loses communication for more than 5 minutes.
E. The ATC contractor shall provide two (4 hour) training sessions for systems orientation, product maintenance, trouble shooting, and emergency contacts. ATC contractor to coordinate with owner/architect/engineer to determine representatives/designated staff to be present for the training.
F. The user shall have the ability to adjust scheduling blocks for each piece of equipment, floor, building, and the entire campus in addition to the individual zones. (i.e., occupied/unoccupied).
G. An icon in the Navigation Bar shall display the pdf's of As-Built control diagrams and sequence of operations for all systems within the building/system being viewed. This shall open in a pop-up window.
H. Furnish all labor, materials, equipment, and service necessary for a complete and operating control system to be integrated with the central building automation system, utilizing Direct Digital Controls as shown on the drawings and as described herein. Drawings are diagrammatic only.
I. Utilizing the BAS supervisor, the system shall be capable of remotely controlling, monitoring, accessing all equipment and systems controls described in this section and the drawings from multiple locations as determined by the client. All equipment and systems shall match and be compatible with the existing Chester School District WEBs System Standards.
J. Contractor to obtain pricing from owner's controls vendor (and include in his bid) for integration work between this project and the existing Campus WEBs System. Provide standard mapping and graphics integration. Contractor to match existing BAS graphics and standards.
K. Utilize network user function to be programmed into the Server. Passwords will need to be issued by the owner to the contractor prior to programming. No additional users shall be created by the vendor.
L. Contractor to provide a hyperlink to the Main Site Map to open up each building floor plan showing areas under control (via the BAS).
M. Provide emergency shut down for all fan forced systems on emergency shut down page on BAS.
N. System shall be setup for auto backup of JACEs on a weekly basis via the AX Provisioning Service.
O. Provide 1 year software maintenance agreement for each JACE provided. The contractor is

responsible for upgrading and installing any upgrades to the Niagara 4 Software during the warranty period.

P. Additional Graphics Requirements.
1. Building floor plan display should be color coded for each particular zone. (i.e., AHU zone: Area should be shaded differently than other zones.) Thermostat locations and thermostat number shall be identified.
2. Building floor plan to display current temperatures of those rooms.
3. Notification of a “blinking” red light shall be displayed when an area is in alarm.
4. If a controller is offline or lost power, a default value of last known value should not be displayed. It should be defined as “offline” and an alarm should be programmed into the system to notify that system is “offline.” Unit temperature display shall become yellow.
5. From the building area floor plan graphic, there should be hyperlink created that allows one to proceed to HVAC equipment page for equipment serving that area.
6. Equipment should have an automated graphic display showing a status of equipment. This should be confirmed by both status and command values.
7. The dampers should be displayed in the position that they are physically in.
8. Set points should be displayed on the graphics.
9. Ability to override commands of valves, dampers, fans to be provided to allow system corrections and/or troubleshooting.
10. All programmed schedules to be accessible from the main floor plan page. Allow for click and change ability to modify schedules based on calendar year changes.
11. Pages shall have hyperlinks to navigate to main site home page, building home page, and adjacent floors within the building.
12. The graphics of a piece of equipment (i.e., fan, motor, etc.) in operation (energized, not energized, etc.) shall be displayed on the graphics to match the operations of the physical piece of equipment.
13. Provide hyperlinking between the equipment to the floor plan.

1.02 SUMMARY

A. Scope: Furnish all labor, materials, and equipment for a complete and operating Building Automation System (BAS) utilizing Direct Digital Controls as shown as drawings and as described herein. Drawings are diagrammatic only. All controllers furnished in this section shall communicate on a peer-to-peer open protocol bus (s) such as LonTalk or BACnet.
1. The intent of the specification is to provide to the owner a BAS system(s) running the Niagara 4 ™ open NICS framework and be truly “open” at all levels. “Open” by definition includes “Sourcing” and “Product,” and “Service” and “Expansion.” Any contractor or integrator “certified” on Niagara 4 platform must be able to work on any device or network controller or supervisor without having to use other vendors or software to access parts of the network. This can best be described as an “open source,” “open protocol,” “open controller,” “open supervisor” system with “open maintenance” and “system expansion.”
2. BAS Systems that meet “Open definition”:
   a. **Manufacturers:** Honeywell Inc., Schneider Electric, or prior approved equal.
   b. Control Contractor Requirement:
      1) Honeywell ACI or ACS – Certified Contractor.
      2) Minimum of (2) WEBS Niagara 4 certified employees.
      3) Minimum of (5) WEBS N4 installations with system supervisor interface.
   c. Preapproved Honeywell ACI and ACS contractors for WEBs-N4™ “installation.”
3. Open NIC Statement

Niagara 4 includes a licensing model that provides OEMs with the ability to define the various levels and types of Niagara 4 interoperability their product will support. There are two primary interactions the NICs address – the sharing of data between stations (JACEs – WEBs-AX™ and Supervisors) and the ability for a tool (i.e., N4 workbench 4.3 or above) to engineer a station.

The NICS provides a structure (or schema) that OEMs can use to define the various levels and types of Niagara 4 interdependability their products will support. The NICs definitions are contained in the license file which is checked by a station or tool when it starts up.

Every licensed station and tool has a (Host ID). This field holds a text descriptor that the OEM chooses as the identifier its product line and each station can have only one Host ID entry.

Station Compatibility “In”
The field is a list of brands that this local station will allow Niagara 4™ data to come in from – “this is the list of brands that can accept data from.”

Station Compatibility “Out”
This Field is a list of brands that this local station will allow Niagara 4™ data to be shared with.

Total Compatibility “In”
This field is a list of brands that this station will allow to be connected to it for engineering of its applications.

Total Compatibility “Out”
This field is a list of brands that this tool is allowed to connect to and engineer.

For a BAS System(s) running Niagara 4™ from NICs framework and be truly “Open” at all levels …
Example: No connectivity restrictions:
The station and tool “NICs” would be as follows:

Property	Value
Station Compatibility In	All
Station Compatibility Out	All
Total Compatibility In	All
Total Compatibility Out	All

4. System architecture shall fully support a multi-vendor environment and be able to integrate third party systems via existing vendor protocols including, as a minimum, LonTalk, and Modbus. Non LonTalk communication protocol for specific pieces of equipment must be approved on a case by case basis.
5. System architecture shall provide secure Web access using MS Internet Explorer from any computer on the owner’s LAN.
6. All control devices furnished with this Section shall be programmable directly from the Niagara-4™ Workbench upon completion of this project. The use of configurable or programmable controllers that require additional software tools for post-installation maintenance shall not be acceptable.

7. Any control vendor that must provide additional BAS server software shall be unacceptable. Only systems that utilize the WEBs Niagara 4™ Framework shall satisfy the requirements of this section.
8. The BAS server shall host all graphic files for the control system. All graphics and navigation schemes for this project shall match those that are on the existing campus Niagara 4 framework server.
9. OPEN NIC STATEMENTS - All Niagara 4 software licenses shall have the following NiCS: “accept.station.in=*”; “accept.station.out=*”and “accept.wb.in=*”and “accept.wb.out=*”. All open NIC statements shall follow Niagara 4 Open NIC specifications
10. All JACE hardware products used on this project must be Made in the USA or come through the Tridium Richmond, VA shipping facility. JACE hardware products not meeting these requirements will not be allowed.

B. Furnish all labor, materials, equipment, and service necessary for a complete and operating control system to be integrated with the central BAS System, utilizing Direct Digital Controls as shown on the drawings and as described herein. Drawings are diagrammatic only.
C. All control wiring regardless of if it is line or low voltage and it performs as control wiring, shall be the ATC contractor’s electrical subcontractor responsibility. ATC contractor to allow for electrical contractor compensation for any line voltage work. Power for operation of valves, dampers, thermostats, and miscellaneous devices is control wiring.
D. Drawings of the BAS network and associated systems are diagrammatic only and any apparatus not shown but required to make the system operative to the complete satisfaction of the owner/engineer shall be furnished and installed without additional cost.
E. All wiring to be CAT 6 plenum rated in concealed areas and in conduit where exposed or subject to damage. All exterior exposed control wiring to be in conduit and weather protected. Conduit to be galvanized. No PVC is permitted in plenum.
F. This contractor shall conform to the General and Supplementary Conditions Provisions under Division 1 of the Specifications. (Where applicable)
G. This contractor shall conform to the Specifications Section 23 05 00: Mechanical General Provisions.
H. Exposed control wiring in interior finished spaces;
   1. Control wiring to run in Wiremold V500 series. (steel raceway, ¾”) and associated fittings.
   2. Finish to be selected by architect.
   3. Contractor to coordinate all final Wiremold run locations and layout with architect/engineer for approval prior to ordering and rough-in.
I. ATC contractor to be present at equipment/system start-up and verify that all wiring and components are installed correctly and the equipment/system sequence of operation is operating as designed. ATC contractor to perform final calibrations of all devices and equipment. ATC contractor to make all the required corrections if the equipment/system does not operate correctly.
J. ATC contractor to coordinate with the test, balancing, and adjusting (TBA) contractor prior to performing equipment/systems tests that all air systems have been tested and balanced.
K. The use or installation of all wireless equipment must be pre-approved by the owner and engineer.
L. Tridium has developed a document that addresses many of the issues that IT managers have relating to Tridium’s Niagara 4 Framework™ and platform and station connections. Refer to www. tridium.com for additional document information.
M. All control panels to be NEMA 3R.

1.03 SYSTEM DESCRIPTIONS

A. The entire BAS shall be comprised of interoperable, stand-alone digital controllers communicating via LonMark™/LonTalk™ and/or ™ communication protocols to a Network Area Controller (NAC). Temperature Control System products shall be by approved manufacturer that meet and fully comply

with the intent of Sections 1.1, A.1.

B. The BAS shall consist of controllers, sensors, thermostats, control valves, dampers and operators, indicating devices, interface equipment and other apparatus and accessories required to operate mechanical systems, and perform functions specified.

C. The BAS shall be comprised of Network Area Controller(s) (NAC) within the facility. The NAC shall connect to the owner's local or wide area network, depending on configuration. Access to the systems, either locally in this building or remotely from a control site or sites, shall be accomplished through standard WEB browsers, supported MS Internet Explorer via Internet and/or local area network. Each NAC shall communicate to LonMark™/LonTalk™ (ILC) and/or ™ (IBC) controllers and other open protocol system/devices provided under Division 23, Division 26, etc.

D. The BAS as provided in this Division shall be based on a hierarchical architecture incorporating the Niagara N4 Frameware™. All control devices furnished shall be programmable directly from Tridium N4™ Workbench, WEBs Station N4™ or WEB Pro N4™ upon completion of this project. WEBs-N4™ "open" license embedded user interface "UI."

1.04 SPECIFICATION NOMENCLATURE - Acronyms used in this specification are as follows:

Actuator	Control device that opens or closes valve or damper in response to control signal.
AI	Analog Input
AO	Analog Output
Analog	Continuously variable state overstated range of values
BAS	Building Automation System
DDC	Direct Digital Control
Discrete	Binary or digital state
DI	Discrete Input
DO	Discrete Output
FC	Failed Closed position of control device or actuator. Devices move to closed position on loss of control signal or energy source.
FO	Fail open (position of control device or actuator). Device moves to open position on loss of control signal or energy source.
GUI	Graphical User Interface
HVAC	Heating, Ventilating and Air Conditioning
IDC	Interoperable Digital Controller
ILC	Interoperable Lon Controller
LAN	Local Area Network
Modulating	Movement of a control device through an entire range of values, proportional to an infinitively variable input value.
Motorized	Control device with actuator
NAC	Network Area Controller
NC	Normally closed position of switch after control signal is removed or normally closed position of manually operated valves or dampers.
NO	Normally open position of switch after control signal is removed; or the open position of a controlled valve or damper after the control signal is removed; or the usual position of a manually operated valve.
OSS	Operating System Server, host for system graphics, alarms, trends, etc.
Operator	Same as actuator
PC	Personal Computer

Peer-to-Peer	Mode of communication between controllers in which each device connected to network has equal status and each share its database values with all other devices connected to network.
P	Proportional control; control mode with continuous linear relationship between observed input signal and final controlled output element.
PI	Proportional-Integral control, control mode with continuous proportional output plus additional change in output based on both amount and duration of change in controller variable (reset control).
PICS	Product Interoperability Compliance Statement.
PID	Proportional-Integral-Derivative control, control mode with continuous correction of final controller output element versus input signal based on proportional error, its time history (reset) and rate at which it's changing (derivative).
Point	Analog or discrete instrument with addressable database value.
WAN	Wide Area Network
TCS	Temperature Control Systems
FMCS	Facility Management Control System
CD	Compact Disc
NICS	NIAGARA 4™ Compatibility Statement – see Part 1.1.3
IBC	Interoperable Controller
I/O Points	AI, AO, DI, DO
ACI	Honeywell designation acronym: Authorized Control Integrator.
ACS	Honeywell designation acronym: Automation Control Specialist
BCS	Honeywell designation acronym: (See ACS)
WBI	WEB Browser Interface
POT	Portable Operator's Terminal
PMI	Power Measurement Interface
OOT	Object Oriented Technology
ASD	Honeywell Designation: Authorized System Distributor
ISO-9001	Model for Quality Assurance in Design/Development, Production, Installation and Servicing.
PEC	Programmable Equipment Controllers
ASC	Application Specific Controllers
AUC	Advance Unitary Controllers
SNC	System Network Controller
SNMP	Simple Network Management Protocol
OEM	Original Equipment Manufacturer
OBDB	Open Database Connectivity
SQL	Structured Query Language

1.05 DIVISION OF WORK

A. The ATC contractor shall be responsible for all controllers (IDC and IBC), control devices, control panels, controller programming, controller programming software, controller input/output and power wiring and controller network wiring.

B. The ATC contractor shall be responsible for the Network Area Controller(s) (NAC), software and programming of the NAC, graphical user interface software (GUI), development of all graphical screens, Web Browser pages, setup of schedules, logs, and alarms, LonWorks network management and connection of the NAC to the local or Wide Area Network.

1.06 RELATED WORK SPECIFIED ELSEWHERE

A. Reference General Conditions Section 23 05 00 for all portions of work that applies to BAS or BAS contractor.
B. Division 26, Electrical:
   1. Providing starters and disconnect switches (unless otherwise noted).
   2. Power wiring and conduit (unless otherwise noted).
   3. Provision, installation and wiring of smoke detectors (unless otherwise noted).
   4. Other equipment and wiring as specified in Division 26.
C. Division 23, Equipment Interface:
   In the event the Division 23 equipment supplier has interface responsibility specified with the BAS, through communications with Lon™, ™ or ModBus, the ATC contractor shall be responsible for the up-loading of I/O points and operational written perimeters, as detailed in Division 23; HVAC equipment and the here after sequence-of-operations to the NAC. It will be the responsibility of the Division 23 manufacturers/equipment supplier to coordinate the time and date with their factory trained control technician to facilitate/accomplish 100%, the I/O points and control perimeters with the ATC contractor to fully meet the specification requirements. Upon completion and testing by both the BAS and the factory technician, all programming software will be given to the BAS for demonstration to the owner and will become property of the owner for use in the future.
D. Refer to International Mechanical Code.
E. Refer to National Electrical Code.

1.07 AGENCY AND CODE APPROVALS

A. All products of the BAS shall be provided with the following agency approvals. Verification that the approvals exist for all submitted products shall be provided on request, with the submittal package. Systems or products not currently offering the following approvals are not acceptable.
   1. Federal Communications Commission (FCC), Rules and Regulations, Volume II – July 1986 Part 15 Class A Radio Frequency Devices
   2. FCC, Part 15, Subpart J, Class A Computing Devices.
   3. UL 504 – Industrial Control Equipment
   4. UL 506 – Specialty Transformers
   5. UL 910 – Test Method for Fire and Smoke Characteristics of Electrical and Optical-Fiber Cables Used in Air-Handling Spaces
   6. UL 916 – Energy Management Systems All
   7. UL 1449 – Transient Voltage Suppression
   8. Standard Test for Flame Propagation Height of Electrical and Optical – Fiber Cables Installed Vertically in Shafts.
   9. EIA/ANSI 232-E – Interface Between Data Technical Equipment and Data Circuit Terminal Equipment Employing Serial Binary Data Interchange.
   10. EIA 455 – Standard Test Procedures for Fiber Optic Fibers, Cables, Transducers, Connecting and Terminating Devices.
   11. IEEE C62.41 – Surge Voltages in Low-Voltage AC Power Circuits.
   12. IEEE 142- Recommended Practice for Grounding of Industrial and Commercial Power Systems
   13. NEMA 250 – Enclosures for Electrical Equipment (SIC)
   14. NEMA ICS 1 – Industrial Control Systems
   15. NEMA ST 1 – Specialty Transformers
   16. NCSBC Compliance, Energy Performance of Control System shall meet or surpass the requirements of ASHRAE/IESNA 90.1.

B. All BACNET equipment/devices shall bear the “BTL” stamp.
C. The BAS shall be BACNET-SC (secure connect) capable.

1.08 SOFTWARE OWNERSHIP

A. The owner shall have full ownership and full access rights for all network management, operating system server, engineering and programming software required for the ongoing maintenance and operation of the BAS.

1.09 MECHANICAL GENERAL PROVISIONS

A. ATC Contractor shall conform to the general and supplemental condition provisions under Division 23 05 00 and this specification.

1.10 DELIVERY STORAGE AND HANDLING AND SHIPPING TO OEM FACTORY.

A. Provide factory shipping cartons for each piece of equipment and control device.
B. Maintain cartons through shipping, storage, and handling as required to prevent equipment damage. Store equipment and materials inside and protected from the weather.
C. Factory mounted Components: Where control devices are specified in this section or other specifications such as (equipment) to be factory mounted, the BAS shall arrange for shipping of control devices to equipment manufacturer. He will have responsibility of “tagging” control hardware prior to shipping if requested by equipment supplier. The BAS contractor will have the option of either down-loading program(s) prior to shipping or installing programs after mechanical equipment has been installed at site unless specific instructions are specified under 1.5C Equipment Interface.

1.11 QUALITY ASSURANCE

A. Single source Responsibility of BAS.
   1. The ATC Contractor shall be responsible for the complete installation and proper operations of the control system specified. The control system contractor shall exclusively be in regular and customary business of design, installation, and service of computerized building management systems similar in size and complexity to the system specified. Subcontracting the “Single Service Responsibility” tasks to others covering any of the following: design and submission, graphics, software programming, field check, demonstrating operating compliance and warranty including using Automation System Distributor is not accepted.
   2. The ATC Contractor shall have a full service DDC office within 50 miles of the project site. This office shall be staffed with applications’ engineers, software engineers, and field technicians. This office shall maintain parts inventory and shall have all testing and diagnostic equipment to support their work, as well as staff trained in the use of this equipment.
   3. The manufacturers of the BAS digital controllers shall, if necessary, provide documentation supporting compliance with ISO-9001.

1.12 RELATED WORK SPECIFIED ELSEWHERE

A. Products Supplied But Not Installed Under This Section:
   1. Wells, sockets, and other inline hardware for water sensors (temperature, pressure, flow).
   2. Automatic control dampers, where not supplied with equipment.
   3. Terminal unit controllers and actuators, when installed by terminal unit manufacturer.

4. Variable Frequency Drives.

B. Products Installed But Not Supplied Under This Section:
   1. None.

C. Products Not Furnished or Installed But Integrated with the Work of This Section:
   1. In-line Meters (gas, water, power).
   2. Refrigerant Monitors.
   3. Smoke Detectors (through alarm relay contacts).

D. Work Required Under Division 26 Related to This Section:
   1. Power wiring to line side of motor starters, disconnects or variable frequency drives.
   2. Provision and wiring of smoke detectors and other devices relating to fire alarm system.
   3. Campus LAN (Ethernet) connection adjacent to JACE network management controller.

PART 2 - PRODUCTS

2.01 SYSTEM OVERVIEW

A. The ATC Contractor shall provide system software based on server/thin-client architecture, designed around the open standards of web technology. The BAS server shall communicate using Ethernet and TCP/IP. Server shall be accessed using a web browser over Owner intranet and remotely over the Internet.

B. The BAS server software must support at least the following server platforms: Windows. The BAS server software shall be developed and tested by the manufacturer of the system stand-alone controllers and network controllers/routers.

C. The web browser Graphical User Interface (GUI) shall provide a completely interactive user interface and must offer and be configured with the following features as a minimum:
   1. Trending.
   2. Scheduling.
   3. Electrical demand limiting.
   4. Duty Cycling.
   5. Download Memory to field devices.
   6. Real time ‘live’ Graphic Programs.
   7. Tree Navigation.
   8. Parameter change of properties.
   9. Setpoint Adjustments.
   10. Alarm/Event Information.
   11. Configuration of operators.
   12. Execution of global commands.
   13. Add, delete, and modify graphics and displayed data.

D. Software Components: All software shall be the most current version. All software components of the BAS system software shall be provided and installed as part of this project. BAS software components shall include:

E. BAS Server Database: The BAS server software shall utilize a JAVA Database Connectivity (JDBC) compatible database such as: MS SQL 8.0, Oracle 8i or IBM DB2, BAS systems written to Non-Standard and/or Proprietary databases are NOT acceptable.

F. Database Open Connectivity: The BAS server database shall allow real time access of data via the following standard mechanisms:
   1. Open protocol standard like SOAP

2. OLE/OPC (for Microsoft Client's/Server platform only)
3. Import/Export of the database from or to XML (Extensible Mark-up Language)

G. The installed system shall provide secure password access to all features, functions and data contained in the overall BAS.

H. Communication Protocol(s): The native protocol of the BAS server software shall be TCP/IP over Ethernet. Proprietary protocols over TCP/IP are NOT acceptable.

I. Thin Client – Web Browser Based: The GUI shall be thin client or browser based and shall meet the following criteria:
1. Web Browser's for PC's: Only the latest version of Microsoft/Firefox will be required as the GUI, and a valid connection to the server network. No installation of any custom software shall be required on the operator's GUI workstation/client. Connection shall be over an intranet or the Internet.
2. Secure Socket Layers: Communication between the Web Browser GUI and BAS server shall offer encryption using 128-bit-encryption technology within Secure Socket Layers (SSL). Communication Protocol shall be Hyper-Text Transfer Protocol (HTTP)

2.02 WEB BROWSER GRAPHICAL USER INTERFACE (GUI)

A. Web Browser Navigation: The Thin Client web browser GUI shall provide a comprehensive user interface. Using a collection of web pages, it shall be constructed to "feel" like a single application and provide a complete and intuitive mouse/menu driven operator interface. It shall be possible to navigate through the system using a web browser to accomplish requirements of this specification. The Web Browser GUI shall (as a minimum) provide for navigation, and for display of animated graphics, schedules, alarms/events, live graphic programs, active graphic setpoint controls, configuration menus for operator access, reports, and reporting actions for events.

B. Login: On launching the web browser and selecting the appropriate domain name or IP address, the operator shall be presented with a login page that will require a login name and password. Navigation in the system shall be dependent on the operator's role privileges, and geographic area of responsibility.

C. Navigation: Navigation through the GUI shall be accomplished by clicking on appropriate building on a campus site plan.
1. Upon navigating to the site, the page shall be broken into two areas, a Navigation Bar and General Area.

D. Navigation Bar: The Navigation Bar shall provide General information of the site and basic navigation functions. It is to be located along the top of the page and shall display the following.
1. General information such as current time, outdoor temperature/humidity, building name, and page name.
2. Navigation information that shall be provided is link back to site plan, to site histories, site specific alarm panel, building schedules, and the sites main home page.
a. Alarm Panel: This shall display the current number of unacknowledged alarms for the site and when selected, open the alarm panel in a popup window.
b. Histories: This shall display the histories for the current site being viewed and open in a popup window.
c. Sequence of Operation: This shall display the sequence of operations for all equipment within the site being viewed. This shall open in a pop-up window.

E. General Area: The general area is the main display area for the site. It shall contain information such as floor plans and equipment details.
1. Floor Plans: The floor plan shall be created from (CAD or REVIT) backgrounds and shall provide a general overview of the building floors that shows building room numbers and corresponding space temperatures and access to the equipment pages.

2. Equipment pages: The views of equipment shall either be provided in a popup window or on the main general area depending on size of graphic need.
    a. It shall display a general layout of the equipment and display all points created for the equipment. The user shall also have access to set points and be able to adjust with a simple click. Refer to section 2.04 for additional user adjustment requirements.

F. Action Pane: The Action Pane shall provide several functional views for each HVAC or mechanical/electrical subsystem specified. A functional view shall be accessed by clicking on the corresponding button.
1. Graphics: Using graphical format suitable for display in a web browser, graphics shall include aerial building/campus views, color building floorplans, equipment drawings, active graphic setpoint controls, web content, and other valid HTML elements. The data on each graphic page shall automatically refresh.
2. Properties: Shall include graphic controls and text for the following: Locking or overriding objects, demand strategies, and any other valid data required for setup. Changes made to the property's pages shall require the operator to depress an 'accept/cancel' button.
3. Schedules: Shall be used to create, modify/edit and view schedules based on the systems geographical hierarchy (using the navigation bar).
4. Alarms: Shall be used to view alarm information geographically (using the navigation bar), acknowledge alarms, sort alarms by category, actions and verify reporting actions.
5. Trends: Shall be used to display associated trend and historical data, modify colors, date range, axis, and scaling.
6. Logic – Live Graphic Programs: Shall be used to display 'live' graphic programs of the control algorithm, (micro block programming) for the mechanical/electrical system selected in the navigation tree.
7. Other actions such as Print, Help, Command, and Logout shall be available via a dropdown window.

G. Color Graphics: The Web Browser GUI shall make extensive use of color in the graphic pane to communicate information related to set points and comfort. Animated, gifs or jpgs, vector scalable, active setpoint graphic controls shall be used to enhance usability. Graphic tools used to create Web Browser graphics shall be non-proprietary and conform to the following basic criteria:
1. Display Size: The GUI workstation software shall graphically display in 1024 by 768 pixels 24 bit True Color.
2. General Graphic: General area maps shall show locations of controlled buildings in relation to local landmarks.
3. Color Floor Plans: Floor plan graphics shall show heating and cooling zones throughout the buildings in a range of colors based on temperature. Difference from set point Red = temperature above set point; Blue = temperature below set point; additionally, Yellow = lost communication, Dark Red = alarm as selected by Owner. Provide a visual display of temperature relative to their respective set points. The colors shall be updated dynamically as a zone's actual comfort condition changes.
4. Mechanical Components: Mechanical system graphics shall show the type of mechanical system components serving any zone through the use of a pictorial representation of components. Selected I/O points being controlled or monitored for each piece of equipment shall be displayed with the appropriate engineering units. Animation shall be used for rotation or moving mechanical components to indicate status of equipment.
5. Minimum System Color Graphics: Color graphics shall be selected and displayed via a web browser for the following:
    a. Each piece of equipment monitored or controlled including each terminal unit.
    b. Each building
    c. Each floor and zone controlled.

H. Hierarchical Schedules: Utilizing the Navigation Bar displayed in the web browser GUI, an operator (with password access) shall be able to define a Normal (occupied/ unoccupied), holiday or override schedule for an individual piece of equipment or room or choose to apply a hierarchical schedule to the entire system, site or floor area. For example, Independence Day 'Holiday' for every level in the system would be created by clicking at the top of the geographic hierarchy defined in the Navigation Bar. No further operator intervention would be required and every control module in the system would be automatically downloaded with the 'Independence Day' Holiday. All schedules that affect the system/area/equipment highlighted in the Navigation Bar shall be shown in a summary schedule table and graph.

1. Schedules: Schedules shall comply with the LonWorks and standards, (Schedule Object, Calendar Object, Weekly Schedule property and Exception Schedule property) and shall allow events to be scheduled based on:
   a. Types of schedule shall be Normal, Holiday or override
   b. A specific date.
   c. A range of dates.
   d. Any combination of Month of Year (1-12, any), Week of Month (1-5, last, any), Day of Week (M-Sun, Any).
2. Wildcard (example, allow combinations like second Tuesday of every month).
3. Schedule categories: The system shall allow operators to define and edit scheduling categories (different types of "things" to be scheduled; for example, lighting, HVAC occupancy, etc.). The categories shall include: name, description, icon (to display in the hierarchy tree when icon option is selected) and type of value to be scheduled.
4. Schedule Groups: In addition to hierarchical scheduling, operators shall be able to define functional groups, comprised of an arbitrary group of areas/rooms/equipment scattered throughout the facility and site. For example, the operator shall be able to define an 'individual tenant' group – who may occupy different areas within a building or buildings. Schedules applied to the 'tenant group' shall automatically be downloaded to control modules affecting spaces occupied by the 'tenant group."
5. Intelligent Scheduling: The control system shall be intelligent enough to automatically turn on any supporting equipment needed to control the environment in an occupied space. If the operator schedules an individual room in a VAV system for occupancy, for example, the control logic shall automatically turn on the VAV air handling unit, chiller, boiler, and/or any other equipment required to maintain the specified comfort and environmental conditions within the room.
6. Partial Day Exceptions: Scheduled events shall be able to accommodate a time range specified by the operator (i.e., board meeting from 6 pm to 9 pm overrides normal schedule for conference room).
7. Schedule Summary Graph: The schedule summary graph shall clearly show Normal versus Holiday versus Override Schedules, and the net operating schedule that results from all contributing schedules. Note: In case of priority conflict between schedules at the different geographic hierarchy, the schedule for the more detailed geographic level shall apply.
8. The user shall have the ability to adjust scheduling blocks for the entire building in addition to individual zones.

I. Alarms: Alarms associated with a specific system, area, or equipment selected in the Navigation Bar, shall be displayed in the Action Pane by selecting an 'Alarms' view. Alarms, and reporting actions shall have the following capabilities:

1. Alarms View: Each Alarm shall display an Alarms Category (using a different icon for each alarm category), date/time of occurrence, current status, alarm report, and a bold URL link to the associated graphic for the selected system, area or equipment. The URL link shall indicate the system location, address, and other pertinent information. An operator shall

easily be able to sort events, edit event templates and categories, acknowledge, or force a return to normal in the Events View as specified in this section.

2. Alarm Categories: The operator shall be able to create, edit or delete alarm categories such as HVAC, Maintenance, Fire, or Generator. An icon shall be associated with each alarm category, enabling the operator to easily sort through multiple events displayed.
3. Alarm Templates: Alarm template shall define different types of alarms and their associated properties. As a minimum, properties shall include a reference name, verbose description, severity of alarm, acknowledgement requirements, and high/low limit and out of range information.
4. Alarm Areas: Alarm Areas enable an operator to assign specific Alarm Categories to specific Alarm Reporting Actions. For example, it shall be possible for an operator to assign all HVAC Maintenance Alarm on the 1st floor of a building to email the technician responsible for maintenance. The Navigation Bar shall be used to setup Alarm Areas in the Graphic Pane.
5. Alarm Time/Date Stamp: All events shall be generated at the DDC control module level and comprise the Time/Date Stamp using the standalone control module time and date.
6. Alarm Configuration: Operators shall be able to define the type of Alarm generated per object. A 'network' view of the Navigation Tree shall expose all objects and their respective Alarm Configuration. Configuration shall include assignment of Alarm, type of Acknowledgement and notification for return to normal or fault status.
7. Alarm Summary Counter: The view of Alarm in Graphic Pane shall provide a numeric counter, indicating how many Alarms are active (in alarm); require acknowledgement, and total number of Alarms in the BAS Server database.
8. Alarm Auto-Deletion: Alarms that are acknowledged and closed shall be auto-deleted from the database and archived to a text file after an operator defined period.
9. Alarm Reporting Actions: Alarm Reporting Actions specified shall be automatically launched (under certain conditions) after an Alarm is received by the BAS server software. Operators shall be able to easily define these Reporting Actions using the Navigation Bar and Graphic Pane through the web browser GUI. Reporting Actions shall be as follows:
    a. Print: Alarm information shall be printed to the BAS server's PC or a networked printer.
    b. Email: Email shall be sent via any POP3-compatible e-mail server (most Internet Service Providers use POP3). Email messages may be copied to several email accounts. Note: Email reporting action shall also be used to support alphanumeric paging services, where email services support pagers.
    c. File Write: The ASCII File write reporting action shall enable the operator to append operator defined alarm information to any alarm through a text file. The alarm information that is written to the file shall be completely definable by the operator. The operator may enter text or attach other data point information (such as AHU discharge temperature and fan condition upon a high room temperature alarm).
    d. Write Property: The write property reporting action updates a property value in a hardware module.
    e. SNMP: The Simple Network Management Protocol (SNMP) reporting action sends an SNMP trap to a network in response to receiving an alarm.
    f. Run External Program: The Run External Program reporting action launches specified program in response to an event.
10. All building alarms must be sent to the campus alarm page accessed from the campus site plan.

J. Trends: Trends shall both be displayed and user configurable through the Web Browser GUI. Trends shall comprise analog, digital or calculated points simultaneously. A trend log's properties

shall be editable using the Navigation Bar and Graphic Pane.

1. Viewing Trends: The operator shall have the ability to view trends by using the Navigation Bar and selecting a Trends button in the Graphic Pane. The system shall allow y- and x-axis maximum ranges to be specified and shall be able to simultaneously graphically display multiple trends per graph.
2. Local Trends: Trend data shall be collected locally by Multi-Equipment/Single Equipment general-purpose controllers, and periodically uploaded to the BAS server. Trend data, including run time hours and start time date and start time date shall be retained in non-volatile module memory. Systems that rely on a gateway/router to run trends are NOT acceptable.
3. Resolution: Sample intervals shall be as small as one second. Each trended point will have the ability to be trended at a different trend interval. When multiple points are selected for displays that have different trend intervals, the system will automatically scale the axis. Provide 15 minute intervals for all trending points unless otherwise noted.
4. Dynamic Update: Trends shall be able to dynamically update at operator-defined intervals.
5. Zoom/Pan: It shall be possible to zoom-in on a particular section of a trend for more detailed examination and 'pan through' historical data by simply scrolling the mouse.
6. Numeric Value Display: It shall be possible to pick any sample on a trend and have the numerical value displayed.
7. Copy/Paste: The operator must have the ability to pan through a historical trend and copy the data viewed to the clipboard using standard keystrokes (i.e., CTRL+C, CTRL+V).

K. Security Access: Systems that Security access from the web browser GUI to BAS server shall require a Login Name and Password. Access to different areas of the BAS system shall be defined in terms of Roles, Privileges and geographic area of responsibility as specified:

1. Roles: Roles shall reflect the actual roles of different types of operators. Each role shall comprise a set of 'easily understood English language' privileges. Roles shall be defined in terms of View, Edit and Function Privileges.
    a. View Privileges shall comprise: Navigation, Network, and Configuration Trees, Operators, Roles and Privileges, Alarm/Event Template and Reporting Action.
    b. Edit Privileges shall comprise: Setpoint, Tuning and Logic, Manual Override, and Point Assignment Parameters.
    c. Function Privileges shall comprise: Alarm/Event Acknowledgment Control Module Memory Download, Upload, Schedules, Schedule Groups, Manual Commands, Print, and Alarm/Event Maintenance.
2. Geographic Assignment of Roles: Roles shall be geographically assigned using a similar expandable/collapsible Navigation Bar. For example, it shall be possible to assign two HVAC Technicians with similar competencies (and the same operator defined HVAC Role) to different areas of the system.

2.03 GRAPHICAL PROGRAMMING

A. The system software shall include a Graphic Programming Language (GPL) for all DDC control algorithms resident in all control modules. Any system that does not use a drag and drop method of graphical icon programming shall not be accepted. All systems shall a GPL is a method used to create a sequence of operations by assembling graphic microblocks that represent each of the commands or functions necessary to complete a control sequence. Microblocks represent common logical control devices in conventional control systems, such as relays, switches, high signal selectors, etc., in addition to the more complex DDC and energy management strategies such as PID loops and optimum start. Each microblock shall be interactive and contain the programming necessary to execute the function of the device it represents.

B. Graphic programming shall be performed while on screen and using a mouse; each microblock shall be selected from a microblock library and assembled with other microblocks necessary to complete the specified sequence. Microblocks are then interconnected on screen using graphic “wires,” each forming a logical connection. Once assembled, each logical grouping of microblocks and their interconnecting wires then form a graphic function block which may be used to control any piece of equipment with a similar point configuration and sequence of operation.

C. GPL Capabilities: The following is a minimum definition of the capabilities of the Graphic Programming software:
   1. Function Block (FB): Shall be a collection of points, microblocks and wires which have been connected together for the specific purpose of controlling a piece of HVAC equipment or a single mechanical system.
   2. Logical I/O: Input/Output points shall interface with the control modules in order to read various signals and/or values or to transmit signal or values to controlled devices.
   3. Microblocks: Shall be software devices that are represented graphically and maybe connected together to perform a specified sequence. A library of microblocks shall be submitted with the control contractors bid.
   4. Wires: Shall be Graphical elements used to form logical connections between microblocks and between logical I/O.
   5. Reference Labels: Labels shall be similar to wires I that they are used to form logical connections between two points. Labels shall form a connection by reference instead of a visual connection, i.e., two points labeled ‘A’ on a drawing are logically connected even though there is no wire between them.
   6. Parameter: A parameter shall be a value that may be tied to the input of a microblock.
   7. Properties: Dialog boxes shall appear after a microblock has been inserted which has editable parameters associated with it. Default parameter dialog boxes shall contain various editable and non-editable fields and shall contain ‘push buttons for the purpose of selecting default parameter settings.
   8. Icon: An icon shall be graphic representation of a software program. Each graphic microblock has an icon associated with it that graphically describes its function.
   9. Menu-bar Icon: Shall be an icon that is displayed on the menu bar on the GPL screen, which represents its associated graphic microblock.
   10. Live Graphical Programs: The Graphic Programming software must support a ‘live’ mode, where all input/output data, calculated data, and set points shall be displayed in a ‘live real-time mode.

D. Additional Graphics Requirements.
   1. Building floor plan display should be color coded for each particular zone. (i.e., AHU Zone: Area should be shaded differently than other zones.). Thermostat locations and thermostat number shall be identified.
   2. Building floor plan to display current temperatures of those rooms.
   3. Notification of a “blinking” red light shall be displayed when an area is in alarm.
   4. If a controller is offline or lost power, a default value of last known value should not be displayed. It should be defined as “offline” and an alarm should be programmed into the system to notify that system is “offline.” Unit temperature display shall become yellow.
   5. From the building area floor plan graphic, there should be hyperlink created that allows one to proceed to HVAC equipment page for equipment serving that area.
   6. Equipment should have an automated graphic display showing a status of equipment. This should be confirmed by both status and command values.
   7. The dampers should be displayed in the position that they are physically in.
   8. Set points should be displayed on the graphics.
   9. Ability to override commands of valves, dampers, fans to be provided to allow system

corrections and/or troubleshooting.

10. All programmed schedules to be accessible from the main floor plan page. Allow for click and change ability to modify schedules based on calendar year changes.
11. Pages shall have hyperlinks to navigate to main site home page, building home page, and adjacent floors within the building.
12. In lieu of building specific outdoor temperature and humidity sensors, BAS shall reference the National Weather Service, Philadelphia International Airport. This does not apply to equipment with integral OA Temp/RH sensors.
13. The graphics of a piece of equipment (i.e., fan, motor, etc.) in operation (energized, not energized, etc.) shall be displayed on the graphics to match the operations of the physical piece of equipment.
14. Provide hyperlinking between the equipment to the floor plan.

E. Contractor prior to programming the system graphics, shall obtain approved equipment templates from the owner to keep the graphics consistent.

2.04 BEST PRACTICES:

A. Local building supervisor:
   1. The local supervisor shall have its time synced with the NTP server.
   2. The passwords for the platform and administration shall be per the owner's standard.
   3. Histories and alarm extensions will reside at this level and then sent up to server.

B. Campus Supervisor:
   1. Local building PX pages shall reside in a folder named for the building and shall not depend on files outside of this for display.
   2. New supervisors shall be added to the scheduled backup for of station.

2.05 LONWORKS NETWORK MANAGEMENT

A. Systems requiring the use of third party LonWorks network management tools shall not be accepted.

B. Network management shall include the following services: device identification, device installation, device configuration, device diagnostics, device maintenance and network variable binding.

C. The network configuration tool shall also provide diagnostics to identify devices on the network, to reset devices, and to view health and status counters within devices.

D. These tools shall provide the ability to "learn" an existing LonWorks network, regardless of what network management tool(s) were used to install the existing network, so that existing LonWorks devices and newly added devices are part of a single network management database.

E. The network management database shall be resident in the Network Area Controller (NAC), ensuring that anyone with proper authorization has access to the network management databases at all times. Systems employing network management databases that are not resident, at all times, within the control system, shall not be accepted.

2.06 OPEN, INTEROPERABLE, INTEGRATED ARCHITECTURE

A. The intent of this specification is to provide a peer-to-peer networked, stand-alone, distributed control system utilizing the LonWorks technology communication protocol and/or in one open, interoperable system.

B. The supplied computer software shall employ object-oriented technology (OOT) for representation of all data and control devices within the system.

C. All components and controllers supplied under this contract shall be true "peer-to-peer"

communicating devices. Components or controllers requiring “polling” by a host to pass data shall not be acceptable.

D. The supplied system must incorporate the ability to access all data using Java enabled browsers without requiring proprietary operator interface and configuration programs. An Open Database Connectivity (ODBC) or Structured Query Language (SQL) compliant server database is required for all system database parameter storage. This data shall reside on the existing Operating System Server currently located in the Facilities Office on the LAN. Systems requiring proprietary database and user interface programs shall not be acceptable.

E. A hierarchical topology is required to assure reasonable system response times and to manage the flow and sharing of data without unduly burdening the customer’s internal intranet network. Systems employing a “flat” single tiered architecture shall not be acceptable.

1. Maximum acceptable response time from any alarm occurrence (at the point of origin) to the point of annunciation shall not exceed 5 seconds for network connected user interfaces.
2. Maximum acceptable response time from any alarm occurrence (at the point of origin) to the point of annunciation shall not exceed 60 seconds for remote or dial-up connected user interfaces.

2.07 PORTABLE OPERATOR’S TOOL (LAPTOP COMPUTER) (ADD ALTERNATE)

A. The laptop computer shall consist of an Intel Premium based laptop computer (minimum processing speed of 2.0 GHz with 8GB RAM with minimum 64 bit O.S. and a 500-gigabyte minimum hard drive). It shall include a CD-ROM drive, and appropriate connectors and cables for communication with the Ethernet network. Operating system shall be Microsoft Windows 10 or latest version.

2.08 BAS SERVER HARDWARE (ADD ALTERNATE)

A. Computer Configuration (Hardware Independent)

1. Central Server. Owner shall provide a dedicated BAS server with configuration that includes the following components as a minimum:
2. 2 GHz, Intel Core I5 or higher, Core 2 Dual also acceptable P4 or higher CPU – Dual Processor.
3. 8 GB of RAM Minimum, 500 gigabyte minimum hard drive, solid state hard drive.
4. 40 gigabytes hard disk, 1.44M 3 ½” floppy drive, SVGA Card with 1024 x 768, 24-bit True Color, Back-up system 24X CD Rom R/W Drive minimum, 24” Flat Screen Color Monitor, Keyboard, and mouse. Dual band wireless, bluetooth.
5. Operating System for the server shall be Microsoft Windows 10 or latest version, 64 bits minimum.
6. Internet Explorer 11.0 or later
7. 10/10/1000 Mbps T Ethernet Port
8. Standard Client: The thin-client Web Browser, BAS GUI shall be Microsoft Internet Explorer (11.0 or later) running on 10 or latest version (with LX Compatibility Mode. No special software shall be required to be installed on the PCs used to access the BAS via a web browser.

2.09 BAS SERVER FUNCTIONS

A. A central server shall be provided. The server shall support all Network Area Controllers (NAC) connected to the customer’s network whether local or remote.

B. Local connections shall be via an Ethernet LAN. Remote connections can be via ISDN, ADSL, T1 or dial-up connection.

C. It shall be possible to provide access to all Network Area Controllers via single connection to the server. In this configuration, each Network Area Controller can be accessed from a remote Graphical User Interface (GUI) or from a standard Web browser (WBI) by connecting to the server.

D. The server shall provide the following functions, at a minimum:
   1. Global Data Access: The server shall provide complete access to distributed data defined anywhere in the system.
   2. Distributed Control: The server shall provide the ability to execute global control strategies based on control and data objects in any NAC in the network, local or remote.
   3. The server shall include a master clock service for its subsystems and provide time synchronization for all Network Area Controllers (NAC).
   4. The server shall accept time synchronization messages from trusted precision Atomic Clock Internet sites and update its master clock based on this data.
   5. The server shall provide scheduling for all Network Area Controllers and their underlying filed control devices.
   6. The server shall be capable of providing demand limiting that operates across all Network Area Controllers. The server must be capable of multiple demand programs for sites with multiple meters and or multiple sources of energy. Each demand program shall be capable of supporting separate demand shed lists for effective demand control.
   7. The server shall implement the Command Prioritization Scheme (16 levels) for safe and effective contention resolution of all commands issued to Network Area Controllers. Systems not employing this prioritization shall not be accepted.
   8. Each Network Area Controller supported by the server shall have the ability to archive its log data, alarm data and database to the server, automatically. Archiving options shall be user-defined including archive time and archive frequency.
   9. The server shall provide central alarm management for all Network Area Controllers supported by the server. Alarm management shall include:
      a. Routing of alarms to display, printer, email, and pagers.
      b. View and acknowledge alarms.
      c. Query alarm logs based on user-defined parameters.
   10. The server shall provide central management of log data for all Network Area Controllers supported by the server. Log data shall include process logs, runtime and event counter logs, audit logs and error logs. Log data management shall include:
      a. Viewing and printing log data
      b. Exporting log data to other software applications
      c. Query log data based on user-defined parameters.

2.10 LIBRARY

A. A Standard library of objects shall be included for development and setup of application logic, user interface displays, system services, and communication networks.

B. The objects in this library shall be capable of being copied and pasted into the user's data base and shall be organized according to their function. In addition, the user shall have the capability to group objects created in their application and store the new instances of these objects in a user-defined library.

C. In addition to the standard libraries specified here, the supplier of the system shall maintain an on-line accessible (over the Internet) Library, available to all registered users to provide new or updated objects and applications as they are developed.

D. All control objects shall conform to the control objects specified in the specification.

E. The library shall include applications or objects for the following functions, at a minimum:
   1. Scheduling Object. The schedule must conform to the schedule object as defined in the

specification, providing 7 day plus holiday and temporary scheduling features and a minimum of 10 on/off events per day. Data entry to be by graphical sliders to speed creation and selection of on-off events.

2. Calendar Object. The calendar must conform to the calendar object as defined in the specification, providing 12 month calendar features to allow for holiday or special event data entry. Data entry to be by graphical "point and click" selection. This object must be linkable" to any or all scheduling objects for effective event control.
3. Duty Cycling Object. Provide a universal duty cycle object to allow repetitive on/off time control of equipment as an energy conserving measure. Any number of these objects may be created to control equipment at varying intervals.
4. Temperature Override Object. Provide a temperature override object that is capable of overriding equipment turned off by other energy saving programs (scheduling, duty cycling, etc.) to maintain occupant comfort or for equipment freeze protection.
5. Start-Stop Time Optimization Object. Provide a start-stop time optimization object to provide the capability of starting equipment just early enough to bring space conditions to desired conditions by the scheduled occupancy time. Also, allow equipment to be stopped before the scheduled unoccupancy time just far enough ahead to take advantage of the building's "flywheel" effect for energy saving. Provide automatic tuning of all start/stop time object properties based on the previous day's performance.
6. Demand Limiting Object. Provide a comprehensive demand-limiting object that is capable of controlling demand for any selected energy utility (electric, oil, and gas). The object shall provide the capability of monitoring a demand value and predicting (by use of a sliding window prediction algorithm) the demand at the end of the user defined interval period (1-60 minutes). This object shall also accommodate a utility meter time sync pulse for fixed interval demand control. Upon a prediction that will exceed the user defined demand limit (supply a minimum of 6 per day), the demand limiting object shall issue shed commands to either turn off user specified loads or modify equipment set points to effect the desired energy reduction. If the list of sheddable equipment is not enough to reduce the demand to below the set point, a message shall be displayed on the user's screen (as an alarm) instructing the user to take manual actions to maintain the desired demand. The shed lists are specified by the user and shall be selectable to be shed in either a fixed or rotating order to control which equipment is shed the most often. Upon suitable reductions in demand, the demand-limiting object shall restore the equipment that was shed in the reverse order in which it was shed. Each sheddable object shall have a minimum and maximum shed time property to effect both equipment protection and occupant comfort.

F. The library shall include control objects for the following functions. All control objects shall conform to the objects as specified in the specification.

1. Analog Object – Minimum requirement is to comply with the standard for data sharing. Allow high, low and failure limits to be assigned for alarming. Also, provide a time delay filter property to prevent nuisance alarms caused by temporary excursions above or below the user defined alarm limits.
2. Analog Output Object – Minimum requirement is to comply with the standard for data sharing.
3. Binary Input Object – Minimum requirement is to comply with the standard for data sharing. The user must be able to specify either input condition for alarming. This object must also include the capability to record equipment run-time by counting the amount of time the hardware input is in an "on" condition. The user must be able to specify either input condition as the "on" condition.
4. Binary Output Object – Minimum requirement is to comply with the BAC net standard for data sharing. Properties to enable minimum on and off time for equipment protection as well

as interstart delay must be provided. The Command Prioritization priority scheme shall be incorporated to allow multiple control applications to execute commands on this object with the highest priority command being invoked. Provide sixteen levels of priority as a minimum. Systems not employing the method of contention resolution shall not be acceptable.

5. PID Control Loop Object – Minimum requirement is to comply with the standard for data sharing. Each individual property must be adjustable as well as to be disabled to allow proportional control only, or proportional with integral control, as well as proportional, integral, and derivative control.
6. Comparison Object – Allow a minimum of two analog objects to be compared to select either the highest, lowest, or equality between the two linked outputs. Also, allow limits to be applied to the output value for alarm generation.
7. Math Object – Allow a minimum of four analog objects to be tested for the minimum or maximum, or the sum, difference, or average of linked objects. Also, allow limits to be applied to the output value for alarm generation.
8. Custom Programming Objects – Provide a blank object template for the creation of new custom objects to meet specific user application requirements. This object must provide a simple BASIC-like programming language that is used to define object behavior. Provide a library of functions including math and logic functions, string manipulation, and e-mail as a minimum. Also, provide a comprehensive on-line debug tool to allow complete testing of the new object. Allow new objects to be stored in the library for re-use.
9. Interlock Object – Provide an interlock object that provides a means of coordination of objects within a piece of equipment such as an Air Handler or other similar types of equipment. An example is to link the return fan to the supply fan such that when the supply fan is started, the return fan object is also started automatically without the user having to issue separate commands or to link each object to a schedule object. In addition, the control loops, damper objects, and alarm monitoring (such as return air, supply air, and mixed air temperature objects) will be inhibited from alarming during a user-defined period after start-up to allow for stabilization. When the air handler is stopped, the interlocked return fan is also stopped, the outside air damper is closed, and other related objects within the air handler unit are inhibited from alarming thereby eliminating nuisance alarms during the off period.
10. Temperature Override Object – Provide an object whose purpose is to provide the capability of overriding a binary output to an “On” state in the event a user specified high or low limit value is exceeded. This object is to be linked to the desired binary output object as well as to an analog object for temperature monitoring, to cause the override to be enabled. This object will execute a Start command at the temperature override level of start/stop command priority unless changed by the user.
11. Composite Object – Provide a container object that allows a collection of objects representing an application to be encapsulated to protect the application from tampering, or to more easily represent large applications. This object must have the ability to allow the user to select the appropriate parameters of the “contained” application that are represented on the graphical shell of this container.

G. The object library shall include objects to support the integration of devices connected to the Network Area Controller (NAC). At a minimum, provide the following as part of the standard library included with the programming software:

1. LonMark/LonWorks devices. These devices shall include, but not be limited to, devices for control of HVAC, lighting, access, and metering. Provide Lon Mark manufacturer-specific objects to facilitate simple integration of these devices. All network variables defined in the LonMark profile shall be supported. Information (type and function) regarding network variables not defined in the LonMark profile shall be provided by the device manufacturer.

2. For devices not confirming to the LonMark standard, provide a dynamic object that can be assigned to the device based on network variable information provided by the device manufacturer. Device manufacturer shall provide an XIF file, resource file and documentation for the device to facilitate device integration.
3. For devices, provide the following objects at a minimum:
   a. Analog In
   b. Analog Out
   c. Analog Value
   d. Binary
   e. Binary In
   f. Binary Out
   g. Binary Value
   h. Multi9-State In
   i. Multi-State Out
   j. Multi-State Value
   k. Schedule Export
   l. Calendar Export
   m. Trend Export
   n. Device
4. For each object, provide the ability to assign the object a device and object instance number.
5. For devices, provide the following support at a minimum.
   a. Segmentation
   b. Segmented Request
   c. Segmented Response
   d. Application Services
   e. Read Property
   f. Read Property Multiple
   g. Write Property
   h. Who-has
   i. I-have
   j. Who-is
   k. I-am
   l. Media Types
   m. Ethernet
   n. IP Annex J
   o. MSTP
   p. Broadcast Management Device (BBMD) function
   q. Routing

   Note: Depending on the project configuration and requirements, it may be desired to integrate data from devices that are not LonMark or. These could include industrial or plant floor devices such as PLC's. Because of the many drivers available, a common method of providing this integration is: Dynamic Data Exchange (DDE), MODBUS (DDEE), and Ole for Process Control (OPC).

2.11 NETWORK AREA CONTROLLER (NAC)/SYSTEM NETWORK CONTROLLER (SNC)

A. These controllers are designed to manage communications between the programmable equipment controllers (PEC), application specific controllers (ASC), and advanced unitary controllers (AUC) which are connected to its communications trunks, manage communications between itself and other system network controllers (SNC) and with any operator workstations (OWS) that are part of

the BAS, and perform control and operating strategies for the system based on information from any controller connected to the BAS.

B. The controllers must be fully programmable to meet the unique requirements of the facility it must control.

C. The controllers must be capable of peer-to-peer communications with other SNC's and with any OWS connected to the BAS, whether the OWS is directly connected, connected via modem or connected via the Internet.

D. The communication protocols utilized for peer-to-peer communications between SNC's will be Niagara 4, TCP/IP and SNMP. Use of proprietary communication protocol for peer-to-peer communications between SNC's is not allowed.

E. The SNC shall be capable of executing application control programs to provide:
   1. Calendar functions
   2. Scheduling
   3. Trending
   4. Alarm monitoring and routing
   5. Time synchronization.
   6. Integration of LonWorks and ModBus controller data.
   7. Network management functions for all SNC, PEC and ASC based devices.

F. The SNC must provide the following hardware features as a minimum:
   1. One Ethernet Port-10/100 Mdps
   2. One RS-232/485 port
   3. One LonWorks Interface Port – 78KB FTT-10A
   4. Battery Backup
   5. Flash memory for long term data backup (if battery backup or flash memory is not supplied, the controller must contain a hard disk with at least 1 gigabyte storage capacity)

G. The SNC shall support standard Web browser access via the Intranet/Internet. It shall support a minimum of 16 simultaneous users.

H. The SNC shall provide alarm recognition, storage, routing, management, and analysis to supplement distributed capabilities of equipment or application specific controllers.

I. The SNC shall be able to route any alarm condition to any defined user location whether connected to a local network or remote via dial-up, telephone connection, or wide-area network.
   1. Alarm generation shall be selectable for annunciation type and acknowledgement requirements including but not limited to:
      a. Alarm
      b. Return to normal
      c. To default
   2. Alarms shall be annunciated in any of the following manners as defined by the user:
      a. Screen message text
      b. Email of complete alarm message to multiple recipients.
      c. Pagers via paging services that initiate a page on receipt of email message.
      d. Graphics with flashing alarm object(s).
   3. The following shall be recorded by the SNC for each alarm (at a minimum):
      a. Time and date.
      b. Equipment (air handler #, accessway, etc.)
      c. Acknowledge time, date, and user who issued acknowledgement.

J. Programming software and all controller "Setup Wizards" shall be embedded into the SNC.

K. Operator Touch Screen Interface
   Provide a color graphic display touch screen operator interface mounted on panel face as indicated on drawings. The Operator Touch Screen Interface shall serve as the user interface to the entire

TCS and shall allow the monitoring and the control of all systems points without the use of a mouse or keyboard.
Access to the system shall be permission-based, configurable permission access levels based on operator's role.
Information on the color graphic display shall be dynamic and automatically updated.

2.12 PROGRAMMABLE EQUIPMENT CONTROLLER (PEC)

A. HVAC control shall be accomplished using LonMark™ based devices where the application has a LonMark™ profile defined. Where LonMark™ devices are not available for a particular application; devices based on LonMark™ shall be acceptable. For each LonWorks™ device that does not have LonMark™ certification, the device supplier must provide an XIF file for the device. The controller platform shall provide options and advanced system functions, programmable and configurable using Niagara 4 Framework™, that allow standard and customizable control solutions required in executing the "Sequence of Operation."
B. All PECs shall be application programmable and shall at all times maintain their LonMark™ certification. All control sequences within or programmed into the ILC shall be stored in non-volatile memory, which is not dependent upon the presence of a battery to be retained.
C. The PECs shall communicate with the SNC at a baud rate of not less than 78.8K baud. The PEC shall provide LED indication of communication and controller performance to the technician, without cover removal.
D. The following integral and remote Inputs/Outputs shall be supported per each PEC:
    1. Four integral dry contact digital inputs.
    2. Six integral analog inputs (configurable as 0-10V, 0-10,000 ohm or, 20K NTC).
    3. Three integral 4-20 ma analog outputs.
    4. Eight integral 24 Vac Triac digital outputs, configurable maintained or floating motor control outputs.
    5. One integral 20 Vdc, 65-mA power supply for auxiliary devices.
E. Each PEC shall have expansion ability to support additional I/O requirements through the use of remote Input/Output modules.

2.13 APPLICATION SPECIFIC CONTROLLERS (ASC'S)

A. Application Specific Controllers (ASC's) shall be standalone EEPROM based configured to perform the sequences specified, and with I/O selected for the application. All unitary DDC controllers shall support the LonMark™ Functional Profile for the given application. ASCs shall be tested and listed under UL916 for computing devices. ASC enclosures shall be flame retardant compact plastic conforming to UL94-V5 for plenum mounting or plated steel. Each ASC shall be provided with face mounted LED type annunciation to continually display its operational mode: power, normal, or in an alarm state. As an alternative to the face mounted integral LED, the control contractor shall provide relay driven pilot lights mounted at the AC location, which shall provide the specified annunciation. ASCs shall be configured for DIN rail mounting using industry standard clip on adapters or direct panel mounted. The controller shall be programmable and configurable using Niagara 4 Framework™ and provide control solutions as required to executing the "Sequence of Operation."
    Input/Output Module
        a. Provide a remote Input/Output module that connects sensors and actuators onto the field bus network for use by the NAC, ILC and ASC DDC Controllers. I/O Device shall support LonMark standard network communication technology for controller-to-controller communications. I/O Device shall have extended operating temperature rating from -40F to +150F so Device can be mounted directly in wiring cabinet of

monitored appliances.

2.14 ADVANCED UNITARY CONTROLLER

A. The advanced unitary controller (AUC) platform shall be designed specifically to control HVAC – ventilation, filtration, heating, cooling, humidification, and distribution. Equipment includes: water service heat pumps, air handlers, heat pumps, natural convection units. The controller platform shall provide options and advanced system functions, programmable and configurable using Niagara 4 Framework™, that allows standard and customizable control solutions required in executing the "Sequence of Operation."

B. Minimum Requirements:

1. The Controller shall be fully programmable with full functionality on any Niagara 4 brand platform.
   a. Support downloads to the controller from any brand of Niagara 4 platform.
   b. Support uploads from the controller to any brand of Niagara 4 platform.
   c. Support simulation/debug mode of the controller.
   d. Maintain native GUI.
   e. Native function-block programming within the Niagara 4 environment.
2. The controller shall be capable of either integrating with other devices or standalone operation.
3. The controller shall have two microprocessors. The Host processor contains on-chip FLASH program memory, FLASH information memory, and RAM to run the main HVAC application. The second processor for network communications. Controller memory minimum requirements include:
   a. FLASH Memory Capacity: 60 Kilobytes with 8 Kilobytes for application program.
   b. FLASH Memory settings retained for ten years.
   c. RAM: 2 Kilobytes.
4. The controller shall have an FTT transformer-coupled communications port interface for common mode-noise rejection and DC isolation.
5. The controller shall have an internal time with the ability to automatically revert from a master time clock on failure.
   a. Operating Range: 24 hours, 365 days, multi-year-calendar including day of week and configuration for automatic day-light savings time adjustment to occur on configured start and stop dates.
   b. Accuracy: +/- minute per month at 77° F (25° C).
   c. Power Failure Backup: 24 hours at 32° to 122° F (0° to 50° C).
6. The controller shall have Significant Event Notification, Periodic Update capability, and Failure Detect when network inputs fail to be detected within their configurable time frame.
7. The controller shall have an internal DC power supply to power external sensors.
   a. Power Output: 20 VDC +/- 10% at 75 Ma
8. The controller shall have visual indication (LED) of the status of the devise:
   a. Controller operating normally.
   b. Controller in process of download.
   c. Controller in manual mode under control of software tool.
   d. Controller lost it configuration.
   e. Now power to controller, low voltage, or controller damage.
   f. Processor and/or controller are not operating.
9. The minimum controller Environmental ratings:
   a. Operating Temperature Ambient Rating: -40° to 150° F (-40 to 65.5° C).
   b. Storage Temperature Ambient Rating: -40° to 150° F (-40 to 65.5° C).

c. Relative Humidity: 5% to 95% non-condensing.

10. The controller shall have the additional approval requirements, listings, and approvals:
    a. UL/cUL (E87741) listed under UL916 (Standard for Open Energy Management Equipment) with plenum rating.
    b. CSA (LR95329-3) Listed.
    c. Meets FCC Part 15, Subpart B, Class B (radiated emissions) requirements.
    d. Meets Canadian standard C108.8 (radiated emissions).
    e. Conforms requirements European Consortium standard EN 61000-6-1; 2001 (EU Immunity)
    f. Conforms requirements European Consortium standard EN 61000-6-3; 2001 (EU Emission)
11. The controller housing shall be UL plenum rated mounting to either a panel or DIN rail (standard EN50022; 7.5mm x 35 mm).
12. The controller housing shall have a mix of digital inputs (DI), digital Triac Outputs (DO), analog outputs and universal inputs (UI).
    a. Analog outputs (AO) shall be capable of being configured as digital outputs (DO).
    b. Input and Output wiring terminals shall be removable from the controller without disconnecting the wiring.
    c. Input and Output wiring terminals shall be designated with color coded labels.
    d. Universal inputs shall be capable of being configured as binary inputs, resistive inputs, voltage inputs (o-10 VDC), or current inputs (4-20mA).
13. The controller shall provide for “user defined’ Network Variables (NV) for customized configurations and naming using Niagara 4 Framework™.
14. The controller shall provide “continuous” automated loop tuning with Adaptive Integral Algorithm Control Loop.
15. The controller platform shall have standard HVAC application programs that are modifiable to support both the traditional and specialized “sequence of operations” as outline in Section four.
    a. Discharge air control and low limit.
    b. Pressure-dependent dual duct without flow mixing.
    c. Variable air volume with return flow tracking.
    d. Economizer with differential enthalpy.
    e. Minimum airflow coordinated with CO2.
    f. Unit ventilator cycle (1, 2, 3) 2-pipe.
    g. Unit ventilator cycle (1, 2, 3) 2-pipe with face/bypass
    h. Unit ventilator cycle (1, 2, 3) 4-pipe.
    i. Unit ventilator cycle (1, 2, 3) 4-pipe with EOC valve.

2.15 OTHER CONTROL SYSTEM HARDWARE

A. Motorized control dampers that are not be integral to the equipment shall be furnished and installed by the Mechanical Contractor/ATC Contractor. Control damper frames shall be constructed of galvanized, steel, formed into changes and welded or riveted. Dampers shall be galvanized, with nylon bearings. Blade edge seals shall be vinyl. Blade edge and tip seals shall be included for all dampers. Blades shall be 16-guage minimum and 6 inches wide maximum and frame shall be of welded channel iron. Bearings shall be composed of a Celcon inner bearing with aluminum hexagon blade pivot pin, rotating within a poly carbonate outer bearing inserted in the frame. The dampers shall be equal to Tamco series 9000 ECT for parallel blade dampers and for opposed blade dampers. Dampers shall have a closed leakage rate of not more than 1.4 CFM per sq. ft. for 3'x3'

damper at 1" S.P leakage class 1A.

B. Control damper actuators shall be furnished by the ACT Contractor. Two-position or proportional electric actuators shall be direct-mount type sized to provide a minimum of 5 in-lb torque per square foot of damper area. Damper actuators shall be spring return type. Operators shall be heavy-duty electronic type for positioning automatic dampers in response to control signal. Motor shall be of sufficient size to operate damper positively and smoothly to obtain correct sequence as indicated. All applications requiring proportional operation shall utilize truly proportional electric actuators. All damper actuators (motors) installed in conjunction with an Air Handler/HVAC unit must be of the spring return, 2 position, occupied/unoccupied type, or modulating where an economizer cycle is required. Combustion air damper actuators shall be of the 2 position, spring return type.

C. Wall Mount Room Temperature sensors: Each room temperature sensor shall provide temperature indication to the digital controller, provide the capability for a software-limited occupant set point adjustment (warmer-cooler slider bar or switch) and limited operation override capability. Room temperature Sensors shall be 20,000-ohm thermistor type with a temperature range of -40 to 140 degrees F. The sensor shall be complete with a decorative cover and suitable for mounting over a standard electrical utility box. These devices shall have an accuracy of 0.5 degrees, F., over the entire range.

D. Duct-mounted and Outside Air Temperature Sensors: 20,000-ohm thermistor temperature sensors with an accuracy of ±0.2°C. Outside air sensors shall include an integral sun shield. Duct-mounted sensors shall have an insertion measuring probe of a length appropriate for the duct size, with a temperature range of -40 to 160 degrees F. The sensor shall include a utility box and a gasket to prevent air leakage and vibration noise. For all mixed air and preheat air applications, install bendable averaging duct sensors with a minimum 8 – foot long sensor element. These devices shall have accuracy of 0.5 degrees F, over the entire range.

E. Humidity sensors shall be thin-film capacitive type sensor with on-board nonvolatile memory, accuracy to plus or minus two percent (2%) at 0 to 90% RH, 12 – 30 VDC input voltage, analog output (0-10 VDC or – 20 mA output). Operating range shall be 0 to 100% RH and 32 59 140-degree F. Sensors shall be selected for wall, duct, or outdoor type installation as appropriate.

F. Carbon Dioxide Sensors (CO2): Sensors shall utilize Non-dispersive infrared technology (N.D.I.R.), repeatable to plus or minus five percent (5%) or 75 PPM, whichever is greater. Response shall be less than one minute. Input voltage shall be 20 to 30 VAC or DC. Output shall be 0 – 10 VDC. Sensor shall be wall or duct mounted type, as appropriate for the application, housed in a high impact plastic enclosure.

G. Current Sensitive Switches: Solid state, split core current switch that operates when the current level (sensed by the internal current transformer) exceeds the adjustable trip point. Current switch to include an integral LED for indication of trip condition and a current level below trip set point.

H. Differential Analog (duct) Static Pressure Transmitters provide a pressure transmitter with integral capacitance type sensing and solid-state circuitry. Accuracy shall be plus or minus 1% of full range; range shall be selected for the specific application. Provide zero and span adjustment capability. Device shall have integral static pickup tube.

I. Differential Air Pressure Switches: Provide SPDT type, UL-approved, and selected for the appropriate operating range where applied. Switches shall have adjustable set points and barbed pressure tips. +/- 5% accuracy, -1” to + 1” P.G.

J. Water Flow Switches: Provide a SPST type contact switch with bronze paddle blade, size for the actual pipe size at the location. If installed outdoors, provide a NEMA-4 enclosure. Flow switch shall be UL listed.

K. Temperature Control Panels: Furnish temperature control panels of code gauge steel with locking doors for mounting all devices as shown. All electrical devices within a control panel shall be factory wired. Control panel shall be assembled by the BAS in a UL-Certified 508A panel shop. A complete set of ‘as-built’ control drawings (relating to the controls within the panel) shall be furnished within

each control panel.

L. Pipe and Duct Temperature sensing elements: 20,000-ohm thermistor temperature sensors with and accuracy of ±1% accuracy. Their range shall be -5 to 250°F. Limited range sensors shall be acceptable provided they are capable of sensing the range expected for the point at the specified accuracy. Thermal wells with heat conductive gel shall be included.

M. Low Air Temperature Sensors: Provide SPST type switch, with 15 to 55 degrees F., range, and vapor-charged temperature sensor. Honeywell model L482A, or approved equivalent.

N. Relays: Start/stop relay model shall provide either momentary or maintained switching action as appropriate for the motor being started. All relays shall be plugged in, interchangeable, mounted on a subbase and wired to numbered terminals strips. Relays installed in panels shall all be DPDT with indicating lamp. Relays installed outside of controlled devices shall be enclosed in a NEMA enclosure suitable for the location. Relays shall be labeled with UR symbol. RIB-style relays are acceptable for remote enable/disable.

O. Emergency Stop Switches: Provide toggle-type switch with normally-closed contact. Switch shall be labeled “AIR HANDLER EMERGENCY SHUTOFF, NORMAL – OFF.”

P. Transducers: Differential pressure transducers shall be electronic with a 4-20 mA output signal compatible to the Direct Digital Controller. Wetted parts shall be stainless steel. Unit shall be designed to operate in the pressure ranges involved.

Q. Control Power Transformers: Provide step-down transformers for all DDC controllers and devices as required. Transformers shall be sized for the load, but shall be sized for 50 watts, minimum. Transformers shall be UL Listed Class 2 type, for 120VAC/24VAC operation.

R. Line voltage protection: All DDC system control panels that are powered by 120 VAC circuits shall be provided with surge protection. This protection is in addition to any internal protection provided by the manufacturer. The protection shall meet UL, ULC 149, IEEE C62.41B A grounding conductor, (minimum 12 AWG), shall be brought to each control panel.

2.16 ECONOMIZER

A. HVAC units shall be provided with economizer controls where indicated on the drawings or elsewhere in these specifications or on any system 4 tons or over. Enthalpy selection system shall consist of one enthalpy transmitter in the outside air, one enthalpy transmitter in the return air, and a relay to select the lower of the two enthalpies. In operation, the signal from the two enthalpy transmitters shall be compared by the differential switching relay so that when the outside air enthalpy is lower than the return air enthalpy, the temperature control system shall modulate the outside, return, and relief dampers to supply up to 100% outside air for "free cooling". When the outside air enthalpy is higher than the return air, the system shall position to minimum outside air. The use of separate temperature and humidity transmitters to arrive at enthalpy is not acceptable. Outside air transmitter shall not be damaged by operation during fog conditions.

B. The economizer module shall be ASHRAE 90.1 compliant (latest version).

C. The module shall have a local display screen for diagnostics at the unit.

D. On projects with building automation systems the economizer shall have a BACNET output and shall be interconnected to the building automation system.

E. The module shall have fault detection diagnostics.

F. Manufacturer: Belimo Zip Economizer series. Equal by Honeywell.

2.17 CONTROL DEVICES

A. All electrical wiring for the control system shall be as specified in this section and the Electrical Section of the Specifications and as required by local codes. The wiring shall be by this contractor.

B. Electric thermostats shall be low-voltage, modulating type to control modulating devices, or low- or

line-voltage type with heat anticipator for two-position controls. Provide locking covers (clear plastic, hinged type).

C. All thermostats to be 24hr./7 day programmable type, auto changeover type, +/-3 degree adjustment capability (when integrated with building automation system), WIFI capability. Manufacturer: Honeywell. Provide locking cover (clear plastic, hinged type).

2.18 DUCT SMOKE DETECTORS

A. Duct smoke detectors shall be of the photo-electronic type with sampling tube of ample length to traverse the entire width of the duct. Duct smoke detectors shall be manufactured by the control companies, the fire alarm companies, B.R.K. Electronics or approved equal. All HVAC units of 2000 CFM or more shall have duct smoke detectors in both the supply and return air streams. A single duct smoke detection in the return air stream shall be provided only when acceptable to the local authority having jurisdiction.
B. Duct smoke detectors shall be analog-addressable type, individually monitored at the FACP for calibration, sensitivity, and alarm condition, and individually adjustable for sensitivity from the FACP.
C. Units of 15,000 CFM or more shall have two detectors. (supply and return air)
D. Furnish and install where indicated on the drawings or required elsewhere in the specifications air duct smoke detectors. They shall integrate photoelectric, ionization and heat sensing technologies for optimum detection accuracy and to prevent unwanted alarms. Auxiliary contacts shall be provided to shut down the air handling unit fan. The detector shall output to a remote alarm indicator.
E. Duct smoke detectors to be furnished by the (mechanical contractor/electrical contractor).
F. Duct smoke detectors shall be installed by the mechanical contractor.
G. Interconnection between the duct smoke detectors and fire alarm system shall be performed by the electrical contractor/fire alarm contractor.
H. Control’s integration to shut down the HVAC equipment in alarm shall be performed by the mechanical contractor/ATC contractor.

2.19 FREEZESTATS

A. The freezestat shall be of the vapor pressure type with a 20 foot minimum element. Element shall respond to the lowest temperature sensed by any one foot section.
B. The freezestat shall be manual reset. Provide reset button and red indicator light. Location to be coordinated with architect.
C. All coils (heating hot water, chilled water, condenser water/water source) with outside air and hot water in ducts or units shall have freezestats.

PART 3 - EXECUTION

3.01 SUBMITTALS

A. The materials, equipment and software design shall be submitted as follows:
   1. Control Contractor shall submit qualifications as outlined in Part 1, 1.1.A.2.b Control contractor requirement including:
      a. Names of Tridium/WEBS N4 certified employees in your employ today.
      b. List (5) WEBs-N4™/ WEBs-N4™ Supervisor projects of similar size.
      c. Location of principal place of business that would respond to service requests the

first year.

d. Letter from Honeywell Regional representative stating your company is in good standing with the ACI and ACS Program.

e. Requirements (a thru d above) shall be submitted to project engineer for review for approval. No work shall be allowed without written approval. All information shall be handled in confidence and not for distribution to third parties.

2. Submittals to include but not limited to:
   a. Submit shop drawings of all components.
   b. Submit manufacturers' data sheets of valve Cv performance.
   c. Submit design data and sequence of operations descriptions for all systems.
   d. Submit wiring diagrams of electrical or electronic control systems.
   e. ATC Contractor to include all input and output points for engineer review and approval.
   f. At the completion of the project, submit final “as-built” drawings/CAD disk, all associated component/equipment cut-sheets/submittals, wiring diagrams, and final/actual sequence of operations descriptions of each system. Include ATC emergency contact information.
3. 3 copies of shop drawings or the entire control system shall be submitted and shall consist of a complete list of equipment and materials, including manufacturers’ catalog data sheets and installation instructions, samples of written controller checkout sheets and performance verification procedures for applications similar in scope shall be included for approval.
4. Shop drawings shall also contain complete wiring I/O point list for each system, schematic diagrams, sequences of operations, control system bus layout and any other details required to demonstrate that the system has been coordinated and will properly function as a system. Shop drawings shall be approved before any equipment is installed. Please allow 10 days for submission, review and return by engineer.
5. All dampers and actuator valves and actuator shall be sized and submitted with shop drawing. Schedule shall include:
   a. Identification tags all dampers/valves.
   b. Location all damper/valves.
   c. Damper and/or Valve type.
   d. Actuator size and type.
   e. Damper and/or valve pressure drop.
6. Submittal shall also a “sample of prior art” for project of the graphics. This web-based interface with the network via dynamic color shall include a flowchart (site map) indicating how the graphics are to be linked to one another for system navigation.
   a. Minimum depiction for graphics for project:
   b. Building picture and site plot plan (aerial or ground view provided by owner).
   c. Building floor plan.
   d. Each mechanical system.
   e. Control devices depicted by point-and-click graphics.

Note:

Floor plan shall indicate each mechanical zone with different colors shaded as required to depict which zones are not maintaining temperature/humidity/pressure/CO_2, etc programmable levels/limits and which zones are in alarm.
Provide animated graphic for each system component including rooftop units, air handling units, UAV terminals, fan powered terminals, exhaust fans, supply fans, hot water systems – boilers, hot water pumps; chilled water systems – chillers, cold water pump condenser water pumps, cooling towers, etc.

The graphics are intended to be 20% - 30% complete at this stage with changes to be based on review comments from the engineer and/or owner.

B. Upon completion of the work, provide a complete set of as-built drawings on compact disk (CD). Additionally, all control device furnished with this section shall be programmable directly from Tridium N4™ workbench.

C. Upon completion of this project, the following copies of software shall be included on CD for the owner:
   1. The ATC contractor shall use the “contract CD to owner – software package” to simulate all software application programs to ensure such programs are free from design errors and they accurately accomplish the application(s) sequence-of-operation. This simulation shall include the WEBs-N4™ embedded tool in controller allowing for the capability of other Niagara 4 factory certified contractor(s) access to the programming capability. The simulation shall be demonstrated before the owner/engineer at time and place arranged by the owner. Allow for a minimum of (8) hours for the demonstration and software changes resulting from the demonstration the owner feels should be changed/enhanced, etc. will/may result in another demonstration if so requested by owner. These changes will be made at no additional expense to owner.
   2. Four copies of the “as-built” drawings shall be provided in addition to the document on compact disk. All “as-built” drawings shall also be installed into the BAS server in a dedicated directory. For each JACE™ (WEBs-N4™) the station shall be copied to supervisor and distribution file copy back-up and written to CD to owners’ hands.
   3. Control contractor shall provide “quote” to owner to install mechanical equipment service information such as, spare parts list, mechanical service contractors, etc into FMCS server as a dedicated directory. Owner, working with engineer, shall develop specification requirements for control contractor. ATC contractor shall include (8) hours of technical support, including updating information as requested by owner, covering the time interval of the warranty period.

3.02 INSTALLATION

A. Install system and materials in accordance with manufacturer’s instructions, and as detailed on the project drawing set.

B. Line and low voltage electrical connections to control equipment show specified or show on the control diagrams shall be furnished and installed by the ATC Contractor in accordance with these specifications.

C. Equipment furnished by the Mechanical Contractor that is normally wired before installation shall be furnished completely wired. Control wiring normally performed in the field will be furnished and installed by the ATC Contractor (ATC Contractor to coordinate with the Mechanical Contractor).

D. All control devices mounted on the face of control panels shall be clearly identified as to function and system served with permanently engraved phenolic label.

E. Installation of Network
   1. Ethernet
      a. The network shall employ Ethernet LAN architecture, as defined by IEEE 802.3. The Network Interface shall be fully Internet Protocol (IP) compliant allowing connection to currently installed IEEE 802.3, Compliant Ethernet Networks.
      b. The network shall directly support connectivity to a variety of cabling types. As a minimum provide the following connectivity: 10 Base 2 (ThinNet RG-58 A/U Coaxial cabling with BNC connectors, 10 Base T (Twisted-Pair-RJ-45 terminated UTP cabling).
   2. LonWorks

a. The network shall employ LonTalk communications FTT-10.

3. MS/TP
   a. The network shall employ MS/TP EIA-485-A Standard.
   b. The MS/TP EIA-485 network shall use shielded, twisted-pair cable with a characteristic impedance between 100 and 130 ohms.
4. Third Party Interfaces: Contractor shall integrate real-time data from building systems by other trades and databases originating from other manufacturers as specified and required to make the system work as one system.

F. Installation of Digital Controllers and Programming
1. Provide a separate digital control panel for each major piece of equipment, such as air handling unit, chiller, pumping unit etc. Points used for control loop reset such as outdoor air, outdoor humidity, or space temperature could be located on any of the remote control units.
2. Provide sufficient internal memory for the specified control sequences and trend logging. There shall be a minimum of 25 percent of available memory free for future use.
3. System point names shall be modular in design, permitting easy operator interface without the use of a written point index.
4. Provide software programming for the applications intended for the systems specified and adhere to the strategy algorithms provided.
5. Provide graphics for each piece of equipment and floor plan in the building. This includes each chiller, cooking tower, air handling unit, fan, terminal unit, boiler, pumping unit etc. These graphics shall show all points dynamically as specified in the point list.

3.03 WIRING

A. All wiring to be CAT 6 plenum rated in concealed areas and in conduit where exposed or subject to damage. All exterior exposed control wiring to be in conduit and weather protected. Conduit to be galvanized. No PVC is permitted in plenum.
B. All control wiring and power wiring to the control panels, NAC, computers, and network components shall be the responsibility of the ATC contractor.
C. All wiring shall be in accordance with the National Electrical Code and any applicable local codes. All wiring shall be installed in the conduit types specified unless otherwise allowed by the National Electrical Code or applicable local codes.

3.04 START UP

A. The ATC contractor shall verify that all wiring is properly connected and free of all shorts and ground faults. Verify that all connections are tightened appropriately. Calibrate each device as required by the manufacturer's recommendations.
B. Verify that the digital output devices operate properly and that the normal positions are correct.
C. Verify that all analog output devices are functional, that start point and span are correct, and that direction and normal positions are correct including fail-safe positions. The ATC contractor shall check all control valves and automatic dampers to ensure proper action and closure. The ATC contractor shall make any necessary adjustment to valve stem and damper blade travel.
D. Complete software shall be installed and tested (dry run) prior to start-up.
E. Software technician shall observe and fine tune all control loops.
F. Alarms and interlocks:
1. Check each alarm separately by including an appropriate signal at a value that will trip the alarm.
2. Interlocks shall be tripped using field contracts to check the logic, as well as to ensure that

the fail-safe condition for all actuators is in the proper direction.

G. Interlock actions shall be tested by simulating alarm conditions to check the initiating value of the variable and interlock action.

H. Return the system to a normal operating state after each phase of start-up, commissioning, and demonstration. Any points overridden, devices place in manual position, setpoint adjusted, etc. are to be restored to normal operation condition prior to acceptance.

I. Connection to the Internet must be tested and communication confirmed.

3.05 SYSTEM VALIDATION AND DEMONSTRATION

A. As part of final system acceptance, a system demonstration is required (see below). Prior to start of this demonstration, the ATC contractor is to perform a complete validation of all aspects of the Controls and Instrumentation System.

B. Validation

1. Prepare and submit for approval a Validation Test Plan including Test Procedures for the performance verification tests. Test Plan shall address all specified functions of the Engineering Control Center and all specified sequences of operation. Explain in detail actions and expected results used to demonstrate compliance with the requirements of this specification. Explain the method for simulating the necessary conditions of operation used to demonstrate performance of the system. Test plan shall include a Test Check List to be used by the Installer's agent to check and initial that each test has been successfully completed. Deliver Test Plan documentation for the performance verification tests to the Architect or Owner's Representative, 30 calendar days prior to start of performance verification tests. Provide draft copy of operation and maintenance manual with performance verification test.
2. After approval of the Validation Test Plan, Installer shall carry out all tests and procedures therein. Installer shall completely check out, calibrate, and test all connected hardware and software to insure that system performs in accordance with approved specifications and sequences of operation submitted. Installer shall complete and submit Test Check List

C. Demonstration

1. System operation and calibration to be demonstrated by the ATC Contractor in the presence of the Engineer, Architect or Owner's representative on random samples of equipment as dictated by the Owner's representative. Should random sampling indicate improper commissioning, the owner reserves the right to subsequently witness complete calibration of the system at no additional cost to the owner.
2. Demonstrate to authorities that all required safeties and life safety functions are fully functional and complete.
3. Make accessible personnel to provide necessary adjustments and corrections to systems as directed by balancing agency.
4. Witnessed validation demonstration of Operator's Terminal functions shall consist of:
   a. Running each specified report.
   b. Display and demonstrate each data entry to show site specific customizing capability. Demonstrate parameter changes.
   c. Step through penetration tree, display all graphics, demonstrate dynamic update, and direct access to graphics.
   d. Execute digital and analog commands in graphic mode.
   e. Demonstrate DDC loop precision and stability via trend logs of inputs and outputs 6 loops minimum.
   f. Demonstrate BAS performance via trend logs and command trace.
   g. Demonstrate scan, update, and alarm responsiveness.

h. Demonstrate spreadsheet/curve plot software, and its integration with database.
i. Demonstrate on-line user guide, and help function and mail facility.
j. Demonstrate digital system configuration graphics with interactive upline and downline load, and demonstrate specified diagnostics.
k. Demonstrate multitasking by showing dynamic curve plot, and graphic construction operating simultaneously via split screen.
l. Demonstrate class programming with point options of beep duration, beep rate, alarm archiving, and color banding.

3.06 PROJECT CLOSEOUT - ACCEPTANCE TESTING

A. Upon completion of the installation, the BAS Contractor shall load all system software and start-up system. The ATC Contractor shall perform all necessary calibration, testing and de-bugging and perform all required operational checks to insure that the system is functioning in full accordance with these specifications.
B. System Acceptance: Satisfactory completion is when the ATC Contractor has performed successfully all the required testing to show performance compliance with the requirements of the Contract Documents to the satisfaction of the Owner's Representative. System acceptance shall be contingent upon completion and review of all corrected deficiencies.

3.07 OPERATOR TRAINING

A. During system commissioning and at such time acceptable performance of the Control System hardware and software has been established, the ATC Contractor shall provide on-site operator instruction to the owner's operating personnel. Operator instruction shall be done during normal working hours and shall be done during normal working hours and shall be performed by a competent representative familiar with the system hardware, software, and accessories.
B. The ATC Contractor shall provide two (4 hour) training sessions for systems orientation, product maintenance, trouble shooting, and emergency contacts. ATC Contractor to coordinate with owner/architect/engineer to determine representatives/designated staff to be present for the training. Train the designated staff or representative to enable them to do the following:
1. Day-to-Day Operations:
a. Proficiently operate the system.
b. Understand control system architecture and configuration.
c. Understand BAS system components.
d. Understand system operation, including BAS system control and optimizing routines (algorithms).
e. Operate the workstation and peripherals.
f. Log on and off the system.
g. Access graphics, point reports, and logs.
h. Adjust and change system set points, time schedule, and holiday schedules.
i. Recognize malfunctions of the system by observation of the printed copy and graphical visual signals.
j. Understand system drawings and Operation and Maintenance Manuals.
k. Understand job layout and location of control components.
l. Access data from BAS controllers and application specific controllers.
m. Operate portable operator terminals.
2. Advanced Operators:
a. Make and change graphics on the workstation.
b. Create, delete, and modify alarms, including annunciation and routing of these.

c. Create, delete, and modify point trend logs and graphic or print these both on an ad-hoc basis and at user-definable intervals.
d. Create, delete, and modify reports.
e. Perform BAS system field checkout procedures.
f. Perform BAS controller unit operation and maintenance procedures.
g. Perform workstation and peripheral operation and maintenance procedures.
h. Perform BAS diagnostic procedures.
i. Configure hardware including PC boards, switches, communication, and I/O points.
j. Adjust, calibrate, and replace system components.

3. System Managers/Administrators
   a. Interface with job-specific, third party operator software.
   b. Add new users and understand password procedures.

3.08 WARRANTY PERIOD SERVICES

A. Equipment, materials, and workmanship incorporated into the work shall be warranted for a period of one year from the time of system acceptance by owner.

B. Within this period, upon notice by the Owner, any defects in the BAS due to faulty materials, methods of installation or workmanship shall be promptly repaired or replaced by the ATC Contractor at no expense to the Owner.

C. Maintenance of Computer Software Programs: The ATC Contractor shall maintain all software during the warranty period. In addition, all factory or sub-vendor upgrades to software shall be added to the systems, when they become available, at no additional cost. New products are not considered upgrades in this context.

D. Maintenance of Control Hardware: The ATC Contractor shall inspect, repair, replace, adjust, and calibrate, as required, the controllers, control devices and associated peripheral units during the warranty period. The ATC Contractor shall then furnish a report describing the status of the equipment, problem areas (if any) noticed during service work and description of the corrective actions taken. The report shall clearly certify that all software and equipment/systems are functioning correctly.

E. Service Period: Calls for service by the Owner shall be honored within 24 hours and are not to be considered as part of routine maintenance.

F. Service Documentation: A copy of the service report associated with each owner-initiated service call shall be provided to the owner.

3.09 WARRANTY ACCESS: Verify with owner(s) and/or IT representative on the model of service access into your BAS system for the warranty period. This access shall cover diagnostics and troubleshooting.

A. The Owner shall grant to the ATC Contractor reasonable access to the BAS during the warranty period. Remote access to the BAS (for the purpose of diagnostics and troubleshooting, via the Internet, during the warranty period) will be allowed.

3.10 OPERATION & MAINTENANCE MANUALS

A. See Part 1 and Part 3 for requirements. O&M manuals shall include the following elements, as a minimum.
   1. As-built control drawings for all equipment.
   2. As-built Network Communication Diagram.
   3. General description and specifications for all components.

4. Completed Performance Verification Sheets.
5. Completed Controller Checkout/Calibration sheets.
6. (1) Copy of “Owner’s CD” as specified in Section 23 00 00.
7. All equipment manufacturers/suppliers shall provide in writing (and documented if requested by the Owner) a NICS statement indication the interface with their equipment has no connectivity restrictions.
8. Niagara 4 JACE start up form must be submitted for each JACE provided. This is to include:
   a. TCP/IP Settings
   b. Platform Credentials
   c. Administration level station access credentials
   d. Installed version number.
   e. Licensed version number.
   f. Model, serial, and Host ID.

   The station and tool “NICS” would be as follows:

Property	Value
Station Compatibility In	All
Station Compatibility Out	All
Total Compatibility In	All
Total Compatibility Out	All

PART 4 - SEQUENCE OF OPERATIONS

END OF SECTION

SECTION 23 23 00 - REFRIGERANT PIPING

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:
   1. Refrigerant pipes and fittings.
   2. Refrigerant piping valves and specialties.
   3. Refrigerants.

1.02 ACTION SUBMITTALS

A. Product Data: For each type of valve, refrigerant piping, and refrigerant piping specialty.
B. Sustainable Design Submittals:
   1. Product Data for EA Prerequisite 3, "Fundamental Refrigerant Management": For refrigerants, indicating compliance with refrigerant management practices.
C. Shop Drawings:
   1. Show piping size and piping layout, including oil traps, double risers, specialties, and pipe and tube sizes to accommodate, as a minimum, equipment provided, elevation difference between compressor and evaporator, and length of piping to ensure proper operation and compliance with warranties of connected equipment.
   2. Show interface and spatial relationships between piping and equipment.
   3. Shop Drawing Scale: 1/4 inch equals 1 foot.

1.03 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

1.04 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For refrigerant valves and piping specialties to include in maintenance manuals.

1.05 QUALITY ASSURANCE

A. Comply with ASHRAE 15, "Safety Code for Refrigeration Systems."
B. Comply with ASME B31.5, "Refrigeration Piping and Heat Transfer Components."

PART 2 - PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

A. Line Test Pressure for Refrigerant R-410A:

1. Suction Lines for Air-Conditioning Applications: 300 psig.
2. Suction Lines for Heat-Pump Applications: 535 psig.
3. Hot-Gas and Liquid Lines: 535 psig.

2.02 COPPER TUBE AND FITTINGS

A. Copper Tube: [ASTM B 88, Type K or L (ASTM B 88M, Type A or B)] [ASTM B 280, Type ACR].
B. Wrought-Copper Fittings: ASME B16.22.
C. Wrought-Copper Unions: ASME B16.22.
D. Solder Filler Metals: ASTM B 32. Use 95-5 tin antimony or alloy HB solder to join copper socket fittings on copper pipe.
E. Brazing Filler Metals: AWS A5.8/A5.8M.
F. Flexible Connectors:
   1. Body: Tin-bronze bellows with woven, flexible, tinned-bronze-wire-reinforced protective jacket.
   2. End Connections: Socket ends.
   3. Offset Performance: Capable of minimum 3/4-inch misalignment in minimum 7-inch-long assembly.
   4. Working Pressure Rating: Factory test at minimum 500 psig.
   5. Maximum Operating Temperature: 250 deg. F.

2.03 VALVES AND SPECIALTIES

A. Diaphragm Packless Valves:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Danfoss Inc.
      b. Heldon Products; Henry Technologies.
      c. Parker - Sporlan Hannifin Corp.
      d. Paul Mueller Company.
   2. Body and Bonnet: Forged brass or cast bronze; globe design with straight-through or angle pattern.
   3. Diaphragm: Phosphor bronze and stainless steel with stainless-steel spring.
   4. Operator: Rising stem and hand wheel.
   5. Seat: Nylon.
   6. End Connections: Socket, union, or flanged.
   7. Working Pressure Rating: 500 psig.
   8. Maximum Operating Temperature: 275 deg. F.
B. Packed-Angle Valves:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Danfoss Inc.
      b. Heldon Products; Henry Technologies.
      c. Parker - Sporlan Hannifin Corp.
      d. Paul Mueller Company.
   2. Body and Bonnet: Forged brass or cast bronze.
   3. Packing: Molded stem, back seating, and replaceable under pressure.
   4. Operator: Rising stem.
   5. Seat: Nonrotating, self-aligning polytetrafluoroethylene.
   6. Seal Cap: Forged-brass or valox hex cap.

7. End Connections: Socket, union, threaded, or flanged.
8. Working Pressure Rating: 500 psig.
9. Maximum Operating Temperature: 275 deg. F.

C. Check Valves:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Danfoss Inc.
   b. Emerson Climate Technologies.
   c. Heldon Products; Henry Technologies.
   d. Parker Hannifin Corp.
   e. Paul Mueller Company.
2. Body: Ductile iron, forged brass, or cast bronze; globe pattern.
3. Bonnet: Bolted ductile iron, forged brass, or cast bronze; or brass hex plug.
4. Piston: Removable polytetrafluoroethylene seat.
5. Closing Spring: Stainless steel.
6. Manual Opening Stem: Seal cap, plated-steel stem, and graphite seal.
7. End Connections: Socket, union, threaded, or flanged.
8. Maximum Opening Pressure: 0.50 psig.
9. Working Pressure Rating: 500 psig.
10. Maximum Operating Temperature: 275 deg. F.

D. Service Valves:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Danfoss Inc.
   b. Emerson Climate Technologies.
   c. Heldon Products; Henry Technologies.
   d. Parker Hannifin Corp.
   e. Paul Mueller Company.
   f. Refrigeration Sales, Inc.
2. Body: Forged brass with brass cap including key end to remove core.
3. Core: Removable ball-type check valve with stainless-steel spring.
4. Seat: Polytetrafluoroethylene.
5. End Connections: Copper spring.
6. Working Pressure Rating: 500 psig.

E. Solenoid Valves: Comply with AHRI 760 and UL 429; listed and labeled by a National Recognized Testing Laboratory (NRTL).
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Danfoss Inc.
   b. Emerson Climate Technologies.
   c. Heldon Products; Henry Technologies.
   d. Parker Hannifin Corp.
   e. Paul Mueller Company.
2. Body and Bonnet: Plated steel.
3. Solenoid Tube, Plunger, Closing Spring, and Seat Orifice: Stainless steel.
4. Seat: Polytetrafluoroethylene.
5. End Connections: Threaded.
6. Electrical: Molded, watertight coil in NEMA 250 enclosure of type required by location with 1/2-inch conduit adapter, and [24] [115] [208]-V ac coil.
7. Working Pressure Rating: 400 psig.

8. Maximum Operating Temperature: 240 deg. F.

F. Safety Relief Valves: Comply with 2010 ASME Boiler and Pressure Vessel Code; listed and labeled by an NRTL.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Danfoss Inc.
      b. Heldon Products; Henry Technologies.
      c. Parker - Sporlan Hannifin Corp.
      d. Paul Mueller Company.
   2. Body and Bonnet: Ductile iron and steel, with neoprene O-ring seal.
   3. Piston, Closing Spring, and Seat Insert: Stainless steel.
   4. Seat: Polytetrafluoroethylene.
   5. End Connections: Threaded.
   6. Working Pressure Rating: 400 psig.
   7. Maximum Operating Temperature: 240 deg. F.

G. Thermostatic Expansion Valves: Comply with AHRI 750.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Danfoss Inc.
      b. Emerson Climate Technologies.
      c. Parker - Sporlan Hannifin Corp.
   2. Body, Bonnet, and Seal Cap: Forged brass or steel.
   3. Diaphragm, Piston, Closing Spring, and Seat Insert: Stainless steel.
   4. Packing and Gaskets: Non-asbestos.
   5. Capillary and Bulb: Copper tubing filled with refrigerant charge.
   6. Suction Temperature: 40 deg. F
   7. Superheat: Adjustable
   8. Reverse-flow option (for heat-pump applications).
   9. End Connections: ODF female, sweat connection, flare.
   10. Working Pressure Rating: 700 psig for 410A, 450 psig for non-410A
   11. Equalizer: External

H. Hot-Gas Bypass Valves: Comply with UL 429; listed and labeled by an NRTL.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Danfoss Inc.
      b. Heldon Products; Henry Technologies.
      c. Parker -sporlan Hannifin Corp.
   2. Body, Bonnet, and Seal Cap: Ductile iron or steel.
   3. Diaphragm, Piston, Closing Spring, and Seat Insert: Stainless steel.
   4. Packing and Gaskets: Non-asbestos.
   5. Solenoid Tube, Plunger, Closing Spring, and Seat Orifice: Stainless steel.
   6. Seat: Polytetrafluoroethylene.
   7. Equalizer: External
   8. Electrical: Molded, watertight coil in NEMA 250 enclosure of type required by location with 1/2-inch conduit adapter and 120-V ac coil.
   9. End Connections: Socket. ODF female, sweat connection, flare.
   10. Set Pressure: 150 psi for 410A
   11. Throttling Range: Maximum 5 psig.
   12. Working Pressure Rating (max): 700 psig.
   13. Maximum Operating (fluid) Temperature: 240 deg. F.

14. Max ambient Temperature: 120 deg. F

I. Straight-Type Strainers:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Danfoss Inc.
   b. Heldon Products; Henry Technologies.
   c. Parker Hannifin Corp.
2. Body: Welded steel with corrosion-resistant coating.
3. Screen: 100-mesh stainless steel.
4. End Connections: Socket or flare.
5. Working Pressure Rating: 500 psig.
6. Maximum Operating Temperature: 275 deg. F.

J. Angle-Type Strainers:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Danfoss Inc.
   b. Heldon Products; Henry Technologies.
   c. Parker Hannifin Corp.
2. Body: Forged brass or cast bronze.
3. Drain Plug: Brass hex plug.
4. Screen: 100-mesh monel.
5. End Connections: Socket or flare.
6. Working Pressure Rating: 500 psig.
7. Maximum Operating Temperature: 275 deg. F.

K. Moisture/Liquid Indicators:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Danfoss Inc.
   b. Emerson Climate Technologies.
   c. Heldon Products; Henry Technologies.
   d. Parker – Sporlan Hannifin Corp.
2. Body: Forged brass.
3. Window: Replaceable, clear, fused glass window with indicating element protected by filter screen.
4. Indicator: Color coded to show moisture content in parts per million (ppm).
5. Minimum Moisture Indicator Sensitivity: Indicate moisture above 60 ppm.
6. End Connections: Socket or flare.
7. Working Pressure Rating: 650 psig
8. Maximum Operating Temperature: 240 deg. F.

L. Replaceable-Core Filter Dryers: Comply with AHRI 730.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Danfoss Inc.
   b. Emerson Climate Technologies.
   c. Heldon Products; Henry Technologies.
   d. Parker Hannifin Corp.
2. Body and Cover: Painted-steel shell with ductile-iron cover, stainless-steel screws, and neoprene gaskets.
3. Filter Media: 10 micron, pleated with integral end rings; stainless-steel support.
4. Desiccant Media: Molecular sieve, Activated alumina.

5. End Connections: Socket.
6. Access Ports: NPS 1/4-inch connections at entering and leaving sides for pressure differential measurement.
7. Maximum Pressure Loss: 2 psig
8. Working Pressure Rating: 650psig
9. Maximum Operating Temperature: 240 deg. F.

M. Permanent Filter Dryers: Comply with AHRI 730.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Danfoss Inc.
   b. Emerson Climate Technologies.
   c. Heldon Products; Henry Technologies.
   d. Parker – Sporlan Hannifin Corp.
2. Body and Cover: Painted-steel shell.
3. Filter Media: 10 micron, pleated with integral end rings; stainless-steel support.
4. Desiccant Media: Molecular sieve, Activated alumina.
5. End Connections: Socket
6. Maximum Pressure Loss: 2 psig
7. Working Pressure Rating: 650 psig
8. Maximum Operating Temperature: 240 deg. F.

2.04 REFRIGERANTS

A. ASHRAE 34, R-410A: Pentafluoroethane/Difluoromethane.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Arkema Inc.
   b. DuPont Fluorochemicals Div.
   c. Genetron Refrigerants; Honeywell International Inc.
   d. Mexichem Fluor Inc.

PART 3 - EXECUTION

3.01 PIPING APPLICATIONS FOR REFRIGERANT R-410A

A. Suction Lines: Copper, Type ACR, annealed-temper tubing and wrought-copper fittings with brazed joints.
B. Hot-Gas and Liquid Lines, and Suction Lines for Heat-Pump Applications: Copper, Type ACR or Type L (B), annealed- or drawn-temper tubing and wrought-copper fittings with brazed joints.
C. Hot-Gas and Liquid Lines, and Suction Lines for Heat-Pump Applications: Copper, Type K (A), annealed- or drawn-temper tubing and wrought-copper fittings with brazed joints.
D. Hot-Gas and Liquid Lines, and Suction Lines for Heat-Pump Applications: Copper, Type ACR, Type K (A) or Type L (B), drawn-temper tubing and wrought-copper fittings with 95-5 tin-antimony soldered joints.
E. Hot-Gas and Liquid Lines, and Suction Lines for Heat-Pump Applications: Copper, Type ACR, Type K (A), or Type L (B), drawn-temper tubing and wrought-copper fittings with Alloy HB soldered joints.
F. Safety-Relief-Valve Discharge Piping: Copper, Type ACR or Type L (B), annealed- or drawn-temper

tubing and wrought-copper fittings with brazed joints.

G. Safety-Relief-Valve Discharge Piping: Copper, Type K (A), annealed- or drawn-temper tubing and wrought-copper fittings with brazed joints.

H. Safety-Relief-Valve Discharge Piping: Copper, Type ACR, Type K (A), Type L (B), drawn-temper tubing and wrought-copper fittings with 95-5 tin-antimony soldered joints.

I. Safety-Relief-Valve Discharge Piping: Copper, Type ACR, Type K (A) or Type L (B), drawn-temper tubing and wrought-copper fittings with Alloy HB soldered joints.

3.02 VALVE AND SPECIALTY APPLICATIONS

A. Install diaphragm packless or packed-angle valves in suction and discharge lines of compressor.

B. Install service valves for gage taps at inlet and outlet of hot-gas bypass valves and strainers if they are not an integral part of valves and strainers.

C. Install a check valve at the compressor discharge and a liquid accumulator at the compressor suction connection.

D. Except as otherwise indicated, install diaphragm packless or packed-angle valves on inlet and outlet side of filter dryers.

E. Install a full-size, three-valve bypass around filter dryers.

F. Install solenoid valves upstream from each expansion valve and hot-gas bypass valve. Install solenoid valves in horizontal lines with coil at top.

G. Install thermostatic expansion valves as close as possible to distributors on evaporators.
   1. Install valve so diaphragm case is warmer than bulb.
   2. Secure bulb to clean, straight, horizontal section of suction line using two bulb straps. Do not mount bulb in a trap or at bottom of the line.
   3. If external equalizer lines are required, make connection downstream of the bulb location where it will reflect suction-line pressure at bulb location.

H. Install safety relief valves where required by 2010 ASME Boiler and Pressure Vessel Code. Pipe safety-relief-valve discharge line to outside according to ASHRAE 15.

I. Install moisture/liquid indicators in liquid line at the inlet of the thermostatic expansion valve or at the inlet of the evaporator coil capillary tube.

J. Install strainers upstream from and adjacent to the following unless they are furnished as an integral assembly for the device being protected:
   1. Solenoid valves.
   2. Thermostatic expansion valves.
   3. Hot-gas bypass valves.
   4. Compressor.

K. Install filter dryers in liquid line between condenser and thermostatic expansion valve [, and in the suction line at the compressor].

L. Install receivers sized to accommodate pump-down charge.

M. Install flexible connectors (Vibration absorbers) at compressors.

3.03 PIPING INSTALLATION

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

B. Install refrigerant piping according to ASHRAE 15.

C. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.

D. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
E. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
F. Install piping adjacent to machines to allow service and maintenance.
G. Install piping free of sags and bends.
H. Install fittings for changes in direction and branch connections.
I. Select system components with pressure rating equal to or greater than system operating pressure.
J. Refer to Section 230923 "Direct Digital Control (DDC) System for HVAC" and Section 230993.11 "Sequence of Operations for HVAC DDC" for solenoid valve controllers, control wiring, and sequence of operation.
K. Install piping as short and direct as possible, with a minimum number of joints, elbows, and fittings.
L. 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 in Section 083113 "Access Doors and Frames" if valves or equipment requiring maintenance is concealed behind finished surfaces.
M. Install refrigerant piping in protective conduit where installed belowground.
N. Install refrigerant piping in rigid or flexible conduit in locations where exposed to mechanical injury.
O. 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.
P. When brazing or soldering, remove solenoid-valve coils and sight glasses; also remove valve stems, seats, and packing, and accessible internal parts of refrigerant specialties. Do not apply heat near expansion-valve bulb.
Q. Install piping with adequate clearance between pipe and adjacent walls and hangers or between pipes for insulation installation.
R. Identify refrigerant piping and valves according to Section 230553 "Identification for HVAC Piping and Equipment."
S. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 230517 "Sleeves and Sleeve Seals for HVAC Piping."
T. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 230517 "Sleeves and Sleeve Seals for HVAC Piping."
U. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 230518 "Escutcheons for HVAC Piping."

3.04 PIPE JOINT CONSTRUCTION

A. Ream ends of pipes and tubes and remove burrs.
B. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
C. Soldered Joints: Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook."
D. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," Chapter "Pipe and Tube."
    1. Use Type BCuP (copper-phosphorus) alloy for joining copper socket fittings with copper pipe.
    2. Use Type BAg (cadmium-free silver) alloy for joining copper with bronze or steel.

3.05 HANGERS AND SUPPORTS

A. Comply with requirements for pipe hangers and supports specified in Section 230529 "Hangers and Supports for HVAC Piping and Equipment."
B. Install the following pipe attachments:
   1. Adjustable steel clevis hangers for individual horizontal runs less than 20 feet long.
   2. Roller hangers and spring hangers for individual horizontal runs 20 feet or longer.
   3. Pipe Roller: MSS SP-58, Type 44 for multiple horizontal piping 20 feet 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.
C. Install hangers for copper tubing with the following maximum spacing and minimum rod diameters:
   1. NPS 1/2-inch: Maximum span, 60 inches; minimum rod, 1/4 inch.
   2. NPS 5/8-inch: Maximum span, 60 inches; minimum rod, 1/4 inch.
   3. NPS 1-inch: Maximum span, 72 inches; minimum rod, 1/4 inch.
   4. NPS 1 ¼ -inch: Maximum span, 96 inches; minimum rod, 3/8 inch.
   5. NPS 1 ½ -inch: Maximum span, 96 inches; minimum rod, 3/8 inch.
   6. NPS 2-inch: Maximum span, 96 inches; minimum rod, 3/8 inch.
   7. NPS 2 ½ -inch: Maximum span, 108 inches; minimum rod, 3/8 inch.
   8. NPS 3-inch: Maximum span, 10 feet; minimum rod, 3/8 inch.
   9. NPS 4-inch: Maximum span, 12 feet; minimum rod, 1/2 inch.
D. Support multifloor vertical runs at least at each floor.

3.06 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:
   1. Comply with ASME B31.5, Chapter VI.
   2. Test refrigerant piping, specialties, and receivers. Isolate compressor, condenser, evaporator, and safety devices from test pressure if they are not rated above the test pressure.
   3. Test high- and low-pressure side piping of each system separately at not less than the pressures indicated in "Performance Requirements" Article.
      a. Fill system with nitrogen to the required test pressure.
      b. System shall maintain test pressure at the manifold gage throughout duration of test.
      c. Test joints and fittings with electronic leak detector or by brushing a small amount of soap and glycerin solution over joints.
      d. Remake leaking joints using new materials, and retest until satisfactory results are achieved.
B. Prepare test and inspection reports.

3.07 SYSTEM CHARGING

A. Charge system using the following procedures:
   1. Install core in filter dryers after leak test but before evacuation.
   2. Evacuate entire refrigerant system with a vacuum pump to 500 micrometers. 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.
   4. Charge system with a new filter-dryer core in charging line.

3.08 ADJUSTING

A. Adjust thermostatic expansion valve to obtain proper evaporator superheat.
B. Adjust high- and low-pressure switch settings to avoid short cycling in response to fluctuating suction pressure.
C. Adjust set-point temperature of air-conditioning or chilled-water controllers to the system design temperature.
D. Perform the following adjustments before operating the refrigeration system, according to manufacturer's written instructions:
    1. Open shutoff valves in condenser water circuit.
    2. Verify that compressor oil level is correct.
    3. Open compressor suction and discharge valves.
    4. Open refrigerant valves except bypass valves that are used for other purposes.
    5. Check open compressor-motor alignment and verify lubrication for motors and bearings.
E. Replace core of replaceable filter dryer after system has been adjusted and after design flow rates and pressures are established.

END OF SECTION

SECTION 23 31 13 - METAL DUCTS

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:
   1. Rectangular ducts and fittings.
   2. Round ducts and fittings.
   3. Sheet metal materials.
   4. Sound attenuating duct lining.
   5. Sealants and gaskets.
   6. Hangers and supports.

B. Related Sections:
   1. Section 230593 "Testing, Adjusting, and Balancing for HVAC" for testing, adjusting, and balancing requirements for metal ducts.
   2. Section 233116 "Nonmetal Ducts" for fibrous-glass ducts, thermoset fiber-reinforced plastic ducts, thermoplastic ducts, PVC ducts, and concrete ducts.
   3. Section 233119 "HVAC Casings" for factory and field fabricated casings for mechanical equipment.
   4. Section 233300 "Air Duct Accessories" for dampers, sound-control devices, duct-mounting access doors and panels, turning vanes, and flexible ducts.

1.02 PERFORMANCE REQUIREMENTS

A. Delegated Duct Design: Duct construction, including sheet metal thicknesses, seam and joint construction, reinforcements, and hangers and supports, shall comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" and performance requirements and design criteria indicated in "Duct Schedule” Article.

B. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ANSI/ASHRAE 62.1.

1.03 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

B. Design Submittals:
   1. Product Data: For ventilation equipment, indicating compliance with ASHRAE 62.1, Section 5 - "Systems and Equipment."
   2. Product Data: For adhesives, indicating VOC content.
   3. Laboratory Test Reports: For adhesives, indicating compliance with requirements for low-emitting materials.
   4. Product Data: For sealants, indicating VOC content.
   5. Laboratory Test Reports: For sealants, indicating compliance with requirements for low-emitting materials.

C. Shop Drawings:
   1. Ductwork shop drawings must be properly submitted. Any ductwork installed without prior approval by the engineer and found to be incorrect, shall be replaced at the expense of the

contractor.

2. Submit shop drawings of all sheet metal for review. Drawings shall be not less than 1/4" scale and show all light fixtures, steel, piping, conduit, equipment and architectural features. It is unacceptable to resubmit and modify McHugh design documents for sheet metal drawing purposes.
   a. Fabrication, assembly, and installation, including plans, elevations, sections, components, and attachments to other work.
   b. Factory- and shop-fabricated ducts and fittings.
   c. Duct layout indicating sizes, configuration, and static-pressure classes.
   d. Elevation of top of ducts. Verify ductwork fits in available space.
   e. Dimensions of main duct runs from building grid lines.
   f. Fittings.
   g. Reinforcement and spacing.
   h. Seam and joint construction.
   i. Penetrations through fire-rated and other partitions.
   j. Equipment
   k. Locations for duct accessories, including dampers, turning vanes, and access doors and panels.
   l. Hangers and supports, including methods for duct and building attachment and vibration isolation.
   m. Indicate waste and storm piping where it occurs in the area of ductwork.
   n. Locate electrical gear on plan. Ductwork is not to run above panels.
   o. Ductwork is to be shown double line with indicated width and height.
   p. Allowance to be made for lining and/or insulation.
   q. Duct sizes shown on contract drawings may be flattened to a 4 to 1 ratio when necessary to establish clearance. Such transitions are to be included in the contract price.
   r. Ductwork fabrication shall not proceed until shop drawings are submitted for review.
   s. All dampers, grilles, registers, diffusers, access panels, louvers, coils, filters, and other components of the system are to be indicated.
   t. Provide detail of fire damper assembly.
   u. Provide drawing sections when requested by the engineer.
   v. Coordinate sheet metal drawings with light fixture layout and sprinkler system piping and heads and shown on the drawing.

D. Delegated-Design Submittal:
   1. Sheet metal thicknesses.
   2. Joint and seam construction and sealing.
   3. Reinforcement details and spacing.
   4. Materials, fabrication, assembly, and spacing of hangers and supports.
   5. Design Calculations: Calculations

1.04 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
   1. Duct installation in congested spaces, indicating coordination with general construction, building components, and other building services. Indicate proposed changes to duct layout.
   2. Suspended ceiling components.
   3. Structural members to which duct will be attached.
   4. Size and location of initial access modules for acoustical tile.

5. Penetrations of smoke barriers and fire-rated construction.
6. Items penetrating finished ceiling including the following:
   a. Luminaires.
   b. Air outlets and inlets.
   c. Speakers.
   d. Sprinklers.
   e. Access panels.
   f. Perimeter moldings.

B. Welding certificates.

1.05 QUALITY ASSURANCE

A. Welding Qualifications: Qualify procedures and personnel according to the following:
   1. AWS D1.1/D1.1M, "Structural Welding Code - Steel," for hangers and supports.
   2. AWS D1.2/D1.2M, "Structural Welding Code - Aluminum," for aluminum supports.
   3. AWS D9.1M/D9.1, "Sheet Metal Welding Code," for duct joint and seam welding.

B. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and System Start-up."

C. ASHRAE/IES Compliance: Applicable requirements in ASHRAE/IES 90.1, Section 6.4.4 - "HVAC System Construction and Insulation."

PART 2 - PRODUCTS

2.01 RECTANGULAR DUCTS AND FITTINGS – SMACNA STANDARDS

A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" based on indicated static-pressure class unless otherwise indicated.

B. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-1, "Rectangular Duct/Transverse Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

C. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-2, "Rectangular Duct/Longitudinal Seams," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

D. Elbows, Transitions, Offsets, Branch Connections, and Other Duct Construction: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 4, "Fittings and Other Construction," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

2.02 FABRICATED DUCT REQUIREMENTS - DUCTMATE

A. All interior rectangular ducts shall be constructed with G-60 or better galvanized steel (ASTM A-653-94) LFQ, chem treat. Exterior ductwork shall be G-90 or better galvanized steel LFQ, chem treat. Kitchen, shower, or dishwasher exhaust shall be aluminum with aluminum joints.

B. Materials: Support, access doors not part of ducts, bar or angle reinforcing damper rods and items

made of uncoated mild steel shall be painted with two coats of primer or provide galvanized equivalent.

C. Longitudinal Seams. Pittsburgh lock shall be used on all longitudinal seams. All longitudinal seams will be sealed with mastic sealant. Snaplock is not acceptable.

D. Flanged interior Gasket. Ductmate 440 or a Butyl Rubber Gasket which meets Mil-C 18969B, Type II Class B, TT-C-1796 A, Type II Class B, and TTS-S-001657 must also pass UL-723. This material, in addition to the above, shall not contain vegetable oils, fish oils, or any other type of vehicle that will support fungal and/or bacterial growth associated with dark, damp areas of ductwork. The recommended test procedure for bacterial and fungal growth is found in 21CFR 177, 1210 closures with sealing gaskets for food containers.

E. Ductmate or W.D.C.I. proprietary duct connection systems will be accepted. Duct constructed using these systems will refer to the manufacturers guidelines for sheet gauge, intermediate reinforcement size and spacing, and joint reinforcements.

F. Formed - on flanges (T.D.C./T.D.F./T-25A/T-25B) be accepted. Formed on flanges will be constructed as SMACNA T-25 flanges, whose limits are defined on page 1.36 1995 SMACNA Manual, Second Edition. No other construction pertaining to formed - on flanges will be accepted. Formed on flanges shall be accepted for use on ductwork 42" wide or less and must include the use of corners, bolts, and cleat. (Over 42", the reinforcement/joint deflection criteria no longer conform with the UMC).

G. Rectangular ductwork above the roof or outside shall be 4" water gauge construction.

H. All ductwork in moist areas (Toilet Rooms, locker rooms, kitchens, etc) shall be aluminum construction with aluminum hangers, supports, and fasteners.

2.03 ROUND DUCTS AND FITTINGS

A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 3, "Round, Oval, and Flexible Duct," based on indicated static-pressure class unless otherwise indicated.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Ductmate Industries, Inc.
      b. Elgen Manufacturing.
      c. Linx Industries (formerly Lindab).
      d. McGill AirFlow LLC.
      e. MKT Metal Manufacturing.
      f. SEMCO LLC.

B. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-1, "Round Duct Transverse Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
   1. Transverse Joints in Ducts Larger Than 60 Inches in Diameter: Flanged.

C. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-2, "Round Duct Longitudinal Seams," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
   1. Fabricate round ducts larger Than 90 inches in diameter with butt-welded longitudinal seams.

D. Tees and Laterals: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-5, "90 Degree Tees and Laterals," and Figure 3-6, "Conical Tees," for static-pressure class, applicable sealing requirements, materials involved, duct-support

intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

2.04 SOUND ATTENUATING DUCT LINING

A. Includes:
1. All interior supply air ductwork.
2. All exterior supply air ductwork. Refer to exterior ductwork specifications (23 07 13) for additional requirements.
3. All interior return ductwork.
4. Return ductwork: Line the first 10’-0” of the main return ductwork extending from the air handling units.
5. All outside air ductwork.
6. All transfer air ductwork.
7. No kitchen supply and return ductwork shall be lined.

NOTE: Refer to ductwork insulation specification (23 07 13) for insulation requirements. Lining indicated is in addition to insulation requirements.

B. Duct liner shall have a flame spread of not over 25, a fuel contributed of not over 50 and a smoke developed of not over 50.

C. Liner shall be minimum 1 inch thick, 1.5 Lbs./Cu. Ft. density with a thermal conductance of .24 at 50 deg. F. mean temperature. (Conductance: BTU/Sq. Ft./F/Hr.).

D. Liner shall not spall or deteriorate at air velocities to 4000 FPM when installed in accordance with the manufacturer’s recommendations.

E. Liner shall be Johns-Manville Linacoustic or approved substitute by Owens-Corning, CertainTeed, or Knauf. Observe all installation instructions.

F. Any ductwork in unconditioned spaces or outdoors shall have insulation totaling R-8.3.

2.05 SHEET METAL MATERIALS

A. General Material Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.

B. Galvanized Sheet Steel: Comply with ASTM A 653/A 653M.
1. Galvanized Coating Designation For Interior Ductwork: G60.
2. Galvanized Coating Designation For Exterior Ductwork: G90.
3. Finishes for Surfaces Exposed to View: Mill phosphatized.

C. Carbon-Steel Sheets: Comply with ASTM A 1008/A 1008M, with oiled, matte finish for exposed ducts.

D. Aluminum Sheets: Comply with ASTM B 209 Alloy 3003, H14 temper; with mill finish for concealed ducts, and standard, one-side bright finish for duct surfaces exposed to view.

E. Reinforcement Shapes and Plates: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.
1. Where black- and galvanized-steel shapes and plates are used to reinforce aluminum ducts, isolate the different metals with butyl rubber, neoprene, or EPDM gasket materials.

F. Tie Rods: Galvanized steel, 1/4-inch minimum diameter for lengths 36 inches or less; 3/8-inch minimum diameter for lengths longer than 36 inches.

G. Fiberglass ductboard is not acceptable.

2.06 SEALANT AND GASKETS

A. General Sealant and Gasket Requirements: Surface-burning characteristics for sealants and gaskets shall be a maximum flame-spread index of 25 and a maximum smoke-developed index of 50 when tested according to UL 723; certified by an NRTL.
B. Water-Based Joint and Seam Sealant:
   1. Application Method: Brush on.
   2. Solids Content: Minimum 65 percent.
   3. Shore A Hardness: Minimum 20.
   4. Water resistant.
   5. Mold and mildew resistant.
   6. VOC: Maximum 75 g/L (less water).
   7. Maximum Static-Pressure Class: 10-inch wg, positive and negative.
   8. Service: Indoor or outdoor.
   9. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum sheets.
C. Flanged Joint Sealant: Comply with ASTM C 920.
   1. General: Single-component, acid-curing, silicone, elastomeric.
   2. Type: S.
   3. Grade: NS.
   4. Class: 25.
   5. Use: O.
   6. For indoor applications, sealant shall have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
   7. Sealant shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
D. Flange Gaskets: Butyl rubber, neoprene, or EPDM polymer with polyisobutylene plasticizer.
E. Round Duct Joint O-Ring Seals:
   1. Seal shall provide maximum leakage class of 3 cfm/100 sq. ft. at 1-inch wg and shall be rated for10-inch wg static-pressure class, positive or negative.
   2. EPDM O-ring to seal in concave bead in coupling or fitting spigot.
   3. Double-lipped, EPDM O-ring seal, mechanically fastened to factory-fabricated couplings and fitting spigots.

2.07 HANGERS AND SUPPORTS

A. Hanger Rods for Noncorrosive Environments: Cadmium-plated steel rods and nuts.
B. Hanger Rods for Corrosive Environments: Electrogalvanized, all-thread rods or galvanized rods with threads painted with zinc-chromate primer after installation.
C. Strap and Rod Sizes: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 5-1, "Rectangular Duct Hangers Minimum Size," and Table 5-2, "Minimum Hanger Sizes for Round Duct."
D. Steel Cables for Galvanized-Steel Ducts: Galvanized steel complying with ASTM A 603.
E. Steel Cables for Stainless-Steel Ducts: Stainless steel complying with ASTM A 492.
F. Steel Cable End Connections: Cadmium-plated steel assemblies with brackets, swivel, and bolts designed for duct hanger service; with an automatic-locking and clamping device.
G. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.
H. Trapeze and Riser Supports:
   1. Supports for Galvanized-Steel Ducts: Galvanized-steel shapes and plates.
   2. Supports for Stainless-Steel Ducts: Stainless-steel shapes and plates.

3. Supports for Aluminum Ducts: Aluminum or galvanized steel coated with zinc chromate.

PART 3 - EXECUTION

3.01 DUCT INSTALLATION

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of duct system. Indicated duct locations, configurations, and arrangements were used to size ducts and calculate friction loss for air-handling equipment sizing and for other design considerations. Install duct systems as indicated unless deviations to layout are approved on Shop Drawings and Coordination Drawings.
B. Install ducts according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" unless otherwise indicated.
C. Install ducts in maximum practical lengths.
D. Install ducts with fewest possible joints.
E. Install factory- or shop-fabricated fittings for changes in direction, size, and shape and for branch connections.
F. Unless otherwise indicated, install ducts vertically and horizontally, and parallel and perpendicular to building lines.
G. Install ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.
H. Install ducts with a clearance of 1 inch, plus allowance for insulation thickness.
I. Route ducts to avoid passing through transformer vaults and electrical equipment rooms and enclosures.
J. Where ducts pass through non-fire-rated interior partitions and exterior walls and are exposed to view, cover the opening between the partition and duct or duct insulation with sheet metal flanges of same metal thickness as the duct. Overlap openings on four sides by at least 1-1/2 inches.
K. Where ducts pass through fire-rated interior partitions and exterior walls, install fire dampers. Comply with requirements in Section 233300 "Air Duct Accessories" for fire and smoke dampers.
L. Protect duct interiors from moisture, construction debris and dust, and other foreign materials. Comply with SMACNA's "IAQ Guidelines for Occupied Buildings Under Construction," Appendix G, "Duct Cleanliness for New Construction Guidelines."

3.02 INSTALLATION OF EXPOSED DUCTWORK

A. Protect ducts exposed in finished spaces from being dented, scratched, or damaged.
B. Trim duct sealants flush with metal. Create a smooth and uniform exposed bead. Do not use two-part tape sealing system.
C. Grind welds to provide smooth surface free of burrs, sharp edges, and weld splatter. When welding stainless steel with a No. 3 or 4 finish, grind the welds flush, polish the exposed welds, and treat the welds to remove discoloration caused by welding.
D. Maintain consistency, symmetry, and uniformity in the arrangement and fabrication of fittings, hangers and supports, duct accessories, and air outlets.
E. Repair or replace damaged sections and finished work that does not comply with these requirements.

3.03 DUCT SEALING

A. Seal ducts for duct static-pressure, seal classes, and leakage classes specified in "Duct Schedule" Article according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
B. Seal ducts at a minimum to the following seal classes according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible":
   1. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
   2. Outdoor, Supply-Air Ducts: Seal Class A.
   3. Outdoor, Exhaust Ducts: Seal Class C.
   4. Outdoor, Return-Air Ducts: Seal Class C.
   5. Unconditioned Space, Supply-Air Ducts in Pressure Classes 2-Inch wg and Lower: Seal Class B.
   6. Unconditioned Space, Supply-Air Ducts in Pressure Classes Higher Than 2-Inch wg: Seal Class A.
   7. Unconditioned Space, Exhaust Ducts: Seal Class C.
   8. Unconditioned Space, Return-Air Ducts: Seal Class B.
   9. Conditioned Space, Supply-Air Ducts in Pressure Classes 2-Inch wg and Lower: Seal Class C.
   10. Conditioned Space, Supply-Air Ducts in Pressure Classes Higher Than 2-Inch wg: Seal Class B.
   11. Conditioned Space, Exhaust Ducts: Seal Class B.
   12. Conditioned Space, Return-Air Ducts: Seal Class C.

3.04 HANGER AND SUPPORT INSTALLATION

A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 5, "Hangers and Supports."
B. Building Attachments: Concrete inserts, powder-actuated fasteners, or structural-steel fasteners appropriate for construction materials to which hangers are being attached.
   1. Where practical, install concrete inserts before placing concrete.
   2. Install powder-actuated concrete fasteners after concrete is placed and completely cured.
   3. Use powder-actuated concrete fasteners for standard-weight aggregate concretes or for slabs more than 4 inches thick.
   4. Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes or for slabs less than 4 inches thick.
   5. Do not use powder-actuated concrete fasteners for seismic restraints.
C. Hanger Spacing: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 5-1, "Rectangular Duct Hangers Minimum Size," and Table 5-2, "Minimum Hanger Sizes for Round Duct," for maximum hanger spacing; install hangers and supports within 24 inches of each elbow and within 48 inches of each branch intersection.
D. Hangers Exposed to View: Threaded rod and angle or channel supports.
E. Support vertical ducts with steel angles or channel secured to the sides of the duct with welds, bolts, sheet metal screws, or blind rivets; support at each floor and at a maximum interval of 16 feet.
F. Install upper attachments to structures. Select and size upper attachments with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

3.05 CONNECTIONS

A. Make connections to equipment with flexible connectors complying with Section 233300 "Air Duct Accessories."
B. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for branch, outlet and inlet, and terminal unit connections.

3.06 START UP

A. Air Balance: Comply with requirements in Section 230593 "Testing, Adjusting, and Balancing for HVAC."

3.07 DUCT SCHEDULE

A. Fabricate ducts with galvanized sheet steel except as otherwise indicated and as follows:
   1. Underground Ducts: Concrete-encased, PVC-coated, galvanized sheet steel with thicker coating on duct exterior.
B. Supply Ducts:
   1. All Supply Ductwork:
      a. Pressure Class: Positive 2-inch wg.
      b. Minimum SMACNA Seal Class: C for 0-2”; B for 3”; A for 4”,6”,10”.
      c. SMACNA Leakage Class for Rectangular: 16 for 0-2”; 8 for 3”; 4 for 4”,6”,10”.
      d. SMACNA Leakage Class for Round and Flat Oval: 8 for 0-2”; 4 for 3”; 2 for 4”,6”,10”.
C. Return Ducts:
   1. All Return Ductwork:
      a. Pressure Class: Positive or negative 1-inch wg.
      b. Minimum SMACNA Seal Class: C.
      c. SMACNA Leakage Class for Rectangular: 16.
      d. SMACNA Leakage Class for Round and Flat Oval: 8.
D. Exhaust Ducts:
   1. Ducts Connected to Fans Exhausting (ASHRAE 62.1, Class 1 and 2) Air:
      a. Pressure Class: Negative 1-inch wg.
      b. Minimum SMACNA Seal Class: C if negative pressure, and A if positive pressure.
      c. SMACNA Leakage Class for Rectangular: 12.
      d. SMACNA Leakage Class for Round and Flat Oval: 8.
   2. All Other Return Air Ductwork:
      a. Pressure Class: Positive or negative 1-inch wg.
      b. Minimum SMACNA Seal Class: A
      c. SMACNA Leakage Class for Rectangular: 16.
      d. SMACNA Leakage Class for Round and Flat Oval: 8.
E. Outdoor-Air (Not Filtered, Heated, or Cooled) Ducts:
   1. Ducts Connected to Fan Coil Units, Furnaces, Heat Pumps, and Terminal Units:
      a. Pressure Class: Positive or negative 1-inch wg.
      b. Minimum SMACNA Seal Class: C.
      c. SMACNA Leakage Class for Rectangular: 16.
      d. SMACNA Leakage Class for Round and Flat Oval: 8.
F. Intermediate Reinforcement:
   1. Galvanized-Steel Ducts: Galvanized steel.
   2. PVC-Coated Ducts:
      a. Exposed to Airstream: Match duct material.
      b. Not Exposed to Airstream: Galvanized.
   3. Stainless-Steel Ducts:
      a. Exposed to Airstream: Match duct material.
      b. Not Exposed to Airstream: Galvanized.
   4. Aluminum Ducts: [Aluminum] [or galvanized sheet steel coated with zinc chromate].
G. Elbow Configuration:

1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-2, "Rectangular Elbows."
   a. Velocity 1000 fpm or Lower:
      1) Radius Type RE 1 with minimum 0.5 radius-to-diameter ratio.
      2) Mitered Type RE 4 without vanes.
   b. Velocity 1000 to 1500 fpm:
      1) Radius Type RE 1 with minimum 1.0 radius-to-diameter ratio.
      2) Radius Type RE 3 with minimum 0.5 radius-to-diameter ratio and two vanes.
      3) Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-3, "Vanes and Vane Runners," and Figure 4-4, "Vane Support in Elbows."
   c. Velocity 1500 fpm or Higher:
      1) Radius Type RE 1 with minimum 1.5 radius-to-diameter ratio.
      2) Radius Type RE 3 with minimum 1.0 radius-to-diameter ratio and two vanes.
      3) Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-3, "Vanes and Vane Runners," and Figure 4-4, "Vane Support in Elbows."
2. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-2, "Rectangular Elbows."
   a. Radius Type RE 1 with minimum 1.5 radius-to-diameter ratio.
   b. Radius Type RE 3 with minimum 1.0 radius-to-diameter ratio and two vanes.
   c. Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-3, "Vanes and Vane Runners," and Figure 4-4, "Vane Support in Elbows."
3. Round Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-4, "Round Duct Elbows."
   a. Minimum Radius-to-Diameter Ratio and Elbow Segments: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 3-1, "Mitered Elbows." Elbows with less than 90-degree change of direction have proportionately fewer segments.
      1) Velocity 1000 fpm or Lower: 0.5 radius-to-diameter ratio and three segments for 90-degree elbow.
      2) Velocity 1000 to 1500 fpm: 1.0 radius-to-diameter ratio and four segments for 90-degree elbow.
      3) Velocity 1500 fpm or Higher: 1.5 radius-to-diameter ratio and five segments for 90-degree elbow.
      4) Radius-to Diameter Ratio: 1.5.
   b. Round Elbows, 12 Inches and Smaller in Diameter: Stamped or pleated.
   c. Round Elbows, 14 Inches and Larger in Diameter: Standing seam.

H. Branch Configuration:
1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-6, "Branch Connection."
   a. Rectangular Main to Rectangular Branch: 45-degree entry.
   b. Rectangular Main to Round Branch: Spin in.
2. Round: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-5, "90 Degree Tees and Laterals," and Figure 3-6, "Conical Tees." Saddle taps are permitted in existing duct.
   a. Velocity 1000 fpm or Lower: 90-degree tap.
   b. Velocity 1000 to 1500 fpm: Conical tap.
   c. Velocity 1500 fpm or Higher: 45-degree lateral.

I. General Requirements
   1. Ductwork in the pool and pool equipment room shall be aluminum construction with aluminum hangers, supports, and fasteners.
   2. Rectangular ductwork above the roof or outside shall be 4" water gauge construction.

J. Rectangular ductwork in the pool and pool equipment room shall be aluminum construction with stainless steel (317L or 904L) hangers, supports, and fasteners.
   1. All ductwork in moist areas (Toilet Rooms, locker rooms, kitchens, etc.) shall be aluminum construction with aluminum hangers, supports, and fasteners.

END OF SECTION

SECTION 23 33 00 - AIR DUCT ACCESSORIES

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:
1. Backdraft and pressure relief dampers.
2. Manual volume dampers.
3. Control dampers.
4. Fire dampers.
5. Smoke dampers.
6. Flange connectors.
7. Turning vanes.
8. Duct-mounted access doors.
9. Flexible connectors.
10. Duct accessory hardware.

B. Related Requirements:
1. Section 233723 "HVAC Gravity Ventilators" for roof-mounted ventilator caps.
2. Section 283000 " Addressable Fire-Alarm System" for duct-mounted fire and smoke detectors.

1.02 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Sustainable Design Submittals:
1. Product data showing compliance with ASHRAE 62.1.
2. Detail duct accessories fabrication and installation in ducts and other construction. Include dimensions, weights, loads, and required clearances, and method of field assembly into duct systems and other construction. Include the following:
a. Special fittings.
b. Manual volume damper installations.
c. Control-damper installations.
d. Fire-damper and smoke-damper installations, including sleeves; and duct-mounted access doors.
e. Wiring Diagrams: For power, signal, and control wiring.

1.03 CLOSEOUT SUBMITTALS

A. Operation and maintenance data.

PART 2 - PRODUCTS

2.01 ASSEMBLY DESCRIPTION

A. Comply with NFPA 90A, "Installation of Air Conditioning and Ventilating Systems," and with NFPA 90B, "Installation of Warm Air Heating and Air Conditioning Systems."
B. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.

2.02 MATERIALS

A. Galvanized Sheet Steel: Comply with ASTM A 653/A 653M.
   1. Galvanized Coating Designation: G60 for indoor applications and G90 for exterior applications.
   2. Exposed-Surface Finish: Mill phosphatized.
B. Stainless-Steel Sheets: Comply with ASTM A 480/A 480M, Type 304, and having a No. 2 finish for concealed ducts and exposed ducts.
C. Aluminum Sheets: Comply with ASTM B 209, Alloy 3003, Temper H14; with mill finish for concealed ducts and standard, 1-side bright finish for exposed ducts.
D. Extruded Aluminum: Comply with ASTM B 221, Alloy 6063, Temper T6.
E. Reinforcement Shapes and Plates: Galvanized-steel reinforcement where installed on galvanized sheet metal ducts; compatible materials for aluminum and stainless-steel ducts.
F. Tie Rods: Galvanized steel, 1/4-inch minimum diameter for lengths 36 inches or less; 3/8-inch minimum diameter for lengths longer than 36 inches.

2.03 BACKDRAFT AND PRESSURE RELIEF DAMPERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. American Warming and Ventilating; a Mestek Architectural Group company.
   2. Greenheck Fan Corporation.
   3. Lloyd Industries, Inc.
   4. Nailor Industries Inc.
   5. NCA Manufacturing, Inc.
   6. Pottorff.
   7. Ruskin Company.
B. Description: Gravity balanced.
C. Maximum Air Velocity: 2500 fpm.
D. Maximum System Pressure: 2-inch wg
E. Frame: Hat-shaped, 0.063-inch-thick extruded aluminum or 0.05-inch- thick stainless steel, with welded corners or mechanically attached and mounting flange.
F. Blades: Multiple single-piece blades, center pivoted, maximum 6-inch width, 0.050-inch-thick aluminum sheet with sealed edges.
G. Blade Action: Parallel.
H. Blade Seals: Extruded vinyl, mechanically locked or Neoprene, mechanically locked.
I. Blade Axles:
   1. Material: Stainless steel.
   2. Diameter: 0.20 inch.
J. Tie Bars and Brackets: Galvanized steel.
K. Return Spring: Adjustable tension.
L. Bearings: Synthetic pivot bushings.
M. Accessories:

1. Adjustment device to permit setting for varying differential static pressure.
2. Counterweights and spring-assist kits for vertical airflow installations.
3. Screen Mounting: Rear mounted.
4. Screen Material: Aluminum.
5. Screen Type: Insect.
6. 90-degree stops.

N. Air Leakage: Class I – Not to exceed 8 CFM/FT2 @ 4” w.g. AMCA Certified.

2.04 MANUAL VOLUME DAMPERS

A. Standard, Steel, Manual Volume Dampers:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. American Warming and Ventilating; a Mestek Architectural Group company.
   b. Flexmaster U.S.A., Inc.
   c. McGill AirFlow LLC.
   d. Nailor Industries Inc.
   e. Pottorff.
   f. Ruskin Company.
2. Standard leakage rating.
3. Suitable for horizontal or vertical applications.
4. Frames:
   a. Frame: Hat-shaped, 0.094-inch-thick, galvanized sheet steel.
   b. Mitered and welded corners.
   c. Flanges for attaching to walls and flangeless frames for installing in ducts.
5. Blades:
   a. Multiple or single blade.
   b. Parallel- or opposed-blade design.
   c. Stiffen damper blades for stability.
   d. Galvanized steel, 0.064 inch thick.
6. Blade Axles: Galvanized steel.
7. Bearings:
   a. Molded synthetic.
   b. Dampers in ducts with pressure classes of 3-inch wg or less shall have axles full length of damper blades and bearings at both ends of operating shaft.
8. Tie Bars and Brackets: Galvanized steel.

B. Standard, Aluminum, Manual Volume Dampers:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. American Warming and Ventilating; a Mestek Architectural Group company.
   b. McGill AirFlow LLC.
   c. Nailor Industries Inc.
   d. Pottorff.
   e. Ruskin Company.
2. Standard leakage rating.
3. Suitable for horizontal or vertical applications.
4. Frames: Hat-shaped, 0.10-inch-thick, aluminum sheet channels; frames with flanges for attaching to walls and flangeless frames for installing in ducts.
5. Blades:
   a. Multiple or single blade.

b. Parallel or opposed-blade design.
c. Stiffen damper blades for stability.
d. Roll-Formed Aluminum Blades: 0.10-inch- thick aluminum sheet.
e. Extruded-Aluminum Blades: 0.050-inch- thick extruded aluminum.

6. Blade Axles: [Galvanized steel] [Stainless steel] [Nonferrous metal].
7. Bearings:
   a. [Oil-impregnated bronze] [Molded synthetic] [Stainless-steel sleeve].
   b. Dampers in ducts with pressure classes of 3-inch wg or less shall have axles full length of damper blades and bearings at both ends of operating shaft.
8. Tie Bars and Brackets: Aluminum.

C. Jackshaft:
1. Size: 1-inch diameter.
2. Material: Galvanized-steel pipe rotating within pipe-bearing assembly mounted on supports at each mullion and at each end of multiple-damper assemblies.
3. Length and Number of Mountings: As required to connect linkage of each damper in multiple-damper assembly.

D. Damper Hardware:
1. Zinc-plated, die-cast core with dial and handle made of 3/32-inch- thick zinc-plated steel, and a 3/4-inch hexagon locking nut.
2. Include center hole to suit damper operating-rod size.
3. Include elevated platform for insulated duct mounting.

2.05 CONTROL DAMPERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. American Warming and Ventilating; a Mestek Architectural Group company.
2. Arrow United Industries.
3. Greenheck Fan Corporation.
4. Lloyd Industries, Inc.
5. McGill AirFlow LLC.
6. Metal Form Manufacturing, Inc.
7. Nailor Industries Inc.
8. Pottorff.
9. Ruskin Company.
10. Tamco
11. Young Regulator Company.

B. Frames:
1. Hat, U, or Angle shaped.
2. 0.05-inch thick stainless steel.
3. Mitered and welded corners.

C. Blades:
1. Multiple blade with maximum blade width of 6 inches.
2. Opposed blade design.
3. Aluminum.
4. 0.0747-inch- thick dual skin.
5. Blade Edging: Closed-cell neoprene.
6. Blade Edging: Inflatable seal blade edging, or replaceable rubber seals.

D. Blade Axles: 1/2-inch-diameter; nonferrous metal; blade-linkage hardware of zinc-plated steel and brass; ends sealed against blade bearings.
1. Operating Temperature Range: From minus 40 to plus 200 deg. F.

E. Bearings:
   1. Molded synthetic.
   2. Dampers in ducts with pressure classes of 3-inch wg or less shall have axles full length of damper blades and bearings at both ends of operating shaft.
   3. Thrust bearings at each end of every blade.
F. Air Leakage: Class I – Not to exceed 8 CFM/FT2 @ 4”w.g.. AMCA Certified.

2.06 FIRE DAMPERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. American Warming and Ventilating; a Mestek Architectural Group company.
   2. Arrow United Industries.
   3. Greenheck Fan Corporation.
   4. Nailor Industries Inc.
   5. Pottorff.
   6. Ruskin Company.
   7. Vent Products Co., Inc.
B. Type: Static; rated and labeled according to UL 555 by an NRTL.
C. Closing rating in ducts up to 4-inch wg static pressure class and minimum 2500-fpm velocity.
D. Fire Rating: 1 ½ and 3 hours. Coordinate with wall rating.
E. Frame: Curtain type with blades inside airstream for duct heights larger than 14” and curtain type with blades outside airstream for duct heights 14” and below; fabricated with roll-formed, 0.034-inch-thick galvanized steel; with mitered and interlocking corners.
F. Mounting Sleeve: Factory- or field-installed, galvanized sheet steel.
   1. Minimum Thickness: 0.138 inch thick, as indicated, and of length to suit application.
   2. Exception: Omit sleeve where damper-frame width permits direct attachment of perimeter mounting angles on each side of wall or floor; thickness of damper frame must comply with sleeve requirements.
G. Mounting Orientation: Vertical or horizontal as indicated.
H. Blades: Roll-formed, interlocking, galvanized sheet steel. In place of interlocking blades, use full-length, 0.034-inch-thick, galvanized-steel blade connectors.
I. Horizontal Dampers: Include blade lock and stainless-steel closure spring.
J. Heat-Responsive Device: Replaceable, 165 deg. F rated, fusible links. Provide 10 % extra links to the owner.
K. SET FIRE DAMPERS IN 20 GAUGE SLEEVES WITH BREAKAWAY CONNECTIONS TO THE DUCTWORK ON EACH SIDE. SEE STANDARD SMACNA DETAILS FOR INSTALLATION. DAMPERS INSTALLED INCORRECTLY WILL BE REQUIRED TO BE REMOVED AND REPLACED CORRECTLY.
L. Provide 12" x 12" access door in ductwork for access to each damper. Label "FIRE DAMPER ACCESS" with 2" high stenciled letters.

2.07 SMOKE DAMPERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. American Warming and Ventilating; a Mestek Architectural Group company.
   2. Greenheck Fan Corporation.
   3. Nailor Industries Inc.
   4. Pottorff.
   5. Ruskin Company.
B. General Requirements: Label according to UL 555S by an NRTL.

C. Smoke Detector: Shall be provided by the Fire Alarm Contractor / Electrical Contractor and installed by the Mechanical Contractor.
D. Frame: Hat-shaped, 0.094-inch-thick, galvanized sheet steel, with interlocking, gusseted or mechanically attached corners and mounting flange.
E. Blades: Roll-formed, horizontal, interlocking, 0.063-inch thick, galvanized sheet steel.
F. Leakage: Class I.
G. Rated pressure and velocity to exceed design airflow conditions.
H. Mounting Sleeve: Factory-installed, 0.05-inch thick, galvanized sheet steel; length to suit wall or floor application [with factory-furnished silicone calking].
I. Damper Motors: two-position action.
J. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Section 230513 "Common Motor Requirements for HVAC Equipment."
    1. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.
    2. Controllers, Electrical Devices, and Wiring: Comply with requirements for electrical devices and connections specified in Section 230923 "Direct Digital Control (DDC) System for HVAC."
    3. Permanent-Split-Capacitor or Shaded-Pole Motors: With oil-immersed and sealed gear trains.
    4. Spring-Return Motors: Equip with an integral spiral-spring mechanism where indicated. Enclose entire spring mechanism in a removable housing designed for service or adjustments. Size for running torque rating of 150 in. x lbf and breakaway torque rating of 150 in. x lbf.
    5. Outdoor Motors and Motors in Outdoor-Air Intakes: Equip with O-ring gaskets designed to make motors weatherproof. Equip motors with internal heaters to permit normal operation at minus 40 deg. F.
    6. Nonspring-Return Motors: For damper’s larger than 25 sq. ft., size motor for running torque rating of 150 in. x lbf and breakaway torque rating of 300 in. x lbf.
    7. Electrical Connection: 24 V.

2.08 COMBINATION SMOKE/FIRE DAMPERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    1. American Warming and Ventilating; a Mestek Architectural Group company.
    2. Greenheck Fan Corporation.
    3. Nailor Industries Inc.
    4. Pottorff.
    5. Ruskin Company.
B. General Requirements:
    1. Dampers shall be furnished with both the 1 1/2 hour (or 3 hour) UL label for fire dampers - UL 555 and the UL label for leakage resistance (smoke) - UL 555S.
    2. Refer to the requirements of Fire Dampers and Smoke Dampers for additional requirements.

2.09 FLANGE CONNECTORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    1. Ductmate Industries, Inc.
B. Description: Roll-formed, factory-fabricated, slide-on transverse flange connectors, gaskets, and components.

C. Material: Galvanized steel.
D. Gage and Shape: Match connecting ductwork.

2.10 TURNING VANES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Aero-Dyne Sound Control Co.
   2. Ductmate Industries, Inc.
   3. Duro Dyne Inc.
   4. Elgen Manufacturing.
   5. Hardcast, Inc.
   6. METALAIRE, Inc.
   7. SEMCO LLC.
B. Manufactured Turning Vanes for Metal Ducts: Curved blades of galvanized sheet steel; support with bars perpendicular to blades set; set into vane runners suitable for duct mounting.
   1. Acoustic Turning Vanes: Fabricate airfoil-shaped aluminum extrusions with perforated faces and fibrous-glass fill.
C. Manufactured Turning Vanes for Nonmetal Ducts: Fabricate curved blades of resin-bonded fiberglass with acrylic polymer coating; support with bars perpendicular to blades set; set into vane runners suitable for duct mounting.
D. General Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"; Figures 4-3, "Vanes and Vane Runners," and 4-4, "Vane Support in Elbows."
E. Vane Construction: Double wall.

2.11 DUCT-MOUNTED ACCESS DOORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. American Warming and Ventilating; a Mestek Architectural Group company.
   2. Ductmate Industries, Inc.
   3. Elgen Manufacturing.
   4. Flexmaster U.S.A., Inc.
   5. Greenheck Fan Corporation.
   6. McGill AirFlow LLC.
   7. Nailor Industries Inc.
   8. Pottorff.
B. Duct-Mounted Access Doors: Fabricate access panels according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"; Figures 7-2, "Duct Access Doors and Panels," and 7-3, "Access Doors - Round Duct."
   1. Door:
      a. Double wall, rectangular.
      b. Galvanized sheet metal with insulation fill and thickness as indicated for duct pressure class.
      c. Vision panel.
      d. Hinges and Latches: 1-by-1-inch butt or piano hinge and cam latches.
      e. Fabricate doors airtight and suitable for duct pressure class.
   2. Frame: Galvanized sheet steel, with bend-over tabs and foam gaskets.
   3. Number of Hinges and Locks:
      a. Access Doors Less Than 12 Inches Square: No hinges and two sash locks.
      b. Access Doors up to 18 Inches Square: Two hinges and two sash locks.
      c. Access Doors up to 24 by 48 Inches: Continuous and two compression latches with

outside handles.

d. Access Doors Larger Than 24 by 48 Inches: Continuous and two compression latches with outside handles.

2.12 DUCT ACCESS PANEL ASSEMBLIES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. 3M.
   2. Ductmate Industries, Inc.
   3. Flame Gard, Inc.

B. Labeled according to UL 1978 by an NRTL.

C. Panel and Frame: Minimum thickness 0.0428-inch stainless steel.

D. Fasteners: Stainless steel. Panel fasteners shall not penetrate duct wall.

E. Gasket: Comply with NFPA 96; grease-tight, high-temperature ceramic fiber, rated for minimum 2000 deg. F.

F. Minimum Pressure Rating: 10-inch wg, positive or negative.

2.13 FLEXIBLE CONNECTORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Ductmate Industries, Inc.
   2. Elgen Manufacturing.
   3. Hardcast, Inc.

B. Materials: Flame-retardant or noncombustible fabrics.

C. Coatings and Adhesives: Comply with UL 181, Class 1.

D. Metal-Edged Connectors: Factory fabricated with a fabric strip 5 ¾ inches wide attached to two strips of 2 ¾ -inch-wide, 0.028-inch- thick, galvanized sheet steel or 0.032-inch- thick aluminum sheets. Provide metal compatible with connected ducts.

E. Indoor System, Flexible Connector Fabric: Glass fabric double coated with neoprene.
   1. Minimum Weight: 26 oz./sq. yd.
   2. Tensile Strength: 480 lbf/inch in the warp and 360 lbf/inch in the filling.
   3. Service Temperature: Minus 40 to plus 200 deg. F.

F. Outdoor System, Flexible Connector Fabric: Glass fabric double coated with weatherproof, synthetic rubber resistant to UV rays and ozone.
   1. Minimum Weight: 24 oz./sq. yd.
   2. Tensile Strength: 530 lbf/inch in the warp and 440 lbf/inch in the filling.
   3. Service Temperature: Minus 50 to plus 250 deg. F.

2.14 DUCT ACCESSORY HARDWARE

A. Instrument Test Holes: Cast iron or cast aluminum to suit duct material, including screw cap and gasket. Size to allow insertion of pitot tube and other testing instruments and of length to suit duct-insulation thickness.

B. Adhesives: High strength, quick setting, neoprene based, waterproof, and resistant to gasoline and grease.

2.15 ABOVE THE ROOF DUCT CURBS

A. Furnish and install - RPS Duct Mounting Pedestals as manufactured by RPS Products and Systems Corp., Bensenville, IL at all necessary specified points or as shown on drawings. The duct mounting

pedestal shall include an equipment rail, a matching length steel slide channel attached to "U" shaped mounting brackets and secured to side of equipment rail with lag bolts. The duct mounting assembly shall have galvanized 18' long continuous threaded rods for 12" vertical adjustment, lateral adjust spacer bracket for 12" horizontal adjustment, and galvanized slide assembly.

2.16 BURGLAR BARS

Furnish and install steel burglar bars in roof curbs. Bars shall be minimum 1/2" x 1/2" steel on 6" centers, permanently attached in roof curb.

2.17 VOLUME DAMPER CONTROL - REMOTE EXTERNAL CONTROL

Applications: Drywall ceilings or where shown on drawings.

1. Location: In ductwork where required to control air flow or balance air systems.
2. Volume Damper Type: Opposed single blade round butterfly damper for external control, EPDM low leakage seals, scoop and spin-in type shell, Young Regulator Co. 5020 CC Series. Rectangular: #830-CC Series.
3. Leakage:10 CFM maximum at 4” s.p. for 4 square dampers.
4. Material: Galvanized steel in galvanized steel ductwork, extruded aluminum in aluminum ductwork.
5. Controls: Bowden Cable Control Kit 270-896C to include hardware, for ceiling mounting in conjunction with external control of round or rectangular dampers, flush 7/8” diameter cold rolled steel cover is zinc plated for painting, 12” wrench (damper adjustments), metal clad control cable.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Install duct accessories according to applicable details in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for metal ducts and in NAIMA AH116, "Fibrous Glass Duct Construction Standards," for fibrous-glass ducts.
B. Install duct accessories of materials suited to duct materials; use galvanized-steel accessories in galvanized-steel and fibrous-glass ducts, stainless-steel accessories in stainless-steel ducts, and aluminum accessories in aluminum ducts.
C. Install backdraft or control dampers at inlet of exhaust fans or exhaust ducts as close as possible to exhaust fan unless otherwise indicated.
D. Install volume dampers at points on supply, return, and exhaust systems where branches extend from larger ducts. Where dampers are installed in ducts having duct liner, install dampers with hat channels of same depth as liner, and terminate liner with nosing at hat channel.
    1. Install steel volume dampers in steel ducts.
    2. Install aluminum volume dampers in aluminum ducts.
E. Set dampers to fully open position before testing, adjusting, and balancing.
F. Install test holes at fan inlets and outlets and elsewhere as indicated.
G. Install fire and smoke dampers according to UL listing.
H. Install duct access doors on sides of ducts to allow for inspecting, adjusting, and maintaining accessories and equipment at the following locations:
    1. On both sides of duct coils.

2. Upstream from duct filters.
3. At outdoor-air intakes and mixed-air plenums.
4. At drain pans and seals.
5. Downstream from manual volume dampers, control dampers, backdraft dampers, and equipment.
6. Adjacent to and close enough to fire or smoke dampers, to reset or reinstall fusible links. Access doors for access to fire or smoke dampers having fusible links shall be pressure relief access doors and shall be outward operation for access doors installed upstream from dampers and inward operation for access doors installed downstream from dampers.
7. At each change in direction and at maximum 50-foot spacing.
8. Upstream from turning vanes.
9. Upstream or downstream from duct silencers.
10. Control devices requiring inspection.
11. Elsewhere as indicated.

I. Install access doors with swing against duct static pressure.

J. Access Door Sizes:
1. One-Hand or Inspection Access: 8 by 5 inches.
2. Two-Hand Access: 12 by 6 inches.
3. Head and Hand Access: 18 by 10 inches.
4. Head and Shoulders Access: 21 by 14 inches.
5. Body Access: 25 by 14 inches.
6. Body plus Ladder Access: 25 by 17 inches.

K. Label access doors according to Section 230553 "Identification for HVAC Piping and Equipment" to indicate the purpose of access door.

L. Install flexible connectors to connect ducts to equipment.

M. Connect terminal units to supply ducts with maximum 12-inch lengths of flexible duct. Do not use flexible ducts to change directions.

N. Connect diffusers or light troffer boots to ducts with maximum 10 feet lengths of flexible duct clamped or strapped in place.

O. Connect flexible ducts to metal ducts with draw bands.

P. Install duct test holes where required for testing and balancing purposes.

Q. Install volume damper control – remote external control when balancing dampers are located above in accessible ceilings similar to gypsum board.

3.02 FIELD QUALITY CONTROL

A. Tests and Inspections:
1. Operate dampers to verify full range of movement.
2. Inspect locations of access doors and verify that purpose of access door can be performed.
3. Operate fire and smoke dampers to verify full range of movement and verify that proper heat-response device is installed.
4. Inspect turning vanes for proper and secure installation.

END OF SECTION

SECTION 23 33 46 - FLEXIBLE DUCTS

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:
   1. Insulated supply flexible ducts.

1.02 ACTION SUBMITTALS

A. Product Data: For each type of product.
B. Sustainable Design Submittals:
   1. Product data showing compliance with ASHRAE 62.1.
   2. Product Data: For adhesives and sealants, indicating VOC content.
   3. Laboratory Test Reports: For adhesives and sealants, indicating compliance with requirements for low-emitting materials.
   4. Laboratory Test Reports: For Insulation, indicating compliance with requirements for low-emitting materials.
   5. Product Data: For insulation, indicating that R-values comply with tables in ASHRAE/IES 90.1, Section 6 - "Heating, Ventilating, and Air Conditioning."
C. Shop Drawings: For flexible ducts.
   1. Include plans showing locations and mounting and attachment details.

1.03 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Reflected ceiling plans, drawn to scale, and coordinated with each other, using input from installers of the items involved.

PART 2 - PRODUCTS

2.01 ASSEMBLY DESCRIPTION

A. Comply with NFPA 90A, "Installation of Air Conditioning and Ventilating Systems," and with NFPA 90B, "Installation of Warm Air Heating and Air Conditioning Systems."
B. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.
C. Comply with the Air Diffusion Council's "ADC Flexible Air Duct Test Code FD 72-R1."
D. Comply with ASTM E 96/E 96M, "Test Methods for Water Vapor Transmission of Materials."

2.02 INSULATED FLEXIBLE DUCTS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Flexmaster U.S.A., Inc.
2. Flex-Tek Group.
3. McGill AirFlow LLC.
4. Thermaflex.
5. Ward Industries; a brand of Hart & Cooley, Inc.

B. Insulated, Flexible Duct: UL 181, Class 1, multiple layers of aluminum laminate supported by helically wound, spring-steel wire; fibrous-glass insulation; polyethylene [aluminized] vapor-barrier film.
1. Pressure Rating: 10-inch wg positive and 10-inch wg negative.
2. Maximum Air Velocity: 4000 fpm.
3. Temperature Range: Minus 20 to plus 210 deg. F.
4. Insulation R-Value: Comply with ASHRAE/IES 90.1 - R4.2 in conditioned space, R8.0 in unconditioned space/outdoors.
5. Comply with 25/50 flame spread and smoke density ratings.

2.03 FLEXIBLE DUCT CONNECTORS

A. Clamps: Nylon strap in sizes 3 through 18 inches, to suit duct size.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Install flexible ducts according to applicable details in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for metal ducts and in NAIMA AH116, "Fibrous Glass Duct Construction Standards," for fibrous-glass ducts.
B. Applies to supply ductwork only. Exhaust and return ductwork to be rigid ductwork.
C. Flexible air connectors and flexible ducts shall not be used to make 90 degree or greater.
D. Install in indoor applications only. Flexible ductwork should not be exposed to UV lighting.
E. Connect terminal units to supply ducts with maximum 12-inch lengths of flexible duct. Do not use flexible ducts to change directions.
F. Connect diffusers or light troffer boots to ducts with maximum 10’-0” lengths of flexible duct clamped or strapped in place.
G. Connect flexible ducts to metal ducts with liquid adhesive plus tape.
H. Install duct test holes where required for testing and balancing purposes.
I. Installation:
1. Install ducts fully extended.
2. Do not bend ducts across sharp corners.
3. Bends of flexible ducting shall not exceed a minimum of one duct diameter.
4. Avoid contact with metal fixtures, water lines, pipes, or conduits.
5. Install flexible ducts in a direct line, without sags, twists, or turns.

J. Supporting Flexible Ducts:
1. Suspend flexible ducts with bands 1 ½ inches wide or wider and spaced a maximum of 48 inches apart. Maximum centerline sag between supports shall not exceed 1/2 inch per 12 inches.
2. Install extra supports at bends placed approximately one duct diameter from center line of the bend.

3. Ducts may rest on ceiling joists or truss supports. Spacing between supports shall not exceed the maximum spacing per manufacturer's written installation instructions.
4. Vertically installed ducts shall be stabilized by support straps at a maximum of 72 inches o.c.

END OF SECTION

SECTION 23 34 16 - CENTRIFUGAL HVAC FANS

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes: For each product.
   1. Backward-inclined centrifugal fans.
   2. Forward-curved centrifugal fans.

1.02 ACTION SUBMITTALS

A. Product Data:
   1. Include rated capacities, furnished specialties, and accessories for each fan.
   2. Certified fan performance curves with system operating conditions indicated.
   3. Certified fan sound-power ratings.
   4. Motor ratings and electrical characteristics, plus motor and electrical accessories.
   5. Material thickness and finishes, including color charts.
   6. Dampers, including housings, linkages, and operators.

B. Shop Drawings:
   1. Include plans, elevations, sections, and attachment details.
   2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
   3. Include diagrams for power, signal, and control wiring.
   4. Vibration Isolation Base Details: Detail fabrication, including anchorages and attachments to structure and to supported equipment. Include auxiliary motor slides and rails, and base weights.

1.03 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Show fan room layout and relationships between components and adjacent structural and mechanical elements. Show support locations, type of support, and weight on each support. Indicate and certify field measurements.

B. Field quality-control reports.

1.04 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For centrifugal fans to include in emergency, operation, and maintenance manuals.

1.05 MAINTENANCE MATERIAL SUBMITTALS

A. Belts: Two set(s) for each belt-driven unit.

PART 2 - PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

A. Refer to drawings for performance requirements.

2.02 BACKWARD-INCLINED CENTRIFUGAL FANS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Acme Engineering & Manufacturing Corp.
   2. Greenheck Corporation
   3. Loren Cook Company.
   4. New York Blower Company (The).

B. Description:
   1. Factory-fabricated, -assembled, -tested, and -finished, belt-driven centrifugal fans consisting of housing, wheel, fan shaft, bearings, motor, drive assembly, and support structure.
   2. Deliver fans as factory-assembled units, to the extent allowable by shipping limitations.
   3. Factory-installed and -wired disconnect switch.

C. Housings:
   1. Formed panels to make curved-scroll housings with shaped cutoff.
   2. Panel Bracing: Steel angle or channel-iron member supports for mounting and supporting fan scroll, wheel, motor, and accessories.
   3. Horizontally split, bolted-flange housing.
   4. Spun inlet cone with flange.
   5. Outlet flange.

D. Backward-Inclined Wheels:
   1. Single-width-single-inlet and double-width-double-inlet construction with curved inlet flange, backplate, backward-inclined blades, and fastened to shaft with set screws.
   2. Welded or riveted to flange and backplate; cast-iron or cast-steel hub riveted to backplate.

E. Shafts:
   1. Statically and dynamically balanced and selected for continuous operation at maximum rated fan speed and motor horsepower, with adjustable alignment and belt tensioning.
   2. Turned, ground, and polished hot-rolled steel with keyway. Ship with protective coating of lubricating oil.
   3. Designed to operate at no more than 70 percent of first critical speed at top of fan's speed range.

F. Grease-Lubricated Shaft Bearings:
   1. Self-aligning, pillow-block-type, ball or roller bearings with adapter mount and two-piece, cast-iron housing.

G. Belt Drives:
   1. Factory mounted, with adjustable alignment and belt tensioning.
   2. Service Factor Based on Fan Motor Size: 1.5.
   3. Fan Pulleys: Cast iron or cast steel with split, tapered bushing; dynamically balanced at factory.
   4. Motor Pulleys: Adjustable pitch for use with motors through 5 hp; fixed pitch for use with larger motors. Select pulley so pitch adjustment is at the middle of adjustment range at fan design conditions.
   5. Belts: Oil resistant, nonsparking, and nonstatic; matched sets for multiple belt drives.
   6. Belt Guards: Fabricate to comply with OSHA and SMACNA requirements of diamond-mesh

wire screen welded to steel angle frame or equivalent, prime coated. Secure to fan or fan supports without short circuiting vibration isolation. Include provisions for adjustment of belt tension, lubrication, and use of tachometer with guard in place.

7. Motor Mount: Adjustable for belt tensioning.

H. Accessories:
1. Access for Inspection, Cleaning, and Maintenance: Comply with requirements in ASHRAE 62.1.
2. Scroll Drain Connection: NPS 1-inch steel pipe coupling welded to low point of fan scroll.
3. Companion Flanges: Rolled flanges for duct connections of same material as housing.
4. Inlet Screens: Grid screen of same material as housing.
5. Shaft Cooler: Metal disk between bearings and fan wheel, designed to dissipate heat from shaft.
6. Spark-Resistant Construction: AMCA 99.
7. Shaft Seals: Airtight seals installed around shaft on drive side of single-width fans.
8. Weather Cover: Enameled-steel sheet with ventilation slots, bolted to housing.

2.03 FORWARD-CURVED CENTRIFUGAL FANS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Acme Engineering & Manufacturing Corp.
2. Greenheck Corporation
3. Loren Cook Company.
4. New York Blower Company (The).

B. Description:
1. Factory fabricated, assembled, tested, and finished, belt-driven centrifugal fans consisting of housing, wheel, fan shaft, bearings, motor, drive assembly, and support structure.
2. Deliver fans as factory assembled units, to the extent allowable by shipping limitations.
3. Factory installed and wired disconnect switch.

C. Housings:
1. Formed panels to make curved-scroll housings with shaped cutoff.
2. Panel Bracing: Steel angle or channel iron member supports for mounting and supporting fan scroll, wheel, motor, and accessories.
3. Horizontally split, bolted-flange housing.
4. Spun inlet cone with flange.
5. Outlet flange.

D. Forward-Curved Wheels:
1. Black-enameled or galvanized-steel construction with inlet flange, backplate, shallow blades with inlet and tip curved forward in direction of airflow.
2. Mechanically secured to flange and backplate; cast-steel hub swaged to backplate and fastened to shaft with set screws.

E. Shafts:
1. Statically and dynamically balanced and selected for continuous operation at maximum rated fan speed and motor horsepower, with adjustable alignment and belt tensioning.
2. Turned, ground, and polished hot-rolled steel with keyway. Ship with protective coating of lubricating oil.
3. Designed to operate at no more than 70 percent of first critical speed at top of fan's speed range.

F. Grease-Lubricated Shaft Bearings:
1. Self-aligning, pillow-block-type, ball or roller bearings with adapter mount and two-piece, cast-iron housing.

G. Belt Drives:
   1. Factory mounted, with adjustable alignment and belt tensioning.
   2. Service Factor Based on Fan Motor Size: 1.5.
   3. Fan Pulleys: Cast iron or cast steel with split, tapered bushing; dynamically balanced at factory.
   4. Motor Pulleys: Adjustable pitch for use with motors through 5 hp; fixed pitch for use with larger motors. Select pulley so pitch adjustment is at the middle of adjustment range at fan design conditions.
   5. Belts: Oil resistant, nonsparking, and nonstatic; matched sets for multiple belt drives.
   6. Belt Guards: Fabricate to comply with OSHA and SMACNA requirements of diamond-mesh wire screen welded to steel angle frame or equivalent, prime coated. Secure to fan or fan supports without short circuiting vibration isolation. Include provisions for adjustment of belt tension, lubrication, and use of tachometer with guard in place.
   7. Motor Mount: Adjustable for belt tensioning.

H. Accessories:
   1. Access for Inspection, Cleaning, and Maintenance: Comply with requirements in ASHRAE 62.1.
   2. Scroll Drain Connection: NPS 1-inch steel pipe coupling welded to low point of fan scroll.
   3. Companion Flanges: Rolled flanges for duct connections of same material as housing.
   4. Inlet Screens: Grid screen of same material as housing.
   5. Shaft Cooler: Metal disk between bearings and fan wheel, designed to dissipate heat from shaft.
   6. Spark-Resistant Construction: AMCA 99.
   7. Shaft Seals: Airtight seals installed around shaft on drive side of single-width fans.

2.04 SOURCE QUALITY CONTROL

A. Sound-Power Level Ratings: Comply with AMCA 301, "Methods for Calculating Fan Sound Ratings from Laboratory Test Data." Factory test fans according to AMCA 300, "Reverberant Room Method for Sound Testing of Fans." Label fans with the AMCA-Certified Ratings Seal.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Install centrifugal fans level and plumb.
B. Disassemble and reassemble units, as required for moving to the final location, according to manufacturer's written instructions.
C. Lift and support units with manufacturer's designated lifting or supporting points.
D. Equipment Mounting:
   1. Install centrifugal fans on cast-in-place concrete equipment base(s). Comply with requirements for equipment bases and foundations specified in the architectural specifications.
   2. Comply with requirements for vibration isolation devices specified in Section 230548.13 "Vibration Controls for HVAC."
E. Curb Support: Install roof curb on roof structure, level and secure, according to "The NRCA Roofing

and Waterproofing Manual," Low-Slope Membrane Roofing Construction Details Section, Illustration "Raised Curb Detail for Rooftop Air Handling Units and Ducts." Install and secure centrifugal fans on curbs, and coordinate roof penetrations and flashing with roof construction. [Secure units to curb support with anchor bolts.]

F. Unit Support: Install centrifugal fans level on structural curbs. Coordinate wall penetrations and flashing with wall construction. Secure units to structural support with anchor bolts.

G. Isolation Curb Support: Install centrifugal fans on isolation curbs, and install flexible duct connectors and vibration isolation.
   1. Comply with requirements in Section 233300 "Air Duct Accessories" for flexible duct connectors.
   2. Comply with requirements in Section 230548.13 "Vibration Controls for HVAC" for vibration isolation devices.

H. Install units with clearances for service and maintenance.

I. Label fans according to requirements specified in Section 230553 "Identification for HVAC Piping and Equipment."

3.02 CONNECTIONS

A. Drawings indicate general arrangement of ducts and duct accessories. Make final duct connections with flexible connectors. Flexible connectors are specified in Section 233300 "Air Duct Accessories."

B. Install ducts adjacent to fans to allow service and maintenance.

C. Install piping from scroll drain connection, with trap with seal equal to 1.5 times specified static pressure, to nearest floor drain with pipe sizes matching the drain connection.

3.03 FIELD QUALITY CONTROL

A. Perform the following tests and inspections with the assistance of a factory-authorized service representative:
   1. Verify that shipping, blocking, and bracing are removed.
   2. Verify that unit is secure on mountings and supporting devices and that connections to ducts and electrical components are complete. Verify that proper thermal-overload protection is installed in motors, starters, and disconnect switches.
   3. Verify that cleaning and adjusting are complete.
   4. Disconnect fan drive from motor, verify proper motor rotation direction, and verify fan wheel free rotation and smooth bearing operation. Reconnect fan drive system, align and adjust belts, and install belt guards.
   5. Adjust belt tension.
   6. Adjust damper linkages for proper damper operation.
   7. Verify lubrication for bearings and other moving parts.
   8. Verify that manual and automatic volume control and fire and smoke dampers in connected ductwork systems are in fully open position.
   9. See Section 230593 "Testing, Adjusting, and Balancing For HVAC" for testing, adjusting, and balancing procedures.
   10. Remove and replace malfunctioning units and retest as specified above.
   11. Kitchen exhaust fan shall be installed within the requirements of NFPA.
   12. Any steel shall be primed with Rustoleum and coated with 2 coats of enamel paint.

B. Test and adjust controls and safeties. Controls and equipment will be considered defective if they do not pass tests and inspections.

C. Prepare test and inspection reports.

END OF SECTION

SECTION 23 34 23 - HVAC POWER VENTILATORS

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:

1. Centrifugal roof ventilators.
2. Ceiling-mounted ventilators.
3. In-line centrifugal fans.

1.02 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.
B. Shop Drawings: 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.
   3. Vibration Isolation Base Details: Detail fabrication including anchorages and attachments to structure and to supported equipment. Include adjustable motor bases, rails, and frames for equipment mounting.
   4. Design Calculations: Calculate requirements for selecting vibration isolators [and seismic restraints] and for designing vibration isolation bases.

1.03 CLOSEOUT SUBMITTALS

A. Operation and maintenance data.

1.04 QUALITY ASSURANCE

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. AMCA Compliance: Fans shall have AMCA-Certified performance ratings and shall bear the AMCA-Certified Ratings Seal.

PART 2 - PRODUCTS

2.01 CENTRIFUGAL ROOF VENTILATORS

A. Manufacturers: Greenheck Fan Corporation, Loren Cook, PennBarry Housing: Removable, spun-aluminum, dome top and outlet baffle; square, one-piece, aluminum base with venturi inlet cone.
   1. Upblast Units (Where indicated on drawings): Provide spun-aluminum discharge baffle to direct discharge air upward, with rain and snow drains.

2. Hinged Subbase: Galvanized-steel hinged arrangement permitting service and maintenance.

B. Fan Wheels: Aluminum hub and wheel with backward-inclined blades.

C. Belt Drives:
1. Resiliently mounted to housing.
2. Fan Shaft: Turned, ground, and polished steel; keyed to wheel hub.
3. Shaft Bearings: Permanently lubricated, permanently sealed, self-aligning ball bearings.
4. Pulleys: Cast-iron, adjustable-pitch motor pulley.
5. Fan and motor isolated from exhaust airstream.

D. Accessories:
1. Variable-Speed Controller: Solid-state control to reduce speed from 100 to less than 50 percent.
2. Provide variable frequency drive (VFD). The motor shall be rated for use with a VFD.
3. Disconnect Switch: Nonfusible type, with thermal-overload protection mounted outside fan housing, factory wired through an internal aluminum conduit.
4. Bird Screens: Removable, 1/2-inch mesh, aluminum, or brass wire.
5. Dampers: Counterbalanced, parallel-blade, backdraft dampers mounted in curb base; factory set to close when fan stops.
6. Motorized Dampers: Parallel-blade dampers mounted in curb base with electric actuator; wired to close when fan stops. Dampers shall be insulated low leakage.

E. Roof Curbs: Galvanized steel; mitered and welded corners; 1-1/2-inch- thick, rigid, fiberglass insulation adhered to inside walls; and 1-1/2-inch wood nailer. Size as required to suit roof opening and fan base.
1. Overall Height: 8 inches.
2. Sound Curb: Curb with sound-absorbing insulation.
3. Pitch Mounting: Manufacture curb for roof slope.
4. Metal Liner: Galvanized steel.
5. Burglar Bars: 1/2-inch thick steel bars welded in place to form 6-inch squares.
6. Mounting Pedestal: Galvanized steel with removable access panel.
7. Vented Curb: Unlined with louvered vents in vertical sides.

2.02 CEILING-MOUNTED VENTILATORS

A. Commercial Application Manufacturers: Greenheck Fan Corporation, Loren Cook, PennBarry.

B. Residential Application (Apartments, Houses, Condominiums) Manufacturers: Panasonic, Nutone, and Broan.

C. Housing: Steel, lined with acoustical insulation.

D. Fan Wheel: Centrifugal wheels directly mounted on motor shaft. Fan shrouds, motor, and fan wheel shall be removable for service.

E. Grille: Plastic, louvered grille with flange on intake and thumbscrew attachment to fan housing.

F. Electrical Requirements: Junction box for electrical connection on housing and receptacle for motor plug-in.

G. Accessories:
1. Variable-Speed Controller: Solid-state control to reduce speed from 100 to less than 50 percent.
2. Manual Starter Switch: Single-pole rocker switch assembly with cover and pilot light.
3. Time-Delay Switch: Assembly with single-pole rocker switch, timer, and cover plate.
4. Motion Sensor: Motion detector with adjustable shutoff timer.
5. Ceiling Radiation Damper: Fire-rated assembly with ceramic blanket, stainless-steel springs, and fusible link.
6. Filter: Washable aluminum to fit between fan and grille.

7. Isolation: Rubber-in-shear vibration isolators.
8. Manufacturer's standard roof jack or wall cap, and transition fittings.
9. Energy Star Fans
    a. Multi-speed module to allow the fan to run continuously on low speed and ramp up to a higher speed.
    b. Condensate Sensor / humidity sensor switch
    c. Motion Sensor Control

2.03 IN-LINE CENTRIFUGAL FANS

A. Manufacturers: Greenheck Fan Corporation, Loren Cook, PennBarry.
B. Housing: Split, spun aluminum with aluminum straightening vanes, inlet and outlet flanges, and support bracket adaptable to floor, side wall, or ceiling mounting.
C. Direct-Drive Units: Motor mounted in airstream, factory wired to disconnect switch located on outside of fan housing; with wheel and inlet cone.
D. Belt-Driven Units: Motor mounted on adjustable base, with adjustable sheaves, enclosure around belts within fan housing, and lubricating tubes from fan bearings extended to outside of fan housing.
E. Fan Wheels: Aluminum, airfoil blades welded to aluminum hub.
F. Accessories:
    1. Variable-Speed Controller: Solid-state control to reduce speed from 100 to less than 50 percent.
    2. Provide variable frequency drive (VFD). The motor shall be rated for use with a VFD.
    3. Volume-Control Damper: Manually operated with quadrant lock, located in fan outlet.
    4. Companion Flanges: For inlet and outlet duct connections.
    5. Fan Guards: 1/2- by 1-inch mesh of galvanized steel in removable frame. Provide guard for inlet or outlet for units not connected to ductwork.
    6. Motor and Drive Cover (Belt Guard): Epoxy-coated steel.

2.04 PROPELLER FANS

A. Manufacturers: Greenheck Fan Corporation, Loren Cook, PennBarry
B. Housing: Galvanized-steel sheet with flanged edges and integral orifice ring with baked-enamel finish coat applied after assembly.
C. Steel Fan Wheels: Formed-steel blades riveted to heavy-gage steel spider bolted to cast-iron hub.
D. Fan Wheel: Replaceable, extruded-aluminum, airfoil blades fastened to cast-aluminum hub; factory set pitch angle of blades.
E. Fan Drive: Motor mounted in airstream; factory wired to disconnect switch located on outside of fan housing.
F. Fan Drive:
    1. Resiliently mounted to housing.
    2. Statically and dynamically balanced.
    3. Selected for continuous operation at maximum rated fan speed and motor horsepower, with final alignment and belt adjustment made after installation.
    4. Extend grease fitting to accessible location outside of unit.
    5. Service Factor Based on Fan Motor Size: 1.4.
    6. Fan Shaft: Turned, ground, and polished steel; keyed to wheel hub.
    7. Shaft Bearings: Permanently lubricated, permanently sealed, self-aligning ball bearings.
        a. Ball-Bearing Rating Life: ABMA 9, L10 of 100,000 hours.
    8. Pulleys: Cast iron with split, tapered bushing; dynamically balanced at factory.
    9. Motor Pulleys: Adjustable pitch for use with motors through 5 hp; fixed pitch for use with

larger motors. Select pulley so pitch adjustment is at the middle of adjustment range at fan design conditions.

10. Belts: Oil resistant, nonsparking, and nonstatic; matched sets for multiple belt drives.
11. Belt Guards: Fabricate of steel for motors mounted on outside of fan cabinet.

G. Accessories:
1. Gravity Shutters: Aluminum blades in aluminum frame; interlocked blades with nylon bearings.
2. Motor-Side Back Guard: Galvanized steel, complying with OSHA specifications, removable for maintenance.
3. Wall Sleeve: Galvanized steel to match fan and accessory size.
4. Weathershield Hood: Galvanized steel to match fan and accessory size.
5. Weathershield Front Guard: Galvanized steel with expanded metal screen.
6. Variable-Speed Controller: Solid-state control to reduce speed from 100 to less than 50 percent.
7. Provide variable frequency drive (VFD). The motor shall be rated for use with a VFD.
8. Disconnect Switch: Nonfusible type, with thermal-overload protection mounted inside fan housing, factory wired through an internal aluminum conduit.

2.05 MOTORS

A. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Section 230513 "Common Motor Requirements for HVAC Equipment."
1. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.

B. Enclosure Type: Totally enclosed, fan cooled.

2.06 SOURCE QUALITY CONTROL

A. Certify sound-power level ratings according to AMCA 301, "Methods for Calculating Fan Sound Ratings from Laboratory Test Data." Factory test fans according to AMCA 300, "Reverberant Room Method for Sound Testing of Fans." Label fans with the AMCA-Certified Ratings Seal.

B. Certify fan performance ratings, including flow rate, pressure, power, air density, speed of rotation, and efficiency by factory tests according to AMCA 210, "Laboratory Methods of Testing Fans for Aerodynamic Performance Rating." Label fans with the AMCA-Certified Ratings Seal.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Equipment Mounting:
1. Install power ventilators on cast-in-place concrete equipment base(s).
2. Comply with requirements for vibration isolation devices specified in Section 230548.13 "Vibration Controls for HVAC."

B. Secure roof-mounted fans to roof curbs with cadmium-plated hardware. Refer to architectural specification sections for installation of roof curbs.

C. Ceiling Units: Suspend units from structure; use steel wire or metal straps.

D. Support suspended units from structure using threaded steel rods and spring hangers having a static deflection of 1 inch. Vibration-control devices are specified in Section 230548.13 "Vibration Controls for HVAC."

E. Install units with clearances for service and maintenance.
F. Label units according to requirements specified in Section 230553 "Identification for HVAC Piping and Equipment."
G. The ceiling exhaust fan shall be supported from construction above, not ceiling tiles or ceiling runners or grids. Connect to ductwork and extend ductwork to the perimeter of the building.
H. Each fan shall be connected to ductwork with a flexible connection.
I. Kitchen exhaust fan shall be installed within the requirements of NFPA.
J. Any steel shall be primed with Rustoleum and coated with 2 coats of enamel paint.

3.02 CONNECTIONS

A. Drawings indicate general arrangement of ducts and duct accessories. Make final duct connections with flexible connectors. Flexible connectors are specified in Section 233300 "Air Duct Accessories."
B. Install ducts adjacent to power ventilators to allow service and maintenance.
C. Ground equipment according to in electrical sections.
D. Connect wiring according to in electrical sections.

3.03 FIELD QUALITY CONTROL

A. Perform tests and inspections.
    1. Manufacturer's Field Service: On systems greater than 5,000 CFM, engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
B. Tests and Inspections:
    1. Verify that shipping, blocking, and bracing are removed.
    2. Verify that unit is secure on mountings and supporting devices and that connections to ducts and electrical components are complete. Verify that proper thermal-overload protection is installed in motors, starters, and disconnect switches.
    3. Verify that cleaning and adjusting are complete.
    4. Disconnect fan drive from motor, verify proper motor rotation direction, and verify fan wheel free rotation and smooth bearing operation. Reconnect fan drive system, align and adjust belts, and install belt guards.
    5. Adjust belt tension.
    6. Adjust damper linkages for proper damper operation.
    7. Verify lubrication for bearings and other moving parts.
    8. Verify that manual and automatic volume control and fire and smoke dampers in connected ductwork systems are in fully open position.
    9. Disable automatic temperature-control operators, energize motor and adjust fan to indicated rpm, and measure and record motor voltage and amperage.
    10. Shut unit down and reconnect automatic temperature-control operators.
    11. Remove and replace malfunctioning units and retest as specified above.
C. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
D. Prepare test and inspection reports.

3.04 ADJUSTING

A. Adjust damper linkages for proper damper operation.
B. Adjust belt tension.
C. Comply with requirements in Section 230593 "Testing, Adjusting, and Balancing for HVAC" for

testing, adjusting, and balancing procedures.

D. Replace fan and motor pulleys as required to achieve design airflow.

E. Lubricate bearings.

END OF SECTION

SECTION 23 37 13.13 - AIR DIFFUSERS

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:
   1. Rectangular and square ceiling diffusers.
   2. Louver face diffusers.
   3. Linear slot diffusers.
   4. Louvers
   5. Air Filters
   6. Sound Traps
   7. Ceiling Opening Protection
   8. Drum Louvers

B. Related Requirements:
   1. Section 233300 "Air Duct Accessories" for fire and smoke dampers and volume-control dampers not integral to diffusers.
   2. Section 233713.23 "Air Registers and Grilles" for adjustable-bar register and grilles, fixed-face registers and grilles, and linear bar grilles.
   3. Section 233713.43 "Security Registers and Grilles" for security registers and security grilles.
   4. Section 233716 "Fabric Air-Diffusion Devices" for continuous tubular diffusers.
   5. The SMACNA Low Velocity Duct Manual, ASHRAE Handbooks, International Mechanical Code, and NFPA Pamphlet 90A shall apply to this work.
   6. Refer to Section 23 31 13 Ductwork.

1.02 WORK INCLUDED

A. Provide labor, material, equipment, and supervision necessary to install a complete air handling system with all supply and return distribution devices as indicated on the drawings and specified herein.

B. Contractor is to furnish and install a volume damper in all supply, return, exhaust, and outside air branch ductwork. If these are omitted from the drawings, the contractor is to make an allowance to install one.

1.03 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Submit manufacturer’s literature and performance data of equipment and devices for review.

C. Samples; Furnish at request of A/E.

1.04 QUALITY ASSURANCE

A. Verify that all equipment is installed in accordance with manufacturer’s warranty requirements.

B. Provide adequate supervision of labor force to see that installations are correct.

PART 2 - PRODUCTS

2.01 RECTANGULAR AND SQUARE CEILING DIFFUSERS

A. Furnish and install terminal air diffusers of the size and capacity indicated on the drawings.
B. Room terminal air velocity shall not exceed 50 fpm. NC level shall not exceed 40. Air static pressure drop shall not exceed 0.10" wg.
C. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Anemostat
   2. Carnes Company.
   3. Hart & Cooley Inc.
   4. Krueger.
   5. METALAIRE, Inc.
   6. Nailor Industries Inc.
   7. Price Industries.
   8. Titus.
   9. Tuttle & Bailey.
D. Devices shall be specifically designed for variable-air-volume flows.
E. Material: Steel. Shall be aluminum if located in a damp area similar to a commercial kitchen, locker room, residential bathrooms.
F. Finish: Baked enamel, white
G. Face Size: 12 by 12 inches for up to 150 cfm, 24 by 24 inches for all other size.
H. Face Style: Plaque.
I. Mounting: Each diffuser shall have a mounting flange specifically selected for the particular type of ceiling finish. Contractor to coordinate with architectural ceiling details.
J. Pattern: Fixed
K. Dampers: Radial opposed blade
L. Accessories:
   1. Equalizing grid.
   2. Plaster ring.
   3. Wire guard.
   4. Sectorizing baffles.
M. Performance shall be tested in accordance with ASHRAE 70-2006 (RA 2011).

2.02 LOUVER FACE DIFFUSERS

A. Furnish and install terminal air diffusers of the size and capacity indicated on the drawings.
B. Room terminal air velocity shall not exceed 50 fpm. NC level shall not exceed 40. Air static pressure drop shall not exceed 0.10" wg
C. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Anemostat
   2. Carnes Company.
   3. METALAIRE, Inc.
   4. Nailor Industries Inc.
   5. Price Industries.
   6. Titus.
   7. Tuttle & Bailey.
D. Devices shall be specifically designed for variable-air-volume flows.
E. Material: Steel. Shall be aluminum if located in a damp area similar to a commercial kitchen, locker

room, residential bathrooms.
F. Finish: Baked enamel, white
G. Face Size: 24” x 24”
H. Mounting: Each diffuser shall have a mounting flange specifically selected for the particular type of ceiling finish. Contractor to coordinate with architectural ceiling details.
I. Pattern: Fixed
J. Pattern: One-way, Two-way, Two-way corner, Three-way or Four-way core style.
K. Dampers: Radial opposed blade
L. Accessories:
1. Square to round neck adaptor.
2. Adjustable pattern vanes.
3. Throw reducing vanes.
4. Equalizing grid.
5. Plaster ring.
6. Sectorizing baffles.
M. Performance shall be tested in accordance with ASHRAE 70-2006 (RA 2011).

2.03 LINEAR SLOT DIFFUSERS

A. Furnish and install linear type air diffusers of the lengths and capacities indicated on the drawings.
B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Anemostat Products; a Mestek company.
2. Carnes Company.
3. Hart & Cooley Inc.
4. Krueger.
5. METALAIRE, Inc.
6. Nailor Industries Inc.
7. Price Industries.
8. Titus.
9. Tuttle & Bailey.
C. Devices shall be specifically designed for variable-air-volume flows.
D. Material - Shell: Steel. Shall be aluminum if located in a damp area similar to a commercial kitchen, locker room, residential bathrooms.
E. Material - Pattern Controller and Tees: Aluminum.
F. Finish - Face and Shell: Baked enamel, black.
G. Finish - Pattern Controller: Baked enamel, black.
H. Finish - Tees: Baked enamel, white.
I. Slot Width: 1 inch
J. Number of Slots: One, Two, Three or Four
K. Length: As noted in the Air Device Schedule
L. Accessories: Plaster frame for drywall or plaster ceilings

2.04 LOUVERS

A. Louvers shall be extruded aluminum with 12 gauge blades and frames 2" deep up to 12" in height. 4" deep from 12" to 36" in height, and 6" deep above 36" in height. Louvers shall be storm proof design and shall not pull rain through the blades at the capacity required by the system.
B. Furnish a bird screen on each louver mounted at the inside face.
C. Frames shall be miter welded with reinforced corners.
D. Louver finish shall be determined by the architect. Contractor to coordinate.

E. Manufacturer: American Warming and Ventilating, Ruskin, Greenheck and Pottorff, United Enertech.

2.05 AIR FILTERS

A. Refer to drawings and schedules for certain air filtration requirements for various systems.
B. These filters are to be installed in air handling equipment if the equipment is capable of receiving them. If not, the contractor shall install the filters in a filter frame with gasketed doors on the entering side of the unit. The filter frame in either case shall provide an airtight fit with gaskets.
C. Furnish and install a red oil manometer for each filter of efficiency of 30 percent or more and with a range of 0 to 30 inches water gage. Gauge to be Dwyer Instruments, Inc.
D. The filter shall meet a minimum of MERV (xx) @ 2000 cfm (500 fpm) per ASHRAE Standard 52.2-2007 and shall be required to meet the same MERV-A value when tested per “Appendix j” of the aforementioned Standard. A filter with a MERV -A value lower than the MERV rating is not acceptable.
E. Manufacturers: CAMFIL/FARR Co., ECO Air Filters, Flanders, American Air Filter.

2.06 SOUND TRAPS

A. Furnish and install prefabricated sound traps of the size and capacity indicated.
B. Outer casing of 22 gauge galvanized steel, lock formed seams, 26 gauge galvanized steel perforated liners, inorganic mineral, or fiberglass fill.
C. Manufacturer: I.A.C., SEMCO, BRD Noise & Vibration Control, Inc., Vibro Acoustics or as indicated on drawings.
D. Contractor to provide three duct diameters on the inlet side of the sound traps.

2.07 CEILING OPENING PROTECTION

A. Furnish and install round, square, or rectangular ceiling radiant dampers for all supply, return, exhaust registers, grilles, and diffusers where indicated on the drawings. These grilles, registers, and diffusers are to be white painted steel.
B. Dampers shall be double blade "butterfly" type with 21 ga. galvanized steel blades in a 14 ga. galvanized steel combination pivot clamp/blade thrust bearing. Frame shall be minimum 21 ga.-maximum 16 ga. steel, one piece miter cut tabbed and locked frame with U.L. Label.
C. Furnish and install a ceramic insulating blanket for lay-in diffusers.
D. Manufacturers: Prefco, Phillips-Aire, Nailor-Hart
E. Field fabricated or shop fabricated systems are not acceptable.

2.08 DRUM LOUVERS

A. Furnish and install the drum louvers of the size and capacity indicated on the drawings.
B. Drum louvers shall be extruded aluminum.
C. Drum louvers shall have opposed blade damper, adjustable louver vanes, 60° angular adjustment control (30° up and 30° down).
D. Custom finish is selected by the architect.
E. Coordinate ductwork opening size with drum louver size.
F. Manufacturers: Krueger “DPL” Series or prior approved equal.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Install diffusers level and plumb.
B. Supports: Galvanized steel per SMACNA.
C. Ceiling-Mounted Outlets and Inlets: Drawings indicate general arrangement of ducts, fittings, and accessories. Air outlet and inlet locations have been indicated to achieve design requirements for air volume, noise criteria, airflow pattern, throw, and pressure drop. Make final locations where indicated, as much as practical. For units installed in lay-in ceiling panels, locate units in the center of panel. Where architectural features or other items conflict with installation, notify Architect for a determination of final location.
D. Install diffusers with airtight connections to ducts and to allow service and maintenance of dampers, air extractors, and fire dampers.

3.02 ADJUSTING

A. After installation, adjust diffusers to air patterns indicated, or as directed, before starting air balancing.

3.03 LOUVERS

A. Louvers shall be set plumb in wall openings left by general contractor.
B. Coordinate openings with G. C.
C. Louvers shall be anchored in masonry construction.
D. Frames shall be caulked watertight. Color of caulking shall be acceptable to the architect.
E. Connections to wall louvers shall be sloped down to louver connection to prevent water draining into interior.

3.04 FILTERS

A. All filters shall be clean prior to acceptance by the owner. Renewable media filters shall be replaced with new filters. Cleanable filters shall be removed and cleaned just prior to acceptance.
B. Provide one spare set of replaceable filters for each system to the owner prior to acceptance of the work.

3.05 CEILING OPENING PROTECTION

A. Each supply, return, and exhaust opening in a ceiling shall be protected in accordance with UL Laboratories for the integrity of the fire stopping rating. This will require that each opening be suitably protected throughout the building.
B. Dampers shall bear the U.L. Label and shall be installed in accordance with the U.L. Standards and manufacturer’s instructions.
C. A ceramic blanket shall be attached to diffuser neck and duct using steel duct clamp or 16 ga. Steel wire. Blanket shall be supported from 4 corners using 12 swg wire.

3.06 SPOT DIFFUSER

A. Mount to ductwork in accordance with manufacturer specifications.

END OF SECTION

SECTION 23 37 13.23 - REGISTERS AND GRILLES

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:
   1. Adjustable blade face registers and grilles.
   2. Fixed face registers and grilles.
B. Related Requirements:
   1. Section 233300 "Air Duct Accessories" for fire and smoke dampers and volume-control dampers not integral to registers and grilles.
   2. Section 233713.13 "Air Diffusers" for various types of air diffusers.
   3. The SMACNA Low Velocity Duct Manual, ASHRAE Handbooks, International Mechanical Code, and NFPA Pamphlet 90A shall apply to this work.
   4. Refer to Section 23 31 13 Ductwork.

1.02 WORK INCLUDED

A. Provide labor, material, equipment, and supervision necessary to install a complete air handling system with all supply and return distribution devices as indicated on the drawings and specified herein.
B. Contractor is to furnish and install a volume damper in all supply, return, exhaust, and outside air branch ductwork. If these are omitted from the drawings, the contractor is to make an allowance to install one.

1.03 ACTION SUBMITTALS

A. Product Data: For each type of product.
B. Submit manufacturer’s literature and performance data of equipment and devices for review.
C. Samples; Furnish at request of A/E.

1.04 QUALITY ASSURANCE

A. Verify that all equipment is installed in accordance with manufacturer’s warranty requirements.
B. Provide adequate supervision of labor force to see that installations are correct.

PART 2 - PRODUCTS

2.01 REGISTERS

A. Furnish and install terminal air registers of the size and capacities indicated on the drawings.
B. Adjustable Blade Face Register:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Anemostat Products; a Mestek company.
b. Carnes Company.
c. Krueger.
d. METALAIRE, Inc.
e. Nailor Industries Inc.
f. Price Industries.
g. Titus.
h. Tuttle & Bailey.

2. Material: Steel. Shall be aluminum if located in a damp area similar to a commercial kitchen, locker room, residential bathrooms.
3. Finish: Baked enamel, white.
4. Face Blade Arrangement: Horizontal, spaced -1/2 inch centers for return and exhaust and 3/4 inch centers for supply, single set at 45 degrees for return or exhaust and double deflection adjustable for supply. Reinforced corners, mitered.
5. Core Construction: Removable.
6. Rear-Blade Arrangement: Vertical, spaced 1/2 inch centers for return and exhaust and 3/4 inch centers for supply.
7. Frame: 1 inch wide.
8. Mounting Frame: Provide separable frames in drywall, plaster, or masonry construction as noted on the architectural drawings.
9. Mounting: Countersunk screw
10. Damper Type: Adjustable opposed blade

C. Fixed Face Register
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. Anemostat Products; a Mestek company.
b. Carnes Company.
c. Krueger.
d. Nailor Industries Inc.
e. Price Industries.
f. Titus.
g. Tuttle & Bailey.
2. Material: Steel. Shall be aluminum if located in a damp area similar to a commercial kitchen, locker room, residential bathrooms.
3. Finish: Baked enamel, white.
4. Face Blade Arrangement: Horizontal, spaced 1/2 inch centers for return and exhaust and 3/4 inch centers for supply, single set at 45 degrees for return or exhaust and double deflection adjustable for supply. Reinforced corners, mitered.
5. Face Arrangement: Perforated core.
6. Core Construction: Removable.
7. Frame: 1 inch wide.
8. Mounting Frame: Provide separable frames in drywall, plaster, or masonry construction as noted on the architectural drawings.
9. Mounting: Countersunk screw
10. Damper Type: Adjustable opposed blade
11. Accessory: Filter.

D. Furnish and install turning vanes for connections to ducts.
E. Where registers are located low near floor, they shall be heavy duty 14 gauge steel with fixed 45 degree blades on 1/2" centers. In damp areas, they shall be extruded aluminum.
F. Where drawings indicate linear return grilles, they shall be linear extruded aluminum with 1/8" bars

3/4" long on 1/4" centers.

2.02 GRILLES

A. Furnish and install terminal air registers of the size and capacities indicated on the drawings.
B. Adjustable Blade Face Grille:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Anemostat Products; a Mestek company.
      b. Carnes Company.
      c. Krueger.
      d. METALAIRE, Inc.
      e. Nailor Industries Inc.
      f. Price Industries.
      g. Titus.
      h. Tuttle & Bailey.
   2. Material: Steel. Shall be aluminum if located in a damp area similar to a commercial kitchen, locker room, residential bathrooms.
   3. Finish: Baked enamel, white.
   4. Face Blade Arrangement: Horizontal spaced 1/2 inch apart.
   5. Core Construction: Removable.
   6. Rear-Blade Arrangement: Horizontal, spaced 1/2 inch centers for return and exhaust and 3/4 inch centers for supply, single set at 45 degrees for return or exhaust and double deflection adjustable for supply. Reinforced corners, mitered.
   7. Frame: 1 inch.
   8. Mounting Frame: Provide separable frames in drywall, plaster, or masonry construction as noted on the architectural drawings.
   9. Mounting: Countersunk screw.
   10. Accessories:
      a. Filter.
C. Fixed Face Grille
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Anemostat Products; a Mestek company.
      b. Carnes Company.
      c. Krueger.
      d. Nailor Industries Inc.
      e. Price Industries.
      f. Titus.
      g. Tuttle & Bailey.
   2. Material: Steel. Shall be aluminum if located in a damp area similar to a commercial kitchen, locker room, residential bathrooms.
   3. Finish: Baked enamel, white
   4. Face Blade Arrangement: Horizontal, spaced 1/2 inch centers for return and exhaust and 3/4 inch centers for supply, single set at 45 degrees for return or exhaust and double deflection adjustable for supply. Reinforced corners, mitered.
   5. Face Arrangement: Perforated core.
   6. Core Construction: Removable.
   7. Frame: 1 inch
   8. Mounting Frame: Provide separable frames in drywall, plaster, or masonry construction as

noted on the architectural drawings.
9. Mounting: Countersunk screw.
10. Accessory: Filter.

D. Furnish and install turning vanes for connections to ducts.
E. Where registers are located low near floor, they shall be heavy duty 14 gauge steel with fixed 45 degree blades on 1/2" centers. In damp areas, they shall be extruded aluminum.
F. Where drawings indicate linear return grilles, they shall be linear extruded aluminum with 1/8" bars 3/4" long on 1/4" centers.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Install registers and grilles level and plumb.
B. Supports: Galvanized steel per SMACNA.
C. Outlets and Inlets Locations: Drawings indicate general arrangement of ducts, fittings, and accessories. Air outlet and inlet locations have been indicated to achieve design requirements for air volume, noise criteria, airflow pattern, throw, and pressure drop. Make final locations where indicated, as much as practical. For units installed in lay-in ceiling panels, locate units in the center of panel. Where architectural features or other items conflict with installation, notify Architect for a determination of final location.
D. Install registers and grilles with airtight connections to ducts and to allow service and maintenance of dampers, air extractors, and fire dampers.

3.02 ADJUSTING

A. After installation, adjust registers and grilles to air patterns indicated, or as directed, before starting air balancing.

END OF SECTION

SECTION 23 72 14 - PACKAGED HEATING/COOLING ENERGY RECOVERY UNIT

PART 1 - GENERAL

1.01 REFERENCE

A. Refer to section 23 00 00 for requirements which are applicable to this section.
B. All equipment shall be installed in accordance with the requirements of SMACNA, ASHRAE, ARI, and meet their standards of performance.

1.02 WORK INCLUDED

A. Provide labor, material, equipment, and supervision necessary to install and place into operation packaged heating and cooling roof mounted energy recovery systems described herein.

1.03 SUBMITTALS

A. Submit shop drawings of all items, components, and systems described in this section. Submit manufacturer’s data sheets, wiring diagrams, installation instructions.

1.04 QUALITY ASSURANCE

A. Verify that all equipment is installed in accordance with the manufactures warranty requirements.
B. Install systems and equipment in accordance with the manufacturer’s instructions.

PART 2 - PRODUCTS

2.01 GENERAL
A. Provide outside air unit as manufactured by LG or pre-approved equal.
B. Alternate manufacturers must be pre-approved and shall be subject to compliance with all the requirements listed in this specification.
C. Project is based on the specified equipment. Any additional costs associated with using alternate manufacturer's equipment shall be borne by the installing contractor or equipment provider.
D. This section includes units with integral heating/cooling/heating and cooling for outdoor/indoor installation.
E. Integral Energy Recovery device shall be a rotary air-to-air total enthalpy wheel. Integral heat source shall be Indirect Gas-Fired furnace/hot water/electric heat.
F. Integral cooling source shall be chilled water/split system DX with remote condenser/packaged DX/Air-source heat pump.
G. Integral heat source shall be indirect gas-fired furnace, electric heat, hot water heat coil, or air-source heat pump (with secondary indirect gas-fired furnace or electric heat).
H. Airflow arrangement shall be Outdoor Air only/Outdoor Air with Recirculation.
I. Each unit shall be constructed in a horizontal configuration and shall incorporate additional product requirements as listed in this specification.

2.02 UNIT PERFORMANCE

A. Unit cooling capacities shall be in accordance with and tested to ARI standard 210/240-84 & 360-85.
B. Unit nameplate shall carry the ARI compliance sticker.
C. Unit minimum cooling efficiency including all items except the supply air blower motor be:
   65,000 BTU/HR or less . . . . . 10.5 SEER
   66,000 BTU/HR or greater . . . 9.5 EER
D. Unit shall have minimum heating system efficiency of 80%.
E. Units shall be safety certified in accordance with UL standard UL465, UL559 and/or ANSI Standard Z21.47.
F. Unit shall be safety certified by an accredited testing laboratory.
G. Unit nameplate shall carry the sticker of the certification agency.
H. Unit shall be shipped completely assembled by the manufacturer including all standard items and optional items.
I. Unit shall be 100% run tested by the manufacturer with a copy of the run test report shipped with the unit.

2.03 UNIT CONSTRUCTION

A. Unit shall be completely factory assembled, piped, and wired and shipped in one piece including DX section, heating section and energy recovery wheel sections.
B. Unit shall be specifically designed for outdoor application with a fully weatherproof cabinet.
C. Unit design shall be dedicated bottom supply/return air style system for mounting on an insulated ground mount plenum curb.
D. Cabinet shall be constructed entirely of G90 wt. galvanized metal with the exterior constructed of 18 gauge or heavier material.
E. The unit roof shall be cross broken and/or sloped to assure drainage.
F. Access to compressor(s), controls, filters, blower, heating section, and other items needing periodic checking or maintenance shall be through hinged access doors with a quarter turn latch (door fastening screws are not acceptable).
G. Air side service access doors shall be fully gasketed with rain break overhangs.
H. Filter access door will have an internal metal liner to protect the doors insulation.
I. Unit exterior shall be painted with corrosion resistant polyurethane paint over a wash primer and a paint lock type galvanized steel. Paint shall withstand a 2,500 hour salt spray test.
J. The interior air side of the cabinet shall be entirely insulated on all exterior panels with 1" thick, three quarter pound density, neoprene coated, and fiberglass insulation.
K. To guarantee no leakage of conditioned air from the cabinet all of the cabinet under positive pressure, downstream from the supply air blower, shall have a separate internal cabinet contained within, and separate from, the exterior cabinet by an air gap. The internal cabinet shall be guaranteed to hold a static pressure of up to 12 inches water column.
L. All openings through the base pan of the unit shall have upturned flanges of at least 1/2" in height around the opening through the base pan.
M. Unit shall have decals and tags to indicate unit lifting - rigging, service areas and caution areas. Wiring diagrams, installation and maintenance manuals shall be supplied with each unit.
N. Unit shall have an IAQ double sloped mastic coated galvanized steel drain pan.
O. Unit exterior grey or as determined by architect.
P. Casing/Panel
   1. Materials: Formed, 2-inch double wall closed cell foam insulated metal panels and 2” double wall closed cell foam insulated metal door construction, fabricated to permit access to internal components for maintenance.

2. Cabinet Insulation shall comply with NFPA 90A and NFPA 90B and erosion requirements of UL 181.
3. Materials: Rigid urethane foam. Foam board not acceptable.
   a. Thickness: 2-inch (50.8 mm).
   b. Thermal Resistance: R13.
   c. Meets UL95HF-1 flame requirements.
   d. Location and application: Full coverage of entire exterior to include walls, roof of unit, unit base and doors.

2.04 CABINET ASSEMBLY

A. Unit shall be fully assembled at the factory and consists of the following:
1. An insulated metal cabinet
2. Downturn outdoor air intake hood with 2” aluminum mesh filter assembly
3. Exhaust air blower
4. Evaporator coil
5. Condensate drain pan
6. P trap
7. Energy wheel
8. Wheel frost control
9. Energy core
10. Energy core bypass
11. Energy core preheat
12. Chilled water coils
13. Hot water coils
14. Hot gas reheat coil
15. Electric post-heater
16. Indirect gas furnace
17. Packaged DX system
18. Air-Source Heat Pump
19. Phase and burnout protection
20. Motorized dampers
21. Barometric relief damper
22. Motorized recirculating damper
23. Sensors
24. Curb assembly
25. Service receptacle
26. Filter assembly for intake air
27. Supply air blower assembly
28. Exhaust/relief blower assembly
29. Filter assembly for exhaust air
30. Electrical control center.

2.05 BLOWERS

A. Supply Air blower assemblies
1. Blower assembly shall consist of an electric motor and direct-drive fan(s). Assembly shall be mounted on heavy gauge galvanized steel rails and further mounted on 1.125 inch thick neoprene vibration isolators. Blower motor(s) shall be capable of continuous speed modulation and controlled by a VFD.

B. Exhaust Air blower assemblies

1. Blower assembly shall consist of an electric motor, with an ODP enclosure and a direct-drive fan. Assembly shall be mounted on heavy gauge galvanized steel rails and further mounted on 1.125 inch thick neoprene vibration isolators. Blower motor shall be capable of continuous speed modulation and controlled by a VFD.

2.06 EVAPORATOR COIL

A. Evaporator coil shall be AHRI Certified and shall be (silver) soldered or brazed into the compressed refrigerant system. Coil shall be constructed of copper tubing, permanently bonded to aluminum fins and enclosed in a galvanized steel frame.
B. Units with two compressors shall have the evaporator coil of “interlaced” configuration, permitting independent operation of either compressor without conflict with the other compressor.
C. Optional: The evaporator and condenser coils are coated with ElectroFin® coil coating, E-Coat coated coils are tested and passed ASTM B-117 Salt Spray tests exceeding 10,000 hours.

2.07 CONTROL PANEL / CONNECTIONS

A. Rooftop Ventilator units shall have an electrical control center where all high and low voltage connections are made. Control center shall be constructed to permit single-point high voltage power supply connections.
B. RTU shall be equipped with a Unit Disconnect Switch. Electric heater shall have a separate electrical control center and separate high voltage power circuit as shown on the plans.
C. Optional: Electric heater shall have single point power.

2.08 ENERGY WHEEL

A. Unit energy wheel shall handle the full volume of outdoor and exhaust air without an energy wheel bypass damper(s).
B. Bypass dampers are only acceptable during economizer operation and cannot be used during normal operation.
C. Energy wheel shall be of total enthalpy, rotary air-to-air type and shall be an element of a removable energy wheel cassette.
D. The cassette shall consist of a galvanized steel framework (designed to produce laminar air flow through the wheel), an energy wheel as specified and a motor and drive assembly.
E. The cassette shall incorporate a pre-tensioned urethane drive belt or a link style belt with a five year warranty.
F. The wheel media shall be a polymer film matrix in a stainless-steel framework.
G. Wheel shall be comprised of individual segments that are removable for servicing Silica gel desiccant shall be permanently bonded to the polymer film.
H. The energy wheel is to have a five year warranty.
I. Performance criteria are to be as specified in AHRI Standard 1060, complying with the Combined Efficiency data in the submittal.

2.09 INDIRECT GAS FURNACE

A. Shall be ETL Certified as a component of the unit.
B. Shall have an integral combustion gas blower.
C. Shall be ETL Certified for installation downstream of a cooling coil.
D. Shall have fault sensors to provide fault conditions to optional digital controller or building controls.
E. Shall have 4-pass tubular heat exchangers, constructed of type 409 stainless steel. Heat exchanger tubes shall be installed on the vest. Heat exchanger tubes shall be supported and also permit expansion and contraction of the tubes.
F. Heat exchanger shall have a standard 25-year warranty.

G. Furnace control shall be Modulating.
H. Shall be encased in a weather-tight metal housing with intake air vents. Large, metal door shall provide easy access to the enclosed vest plate, control circuitry, gas train, burner assembly, and exhaust blower.
I. Shall have solid state controls permitting stand-alone operation or control by building controllers.

2.10 PACKAGED DX SYSTEM

A. Unit shall have an integral compressor(s) and evaporator coil located within the weather-tight unit housing.
B. Condenser coils and appurtenant condenser fan assemblies shall be factory installed as integral subassemblies of the unit and mounted on the exterior of the unit.
    1. Unit condenser fans shall feature swept owlet blade design resulting in reduced sound levels.
    2. Condenser fan motors shall be three phase, external rotor, type 56 frame, open air over and shaft up.
    3. Each condenser fan motor shall have a vented frame, rated for continuous duty and be equipped with an automatic reset thermal protector.
C. Motors shall be UL Recognized and CSA Certified. The refrigerant compressor(s) shall be inverter driven.
D. Optional: inverter hermetic scroll-type and shall be equipped with:
    1. Liquid line filter drier
    2. Thermostatic (optional: electronic) expansion valves (TXV) (EXV)(s)
    3. Manual reset high pressure and low pressure cutouts
    4. Sensors
    5. Service ports and safety devices.
    6. Compressed refrigerant system shall be fully charged with R-410A refrigerant.
    7. Each compressor shall be factory-equipped with electric crankcase heater to boil off liquid refrigerant from the oil.

2.11 GAS HEATING SECTION

A. Unit shall be equipped with a heating section using natural gas fuel.
B. Gas burner shall modulate to 30% turndown.
C. Unit shall be provided with a gas heating furnace consisting of a 304 stainless steel tubular heat exchanger, an induced draft blower, and an electric pressure switch to lock out the gas valve until the combustion chamber is purged and combustion air flow is established.
D. Unit shall be provided with a gas ignition system consisting of an electronic ignitor to a pilot system, which will be continuous when the heater is operating, but will shut off the pilot when heating is not required.
E. Unit shall have gas supply piping entrances in the unit base for through the curb gas piping and in the outside cabinet wall for across the roof gas piping.
F. Units tubular heat exchanger shall carry a twenty-five (25) year warranty.

2.12 POWER/ELECTRICAL

A. Unit shall be equipped with a single point electrical connection with motor starters, relays, low voltage transformer and terminal block for controls interface.
B. Unit shall be equipped with a factory mounted disconnect switch.

C. Unit shall include a laminated, color coded electrical wiring diagram attached to the door of the unit.
D. Damper actuators shall be wired to the unit's low voltage terminal block.
E. All components are UL listed, approved, or classified.

2.13 FILTERS

A. Units shall have supply final air filter shall be of 2 inch MERV 8.
   1. Hood filter shall be of 1 inch aluminum type.
   2. 4 inch MERV 13 with a 2 inch MERV 8 pre-filter,
   3. Energy recovery section shall have outdoor air and exhaust air filters of 2 inch MERV 8.
B. Additional Materials
   1. Furnish Extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
   2. Filters: Sets of MERV 8 and MERV 13 disposable filters for each unit. When MERV 13 filters are specified, they are used in tandem with MERV 8 pre-filters for Supply Air only.

2.14 CONTROLS

A. Unit shall be equipped with a digital, programmable make-up air controller. The controls shall modulate discharge air with via duct averaging and shall have the capability to have space reset. Units may include a field mounted duct averaging discharge air sensor, a space sensor, and a space potentiometer.
B. Controller shall be configured for remote start/stop and remote discharge or supply air temperature reset by BAS system.
C. Controls shall include a remote (field mounted) programming panel. Panel shall be able to program unit controller.
D. Controls shall be BACNet resident compliant.

2.15 ROOF CURBS

A. Curb shall be constructed of 14 gauge galvanized steel with a wood nailer strip. Curbs are to be fully gasketed between the curb top and unit bottom with the curb providing full perimeter support, cross structure support and air seal for the unit.

2.16 MANUFACTURER

A. LG or prior approved equal.

PART 3 - EXECUTION

3.01 ROOF MOUNTED ENERGY RECOVERY UNITS

A. Coordinate location on roof with the general contractor. Layout and arrange for roof penetrations for ductwork.
B. Furnish and install equipment roof mounting curbs and duct roof curbs. Curbs shall be flashed by the roofing contractor and counter flashed by the mechanical contractor.

C. Coordinate the electrical requirements of the unit with the electrical contractor prior to ordering or installing the equipment.
D. Furnish and install all controls and control wiring. Wiring shall be in accordance with the NEC. Control wiring above the roof shall be in galvanized steel conduit with watertight fittings.
E. Installations shall be in accordance with the instructions of the manufacturer and meet all requirements.
F. Protect and be responsible for equipment until accepted in place by the owner.
G. Units shall be arranged for either horizontal discharge or vertical down discharge through the roof curb as indicated on the drawings. Horizontal discharge units shall be mounted on spring vibration isolating curbs with a minimum of 1 inch deflection.
H. Any equipment mars, blemishes, scratches, abrasions or other surface imperfections shall be sanded, primed, and refinished to match adjacent surfaces.
I. No equipment will be accepted by the owner which has rust, or corrosion in progress.
J. Equipment shall not be used for temporary heat unless separately negotiated with the owner.
K. All filters shall be new at time of acceptance by the owner.
L. All bare ferrous metal shall be painted prior to acceptance.
M. Equipment shall be in perfect working order prior to acceptance.

END OF SECTION

SECTION 23 74 16.11 - PACKAGED, SMALL-CAPACITY, GAS FIRED ROOFTOP UNITS (3-10 TONS)

PART 1 - GENERAL

1.01 SUMMARY

A. Section includes packaged, small-capacity, rooftop air-conditioning units (RTUs) with the following components and accessories:
   1. Casings.
   2. Fans.
   3. Motors.
   4. Coils.
   5. Refrigerant circuit components.
   6. Air filtration.
   7. Gas furnaces.
   8. Dampers.
   9. Electrical power connections.
   10. Controls.
   11. Accessories.
   12. Roof curbs.

1.02 ACTION SUBMITTALS

A. Product Data: For each RTU.
B. Sustainable Design Submittals:
   1. Product Data: For air filtration performance.
   2. Product Data: For ventilation equipment, indicating compliance with ASHRAE 62.1, Section 5 - "Systems and Equipment."
   3. Product Data for EA Prerequisite 3, "Fundamental Refrigerant Management": For refrigerants, indicating compliance with refrigerant management practices.
C. Shop Drawings:
   1. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
   2. Include diagrams for power, signal, and control wiring.

1.03 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Plans and other details, drawn to scale and coordinated with each other, using input from installers of the items involved.
B. Field quality-control reports.
C. Sample warranty.

1.04 CLOSEOUT SUBMITTALS

A. Operation and maintenance data.

1.05 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of RTUs that fail in materials or workmanship within specified warranty period.
   1. Warranty Period for Parts: One year from start-up.
   2. Warranty Period for Compressors: Manufacturer's standard, but not less than five years from date of Substantial Completion.
   3. Warranty Period for Gas Furnace Heat Exchangers: Manufacturer's standard, but not less than five years from date of Substantial Completion.
   4. Warranty Period for Solid-State Ignition Modules: Manufacturer's standard, but not less than three years from date of Substantial Completion.
   5. Warranty Period for Control Boards: Manufacturer's standard, but not less than three years from date of Substantial Completion.

PART 2 - PRODUCTS

2.01 DESCRIPTION

A. AHRI Compliance:
   1. Comply with AHRI 210/240 for testing and rating energy efficiencies for RTUs for 3 to 5 ton units.
   2. Comply with AHRI 340/360 for testing and rating energy efficiencies for RTUs for 6 to 10 ton units.
   3. Comply with AHRI 270 for testing and rating sound performance for RTUs.
B. AMCA Compliance:
   1. Comply with AMCA 11 and bear the AMCA-Certified Ratings Seal for air and sound performance according to AMCA 211 and AMCA 311.
   2. Damper leakage tested according to AMCA 500-D.
   3. Operating Limits: Classify according to AMCA 99.
C. ASHRAE Compliance:
   1. Comply with ASHRAE 15 for refrigeration system safety.
   2. Comply with ASHRAE 33 for methods of testing cooling coils.
   3. Comply with applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and Startup."
D. ASHRAE/IES Compliance: Comply with applicable requirements in ASHRAE/IES 90.1, Section 6 - "Heating, Ventilating, and Air-Conditioning."
E. NFPA Compliance: Comply with NFPA 90A or NFPA 90B.
F. UL Compliance: Comply with UL 1995.
G. 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.

2.02 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Daikin Applied.
   2. AAON
   3. LG
   4. Lennox Industries, Inc.; Lennox International.
   5. Trane – Precedent Series.

6. YORK; a Johnson Controls company.

2.03 CAPACITIES AND CHARACTERISTICS

A. Refer to drawings for performance requirements.

2.04 CASINGS

A. General Fabrication Requirements for Casings: Fabricated to allow removal for access to internal parts and components, with joints between sections sealed.
B. Exterior Casing Material: Galvanized steel with factory-painted finish, with pitched roof panels and knockouts with grommet seals for electrical and piping connections and lifting lugs.
C. Corrosion Protection: 1,000 hours' salt spray test according to ASTM B 117.
D. Plastic Condensate Drain Pans: Fabricated using rigid heavy plastic polymer, a minimum of 2 inches deep, and complying with ASHRAE 62.1 for design and construction of drain pans.
E. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.
F. Units shall be convertible airflow design as manufactured.
G. Cabinet construction shall allow for all service / maintenance from one side of the unit.

2.05 FANS

A. Supply-Air Fans: Aluminum or painted-steel wheels, and galvanized- or painted-steel fan scrolls.
   1. Direct-Driven Supply-Air Fans: Motor shall be resiliently mounted in the fan inlet.
   2. Belt-Driven Supply-Air Fans: Motors shall be installed on an adjustable fan base resiliently mounted in the casing.
B. Condenser-Coil Fan: Direct Drive propeller, mounted on shaft of permanently lubricated motors.
C. Relief-Air Fan: Provide on all units with economizers unless otherwise indicated.

2.06 MOTORS

A. Comply with NEMA MG 1, Design B, medium induction motor, unless otherwise indicated.
B. Comply with IEEE 841 for severe-duty motors.
C. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.
D. Duty: Continuous duty at ambient temperature of 104 deg. F and at altitude of 3300 feet above sea level.
E. Capacity and Torque Characteristics: Sufficient to start, accelerate, and operate connected loads at designated speeds, at installed altitude and environment, with indicated operating sequence, and without exceeding nameplate ratings or considering service factor.
F. Efficiency: Energy efficient, as defined in NEMA MG 1.
G. Comply with NEMA designation, temperature rating, service factor, and efficiency requirements.
H. Multispeed Motors: Variable torque.
   1. For motors with 2:1 speed ratio, consequent pole, single winding.
   2. For motors with other than 2:1 speed ratio, separate winding for each speed.
I. Multispeed Motors: Separate winding for each speed.
J. Rotor: Random-wound, squirrel cage.
K. Bearings: Regreasable, shielded, antifriction ball bearings suitable for radial and thrust loading.
L. Temperature Rise: Match insulation rating.
M. Insulation: Class F.

N. Code Letter Designation:
   1. Motors 15 HP and Larger: NEMA starting Code F or Code G.
   2. Motors Smaller Than 15 HP: Manufacturer's standard starting characteristic.
O. Enclosure Material: Cast iron for motor frame sizes 324T and larger; rolled steel for motor frame sizes smaller than 324T.
P. Motors Used with Reduced-Voltage and Multispeed Controllers: Match wiring connection requirements for controller with required motor leads. Provide terminals in motor terminal box, suited to control method.
Q. Motors Used with Variable-Frequency Controllers: Ratings, characteristics, and features coordinated with and approved by controller manufacturer.
   1. Windings: Copper magnet wire with moisture-resistant insulation varnish, designed and tested to resist transient spikes, high frequencies, and short-time rise pulses produced by pulse-width-modulated inverters.
   2. Energy- and Premium-Efficient Motors: Class B temperature rise; Class F insulation.
   3. Inverter-Duty Motors: Class F temperature rise; Class H insulation.
   4. Thermal Protection: Comply with NEMA MG 1 requirements for thermally protected motors.
   5. Service Factor: 1.15.
   6. Efficiency: Premium efficient.

2.07 COILS

A. Supply-Air Refrigerant Coil:
   1. Aluminum plate fin and seamless copper tube in steel casing with equalizing-type vertical distributor.
   2. Polymer strip shall prevent all copper coils from contacting steel coil frame or condensate pan.
   3. Coil Split: Interlaced.
   4. Coated.
B. Outdoor-Air Refrigerant Coil:
   1. Aluminum plate fin and seamless copper tube in steel casing with equalizing-type vertical distributor.
   2. Polymer strip shall prevent all copper coils from contacting steel coil frame or condensate pan.

2.08 REFRIGERANT CIRCUIT COMPONENTS

A. Compressor: Hermetic, variable-speed scroll, mounted on vibration isolators; with internal overcurrent and high-temperature protection, internal pressure relief, and crankcase heater.
B. Refrigeration Specialties:
   1. Refrigerant: R-410A.
   2. Expansion valve with replaceable thermostatic element.
   3. Refrigerant filter/dryer.
   4. Manual-reset high-pressure safety switch.
   5. Automatic-reset low-pressure safety switch.
   6. Minimum off-time relay.
   7. Automatic-reset compressor motor thermal overload.
   8. Brass service valves installed in compressor suction and liquid lines.
C. Units shall have cooling capabilities down to 0 degree F as standard.
D. Provide Dual Circuit refrigerant circuit(s) factory-supplied completely piped with liquid line filter-drier, suction, and liquid line pressure ports on units greater than 5 tons cooling capacity.

2.09 AIR FILTRATION

A. Minimum arrestance and MERV according to ASHRAE 52.2 2007 and shall be required to meet the same MERV-A value when tested per “Appendix j” of the aforementioned Standard. A filter with a MERV -A value lower than the MERV rating is not acceptable.

2.10 GAS FURNACE

A. Description: Factory assembled, piped, and wired; complying with ANSI Z21.47/CSA 2.3 and NFPA 54.
   1. CSA Approval: Designed and certified by and bearing label of CSA.
B. Burners: Stainless steel.
   1. Fuel: Natural gas.
   2. Ignition: Electronically controlled electric spark or hot-surface igniter with flame sensor.
C. Heat-Exchanger and Drain Pan: Stainless steel.
D. Venting: Gravity vented.
E. Power Vent: Integral, motorized centrifugal fan interlocked with gas valve.
F. Gas Valve Train: Single-body, regulated, redundant, 24-V ac gas valve assembly containing pilot solenoid valve, pilot filter, pressure regulator, pilot shutoff, and manual shutoff.

2.11 DAMPERS

A. Leakage Rate: Comply with ASHRAE/IES 90.1.
B. Damper Motor: Modulating with adjustable minimum position.

2.12 ELECTRICAL POWER CONNECTIONS

A. RTU shall have a single connection of power to unit with unit-mounted disconnect switch accessible from outside unit and control-circuit transformer with built-in overcurrent protection.

2.13 CONTROLS

A. Control equipment and sequence of operation are specified in Section 230933 "Building Automation System”
B. Basic Unit Controls:
   1. Control-voltage transformer.
   2. Wall-mounted thermostat with the following features:
      a. Heat-cool-off switch.
      b. Fan on-auto switch.
      c. Fan-speed switch.
      d. Automatic changeover.
      e. Adjustable deadband.
C. DDC Controller:
   1. Controller shall have volatile-memory backup.
   2. Safety Control Operation:
      a. Smoke Detectors: Stop fan and close outdoor-air damper if smoke is detected. Provide additional contacts for alarm interface to fire-alarm control panel.
      b. Fire-Alarm Control Panel Interface: Provide control interface to the fire alarm system.
   3. Scheduled Operation: Occupied and unoccupied periods on 365-day clock with a minimum

of two programmable periods per day.
4. Refer to the control specification section for the sequence of operation.

D. Interface Requirements for HVAC Instrumentation and Control System:
1. Interface relay for scheduled operation.
2. Interface relay to provide indication of fault at the central workstation and diagnostic code storage.
3. Provide BACnet compatible interface for central HVAC control workstation for the following:
a. Adjusting set points.
b. Monitoring supply fan start, stop, and operation.
c. Inquiring data to include outdoor-air damper position, supply- and room-air temperature and humidity.
d. Monitoring occupied and unoccupied operations.
e. Monitoring constant and variable motor loads.
f. Monitoring variable-frequency drive operation.
g. Monitoring cooling load.
h. Monitoring economizer cycles.
i. Monitoring air-distribution static pressure and ventilation air volume.

2.14 ACCESSORIES

A. Duplex, 115-V, ground-fault-interrupter outlet with 15-A overcurrent protection. Include transformer if required. Outlet shall be energized even if the unit main disconnect is open.
B. Filter differential pressure switch with sensor tubing on either side of filter. Set for final filter pressure loss.
C. Factory- or field-installed, demand-controlled ventilation.
D. Safeties:
1. Smoke detector - Smoke detector shall be factory installed photoelectric smoke detector mounted in the return air section and/or supply air fan compartment.
2. Condensate overflow switch.
3. Phase-loss reversal protection.
4. High and low pressure control.
5. Gas furnace airflow-proving switch.
E. Hail guards of galvanized steel, painted to match casing.
F. Door switches to disable heating or reset set point when open.
G. Outdoor-air intake weather hood.
H. On rooftop units larger than 4.5 tons cooling capacity, provide a fully integrated 100% modulating outside air economizer with unit return and barometric relief air dampers, minimum position setting, preset linkage, wiring harness with plug. Unit operation is through primary temperature controls that automatically modulate dampers to maintain space temperature conditions. Economizer shall be dual enthalpy control.
I. Economizer Power Exhaust – Factory supplied, field installed power exhaust assembly.
J. Dehumidification / Hot Gas Reheat - Unit shall be equipped with internally finned, 5/16” copper tubes. The coil shall be 2 rows with a minimum of 16 fins per inch. Dehumidification shall be achieved by routing hot refrigerant gas from the discharge line of the compressor through the reheat coil.

2.15 ROOF CURBS

A. Roof curbs with vibration isolators are specified in Section 230548 "Vibration Controls for HVAC."
B. Materials: Galvanized steel with corrosion-protection coating, watertight gaskets, and factory-

installed wood nailer; complying with NRCA standards.

C. Curb Dimensions: Height of 14 inches

PART 3 - EXECUTION

3.01 INSTALLATION

A. Roof Curb: Install on roof structure or concrete base, level and secure, according to the roofing manufacturers requirements. Install RTUs on curbs and coordinate roof penetrations and flashing with roof construction specified in the architectural specifications. Secure RTUs to upper curb rail, and secure curb base to roof framing with anchor bolts.

B. Unit Support: Install unit level on structural curbs steel supports. Coordinate wall penetrations and flashing with wall construction. Secure RTUs to structural support with anchor bolts.

C. Any equipment mars, blemishes, scratches, abrasions, or other surface imperfections shall be sanded, primed, and refinished to match adjacent surfaces.

D. No equipment will be accepted by the owner which has rust, corrosion, or otherwise in progress.

E. Equipment shall not be used for temporary heat unless separately negotiated with the owner.

F. All filters shall be new at time of acceptance by the owner.

G. All bare ferrous metal shall be painted prior to acceptance.

H. Equipment shall be in perfect working order prior to acceptance.

I. Furnish and install all controls and control wiring. Wiring shall be in accordance with the NEC. Control wiring above the roof shall be in galvanized steel conduit with watertight fittings.

3.02 CONNECTIONS

A. Comply with duct installation requirements specified in other HVAC Sections. Drawings indicate general arrangement of ducts. The following are specific connection requirements:
   1. Install ducts to termination at top of roof curb.
   2. Remove roof decking only as required for passage of ducts. Do not cut out decking under entire roof curb.
   3. Connect supply ducts to RTUs with flexible duct connectors specified in Section 233300 "Air Duct Accessories."
   4. Install return-air duct continuously through roof structure.

B. Install condensate drain, minimum connection size, with trap and indirect connection to nearest roof drain or area drain.

C. Where installing piping adjacent to RTUs, allow space for service and maintenance.
   1. Gas Piping: Comply with applicable requirements in Section 231123 "Facility Natural-Gas Piping." Connect gas piping to burner, full size of gas train inlet, and connect with union and shutoff valve with sufficient clearance for burner removal and service.

3.03 FIELD QUALITY CONTROL

A. Perform tests and inspections.
   1. Tests and Inspections:
   2. After installing RTUs and after electrical circuitry has been energized, test units for

compliance with requirements.

3. Inspect for and remove shipping bolts, blocks, and tie-down straps.
4. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
5. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

B. RTU will be considered defective if it does not pass tests and inspections.
C. Prepare test and inspection reports.

3.04 CLEANING AND ADJUSTING

A. Occupancy Adjustments: When requested within 12 months from date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions.
B. After completing system installation and testing, adjusting, and balancing RTU and air-distribution systems, clean filter housings and install new filters.

3.05 DEMONSTRATION

A. Train Owner's maintenance personnel to adjust, operate, and maintain RTUs.

END OF SECTION

SECTION 23 74 16.13 - PACKAGED, MID-CAPACITY, GAS FIRED ROOFTOP UNITS (12.5 TO 25 TONS)

PART 1 - GENERAL

1.01 SUMMARY

A. Section includes packaged, large-capacity, rooftop air conditioning units (RTUs) with the following components and accessories:
   1. Casings.
   2. Fans.
   3. Motors.
   4. Coils.
   5. Refrigerant circuit components.
   6. Air filtration.
   7. Supported bag filters.
   8. Gas furnaces.
   9. Dampers.
   10. Electrical power connections.
   11. Controls.
   12. Accessories
   13. Roof curbs.

1.02 ACTION SUBMITTALS

A. Product Data: For each type of product.
B. Sustainable Design Submittals:
   1. Product Data: For adhesives, mastics, and sealants, indicating VOC content.
   2. Laboratory Test Reports: For adhesives, mastics, and sealants, indicating compliance with requirements for low-emitting materials.
   3. Product Data: For energy performance.
   4. Product Data: For ventilation equipment, indicating compliance with ASHRAE 62.1, Section 5 - "Systems and Equipment."
   5. Product Data: For air filtration performance.
C. Shop Drawings:
   1. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
   2. Include diagrams for power, signal, and control wiring.

1.03 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Plans and other details, drawn to scale and coordinated with each other, using input from installers of the items involved.
B. Field quality-control reports.
C. Sample warranty.

1.04 CLOSEOUT SUBMITTALS

A. Operation and maintenance data.

1.05 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of RTUs that fail in materials or workmanship within specified warranty period.
   1. Warranty Period for Compressors: Manufacturer's standard, but not less than five years from date of Substantial Completion.
   2. Warranty Period for Gas Furnace Heat Exchangers: Manufacturer's standard, but not less than five years from date of Substantial Completion.
   3. Warranty Period for Solid-State Ignition Modules: Manufacturer's standard, but not less than three years from date of Substantial Completion.
   4. Warranty Period for Control Boards: Manufacturer's standard, but not less than three years from date of Substantial Completion.

PART 2 - PRODUCTS

2.01 SYSTEM DESCRIPTION

A. AHRI Compliance:
   1. Comply with AHRI 340/360 for testing and rating energy efficiencies for RTUs.
   2. Comply with AHRI 270 / 370 for testing and rating sound performance for RTUs.
   3. Comply with AHRI 210/240 for testing and rating energy efficiencies for RTUs.

B. AMCA Compliance:
   1. Comply with AMCA 11 and bear the AMCA-Certified Ratings Seal for air and sound performance according to AMCA 211 and AMCA 311.
   2. Damper leakage tested in accordance with AMCA 500-D.
   3. Operating Limits: Classify according to AMCA 99.

C. ASHRAE Compliance:
   1. Comply with ASHRAE 15 for refrigeration system safety.
   2. Comply with ASHRAE 33 for methods of testing cooling and heating coils.
   3. Comply with applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and Startup."

D. ASHRAE/IES 90.1 Compliance: Applicable requirements in ASHRAE/IES 90.1, Section 6 - "Heating, Ventilating, and Air-Conditioning."

E. NFPA Compliance: Comply with NFPA 90A or NFPA 90B.

F. UL Compliance: Comply with UL 1995.

G. 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.

2.02 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Daikin Applied.
   2. AAON
   3. LG
   4. Lennox Industries, Inc.; Lennox International.
   5. Trane – Voyager II Series.
   6. YORK; a Johnson Controls company.

2.03 CAPACITIES AND CHARACTERISTICS

A. Refer to drawings for performance requirements.

2.04 CASINGS

A. General Fabrication Requirements for Casings: Formed and reinforced insulated panels, fabricated to allow removal for access to internal parts and components, with joints between sections sealed.
B. Single Wall Construction.
C. Exterior Casing Material: Galvanized steel with factory-painted finish, with pitched roof panels and knockouts with grommet seals for electrical and piping connections and lifting lugs.
    1. Corrosion Protection: 1,000 hours salt spray test in accordance with ASTM B117.
D. Inner Casing Fabrication Requirements:
    1. Inside Casing: G-90-coated galvanized steel, 0.028 inch thick.
E. Casing Insulation and Adhesive: Comply with NFPA 90A or NFPA 90B.
    1. Materials: ASTM C 1071, Type I.
    2. Thickness: 1/2 inch.
    3. Liner materials shall have air-stream surface coated with an erosion- and temperature-resistant coating or faced with a plain or coated fibrous mat or fabric.
    4. Liner Adhesive: Comply with ASTM C 916, Type I.
F. Condensate Drain Pans: Fabricated using stainless steel, a minimum of 2 inches deep, and complying with ASHRAE 62.1 for design and construction of drain pans.
    1. Double-Wall Construction: Fill space between walls with foam insulation and seal moisture tight.
    2. Drain Connections: Threaded nipple.
G. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.

2.05 FANS

A. Supply-Air Fans: Aluminum or painted-steel wheels, and galvanized- or painted-steel fan scrolls.
    1. Forward curved, double width, double inlet, centrifugal type fan.
    2. Belt-Driven Supply-Air Fans: Motors shall be installed on an adjustable fan base resiliently mounted in the casing.
B. Condenser-Coil Fan: Direct drive propeller, mounted on shaft of permanently lubricated motors.

2.06 MOTORS

A. Comply with NEMA MG 1, Design B, medium induction motor, unless otherwise indicated.
B. Comply with IEEE 841 for severe-duty motors.
C. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.
D. Duty: Continuous duty at ambient temperature of 104 deg. F and at altitude of 3300 feet above sea level.
E. Capacity and Torque Characteristics: Sufficient to start, accelerate, and operate connected loads at designated speeds, at installed altitude and environment, with indicated operating sequence, and without exceeding nameplate ratings or considering service factor.
F. Efficiency: Energy efficient, as defined in NEMA MG 1.

G. Comply with NEMA designation, temperature rating, service factor, and efficiency requirements.
H. Multispeed Motors: Variable torque.
   1. For motors with 2:1 speed ratio, consequent pole, single winding.
   2. For motors with other than 2:1 speed ratio, separate winding for each speed.
I. Multispeed Motors: Separate winding for each speed.
J. Rotor: Random-wound, squirrel cage.
K. Bearings: Regreasable, shielded, antifriction ball bearings suitable for radial and thrust loading.
L. Temperature Rise: Match insulation rating.
M. Insulation: Class F.
N. Code Letter Designation:
   1. Motors 15 HP and Larger: NEMA starting Code F or Code G.
   2. Motors Smaller than 15 HP: Manufacturer's standard starting characteristic.
O. Enclosure Material: Cast iron for motor frame sizes 324T and larger; rolled steel for motor frame sizes smaller than 324T.
P. Motors Used with Reduced-Voltage and Multispeed Controllers: Match wiring connection requirements for controller with required motor leads. Provide terminals in motor terminal box, suited to control method.

2.07 COILS

A. Supply-Air Refrigerant Coil:
   1. Aluminum-plate fin and seamless internally grooved copper tube in steel casing with equalizing-type vertical distributor.
   2. Polymer strip shall prevent all copper coil from contacting steel coil frame or condensate pan.
   3. Coil Split: Interlaced.
   4. Condensate Drain Pan: Galvanized steel with corrosion-resistant coating formed with pitch and drain connections.
B. Outdoor-Air Refrigerant Coil:
   1. Aluminum plate fin and seamless internally grooved copper tube in steel casing with equalizing-type vertical distributor.
   2. Polymer strip shall prevent all copper coil from contacting steel coil frame or condensate pan.

2.08 REFRIGERANT CIRCUIT COMPONENTS

A. Number of Refrigerant Circuits: Two.
B. Compressor: Hermetic, direct drive scroll, mounted on vibration isolators; with internal overcurrent and high-temperature protection, internal pressure relief, and crankcase heater.
C. Refrigeration Specialties:
   1. Refrigerant: R-410A.
   2. Expansion valve with replaceable thermostatic element.
   3. Refrigerant filter/dryer.
   4. Manual-reset high-pressure safety switch.
   5. Automatic-reset low-pressure safety switch.
   6. Minimum off-time relay.
   7. 7Automatic-reset compressor motor thermal overload.
   8. Brass service valves installed in compressor suction and liquid lines.
   9. Units shall have cooling capabilities down to 0 degree F as standard. For field-installed low ambient accessory, the manufacturer shall provide a factory-authorized service technician that will assure proper installation and operation.

Variable Speed Compressors (12.5-17.5 tons only)

Variable speed compressor shall be capable of speed modulation from 15Hz to a maximum of 75Hz. The minimum unit capacity shall be 25% of full load or less. The compressor motor shall be permanent magnet type. Each variable speed compressor shall be matched with a specifically designed, refrigerant cooled, variable frequency drive which modulates the speed of the compressor motor and provides several compressor protection functions. Control of the variable speed compressor and inverter control, as well as tandem direct driver, scroll type compressors shall be integrated with the controller to ensure optimal equipment reliability and efficiency. Each compressor shall have a crankcase heater as standard.

2.09 AIR FILTRATION

A. Minimum arrestance and MERV according to ASHRAE 52.2 2007 and shall be required to meet the same MERV-A value when tested per “Appendix j” of the aforementioned Standard. A filter with a MERV -A value lower than the MERV rating is not acceptable.

2.10 GAS FURNACES

A. Description: Factory assembled, piped, and wired; complying with ANSI Z21.47/CSA 2.3 and NFPA 54.
   1. CSA Approval: Designed and certified by and bearing label of CSA.
B. Burners: Stainless steel.
   1. Fuel: Natural gas.
   2. Ignition: Electronically controlled electric spark or hot-surface igniter with flame sensor.
C. Heat-Exchanger and Drain Pan: Stainless steel.
D. Venting: Gravity vented
E. Power Vent: Integral, motorized centrifugal fan interlocked with gas valve with vertical extension.
F. Safety Controls:
   1. Gas Control Valve: Modulating.
   2. Gas Train: Single-body, regulated, redundant, 24-V ac gas valve assembly containing pilot solenoid valve, pilot filter, pressure regulator, pilot shutoff, and manual shutoff.

2.11 DAMPERS

A. Outdoor- and Return-Air Mixing Dampers: Opposed blade galvanized-steel dampers mechanically fastened to cadmium plated for galvanized-steel operating rod in reinforced cabinet. Connect operating rods with common linkage or gears and interconnect so dampers operate simultaneously.
   1. Leakage Rate: As required by ASHRAE/IES 90.1.
   2. Damper Motor: Modulating with adjustable minimum position.
   3. Relief-Air Damper: Gravity actuated or motorized, as required by ASHRAE/IES 90.1, with bird screen and hood.

2.12 ELECTRICAL POWER CONNECTIONS

A. RTU shall have a single connection of power to unit with unit-mounted disconnect switch accessible from outside unit and control-circuit transformer with built-in overcurrent protection.

2.13 CONTROLS

A. Control equipment and sequence of operation are specified in Section 230933 "Building Automation

System."

Basic Unit Controls:

1. Control-voltage transformer.
2. Wall-mounted thermostat with the following features:
   a. Heat-cool-off switch.
   b. Fan on-auto switch.
   c. Fan-speed switch.
   d. Automatic changeover.
   e. Adjustable deadband.

B. DDC Controller:

1. Controller shall have volatile-memory backup.
2. Safety Control Operation:
   a. Smoke Detectors: Stop fan and close outdoor-air damper if smoke is detected. Provide additional contacts for alarm interface to fire-alarm control panel.
   b. Fire-Alarm Control Panel Interface: Provide control interface to the fire alarm system.
3. Scheduled Operation: Occupied and unoccupied periods on 365-day clock with a minimum of two programmable periods per day.
4. Refer to the control specification section for the sequence of operation.

C. Interface Requirements for HVAC Instrumentation and Control System:

1. Interface relay for scheduled operation.
2. Interface relay to provide indication of fault at the central workstation and diagnostic code storage.
3. Provide BACnet compatible interface for central HVAC control workstation for the following:
   a. Adjusting set points.
   b. Monitoring supply fan start, stop, and operation.
   c. Inquiring data to include outdoor-air damper position, supply- and room-air temperature and humidity.
   d. Monitoring occupied and unoccupied operations.
   e. Monitoring constant and variable motor loads.
   f. Monitoring variable-frequency drive operation.
   g. Monitoring cooling load.
   h. Monitoring economizer cycles.
   i. Monitoring air-distribution static pressure and ventilation air volume.

2.14 ACCESSORIES

A. Duplex, 115-V, ground-fault-interrupter outlet with 15-A overcurrent protection. Include transformer if required. Outlet shall be energized even if the unit main disconnect is open.

B. Filter differential pressure switch with sensor tubing on either side of filter. Set for final filter pressure loss.

C. Factory- or field-installed, demand-controlled ventilation.

D. Safeties:

1. Smoke detector - Smoke detector shall be factory installed photoelectric smoke detector mounted in the return air section and/or supply air fan compartment.
2. Condensate overflow switch.
3. Phase-loss reversal protection.
4. High and low pressure control.
5. Gas furnace airflow-proving switch.

E. Hail guards of galvanized steel, painted to match casing.
F. Door switches to disable heating or reset set point when open.
G. Outdoor-air intake weather hood.
H. Provide a fully integrated 100% modulating outside air economizer with unit return and barometric relief air dampers, minimum position setting, preset linkage, wiring harness with plug. Unit operation is through primary temperature controls that automatically modulate dampers to maintain space temperature conditions. Economizer shall be dual enthalpy control.
I. Economizer Power Exhaust – Factory supplied, field installed power exhaust assembly.
J. Dehumidification / Hot Gas Reheat - Unit shall be equipped with internally finned, 5/16” copper tubes. The coil shall be 2 rows with a minimum of 16 fins per inch. Dehumidification shall be achieved by routing hot refrigerant gas from the discharge line of the compressor through the reheat coil.

2.15 ROOF CURBS

A. Roof curbs with vibration isolators and wind or seismic restraints are specified in Section 230548 "Vibration and Seismic Controls for HVAC."
B. Materials: Galvanized steel with corrosion-protection coating, watertight gaskets, and factory-installed wood nailer; complying with NRCA standards.
C. Curb Dimensions: Height of 14 inches
D. Hot gas re-heat units require horizontal discharge roof curbs 36” / 48” in height in units 12.5 to 25 tons.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Roof Curb: Install on roof structure, level and secure, according to the roofing manufacturers requirements. Install RTUs on curbs and coordinate roof penetrations and flashing with roof construction specified in the architectural specifications. Secure RTUs to upper curb rail, and secure curb base to roof framing with anchor bolts.
B. Unit Support: Install unit level on structural curbs. Coordinate wall penetrations and flashing with wall construction. Secure RTUs to structural support with anchor bolts.
C. Any equipment mars, blemishes, scratches, abrasions, or other surface imperfections shall be sanded, primed, and refinished to match adjacent surfaces.
D. No equipment will be accepted by the owner which has rust, corrosion, or otherwise in progress.
E. Equipment shall not be used for temporary heat unless separately negotiated with the owner.
F. All filters shall be new at time of acceptance by the owner.
G. All bare ferrous metal shall be painted prior to acceptance.
H. Equipment shall be in perfect working order prior to acceptance.
I. Furnish and install all controls and control wiring. Wiring shall be in accordance with the NEC. Control wiring above the roof shall be in galvanized steel conduit with watertight fittings.

3.02 CONNECTIONS

A. Install condensate drain, minimum connection size, with trap and indirect connection to nearest roof drain or area drain.

B. Install piping adjacent to RTUs to allow service and maintenance.
   1. Gas Piping: Comply with applicable requirements in Section 231123 "Facility Natural-Gas Piping." Connect gas piping to burner, full size of gas train inlet, and connect with union and shutoff valve with sufficient clearance for burner removal and service.

C. Duct installation requirements are specified in other HVAC Sections. Drawings indicate the general arrangement of ducts. The following are specific connection requirements:
   1. Install ducts to termination at top of roof curb.
   2. Remove roof decking only as required for passage of ducts. Do not cut out decking under entire roof curb.
   3. Connect supply ducts to RTUs with flexible duct connectors specified in Section 233300 "Air Duct Accessories."
   4. Install return-air duct continuously through roof structure.

3.03 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

B. Perform the following tests and inspections with the assistance of a factory-authorized service representative:
   1. After installing RTUs and after electrical circuitry has been energized, test units for compliance with requirements.
   2. Inspect for and remove shipping bolts, blocks, and tie-down straps.
   3. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
   4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

C. RTU will be considered defective if it does not pass tests and inspections.

D. Prepare test and inspection reports.

3.04 DEMONSTRATION

A. Train Owner's maintenance personnel to adjust, operate, and maintain RTUs.

END OF SECTION

SECTION 23 81 20 – VARIABLE REFRIGERANT SYSTEM (LG)

PART 1 - GENERAL

1.01 REFERENCE

A. Refer to ARI Standards.

1.02 WORK INCLUDED

A. Provide full system design including all piping, calculations, refrigerant volumes, routing, floor plans, components, de-rating, capacities, etc.
B. Provide all labor, material, and supervision necessary to furnish, install, and place into working order a complete variable refrigerant system.

1.03 SUBMITTALS

A. Submit shop drawings of air handlers, fan coils, outdoor units, controls, devices, piping, wiring, and refrigerant.
B. Submit capacities, electrical efficiency.
C. Submit design drawings of refrigerant distribution and routing.

PART 2 - PRODUCTS

2.01 OUTDOOR UNITS

A. Variable Refrigerant Flow Heat Recovery
B. Product Description: Variable Refrigerant Flow (VRF) HVAC system shall be a variable capacity, direct expansion (DX) heat recovery engineered system. The outdoor unit shall consist of one or more frames) connected through common refrigerant piping and control communication wiring. Each system shall have single or multiple, inverter compressor(s). Each system shall be connected to multiple indoor units (ducted, non-ducted or mixed combinations) through a common refrigerant piping network and integrated system controls and communication network. Each indoor unit shall be controlled individually or as a group. Additionally, heat recovery systems shall be capable of simultaneous heating and cooling of individual zone(s).
    1. Basis of Design shall be LG (Substitution Requires Full Design): Acceptable standards shall be supplied based upon the performance characteristics and features of the LG model number(s) specified, LG model families specified and as otherwise specified here. Alternate suppliers shall request permission to bid, in writing, from the engineer at least 10 days prior to the bid date. This request by the contractor to bid an alternate supplier to the basis of design, listed or not listed, shall not relieve the contractor of supplying all materials, options, controls, sequences, efficiencies, and intents of the original specifications written or implied by LG model number or model family or as otherwise specified. The written request and engineers' written response to such request shall be included in all submittal documents for

approval.

2. Alternate Equipment Bid Instruction: If the contractor should wish to propose any alternate products to the basis of designed products, they shall provide a separate and complete Bid detailing the proposed alternate products and the associated adjustment of price to support the change from basis of design products. Any and all additional cost, to any party, because of any product submitted on or supplied other than that of the original specified products shall be the responsibility of the contractor without recourse. Any product proposed as an alternate shall have been offered, as a VRF product, in the United States for a minimum of (5) years.
3. System Performance Documentation: The VRF manufacturer shall provide published outdoor unit performance data in table format which states the products heating and cooling capacity expressed in British thermal units per hour (BtuH) and power consumption expressed in kilowatts (kW) at a minimum of 8 possible combinations of allowed conditions between 50% and 130% connection ratio. Possible combinations of allowed condition variables include Combination Ratios expressed as a percentage value, Outdoor Ambient Temperature expressed in degrees Fahrenheit (°F), and indoor unit Entering Air wet and dry bulb temperature expressed in degrees Fahrenheit (°F). Any product whose system design and engineering manuals or guides where published data tables are expressed in units other than these specified will not be accepted.
4. Any product whose published documentation requires the design engineer to apply a correction factor derived from a published curve or tabular data for combination ratio, outdoor ambient temperature, and/or entering air temperature against rated conditions to obtain performance at any possible combination of allowed conditions will not be accepted.
5. Submittals: a complete submittal package shall be complied, and 10 copies shall be forwarded to the general contractor who shall supply the architect with the submittals for dissemination to all parties. The submittal shall be a collection of documents that represent the technical aspects of each product or collection of products to be used on the project. All performance submissions shall be calculated at the design temperatures; nominal performance data shall not be allowed. The submission and approval of said submittals does not relieve the contractor of supplying all requirements set forth in the specification and drawings. Any substitutions offered by the contractor shall include, as a separate document, any and all differences between the submitted products and the specified products including but not limited to, all dimensions, electrical, control, weights, warranties, country of origin and a statement from the manufacture that no child labor has been used in the manufacture or assembly of said products and a copy shall be supplied with the product outdoor unit submittal.
6. If submittals contain any proposed alternate equipment specifications, calculations, dimensions, electrical specifications, sound specifications or any other mandated submission which are not accepted, are noted, or rejected for any reason the contractor shall be allowed to correct any deficiency and re-submit a second time. Should there be any issues found on second submission the contractor will be directed to and agrees to submit on the original specified products and provide the specified products without any additional compensation.

C. Simultaneous Cooling and Heating VRF System Heat Recovery System:

D. The heat recovery system shall be an air cooled, system consisting of one to three outdoor unit modules, conjoined to make a 6-42 ton single refrigerant circuit, connected to Heat Recovery (HRU) unit(s) and indoor unit(s). Multi-port heat recovery units shall allow simultaneous heating and cooling of individual zone(s) at various capacities as required to satisfy their zone requirements. Simultaneous heating and cooling shall be supported. The heat recovery system shall consist of three pipes, liquid, suction, and hot gas pipes, two pipe heat recovery systems that cannot deliver, at zero degrees outdoor ambient, 162F hot gas to the indoor coils for heat shall not be acceptable.

The heat recovery system shall be capable of operating with <460V> 3 phase power.

E. VRF (variable refrigerant flow) heat pump systems shall have published performance ratings certified by AHRI (Air-Conditioning, Heating, and Refrigeration Institute) and listed in the AHRI Standard 1230 certified product directory.

F. All VRF heat pump system components shall be manufactured in production facilities maintaining the following ISO certifications:
   a. ISO 9001 Quality Management System
   b. ISO 14001 Environmental Management System

G. All VRF heat pump system components shall comply with Underwriters Laboratories (UL) 1995 4th edition of Heating and Cooling Equipment Standard for Safety and bear the Electrical Testing Laboratories (ETL) mark.

H. All VRF heat pump system electrical power wiring shall be installed according to National Electrical Code (NEC) or applicable state and local building codes.

I. All three-phase heat recovery outdoor units shall be from the same product design. Mixing of different product designs, families, or product lines are not acceptable.

J. All three-phase VRF heat pump and heat recovery outdoor units shall be from the same product development generation. Mixing of outdoor units from different development generations is not acceptable.

K. The VRF systems shall be capable of providing continuous compressor operation over the required ambient operating range stated in section 4.04. VRF systems that provide possible but don't guarantee continuous compressor operation over the required ambient operating range stated in section 4.04 will not be accepted. Submittal that states performance data is reference data, data that is for reference only, or that is footnoted as such shall not be accepted.

L. Outdoor Unit shall be capable of continuous compressor operation between the following operating ambient air conditions, operation outside of these conditions are possible and may involve non-continuous operations.
   1. Heat Recovery System
      a. Cooling: 14°F DB to 122°F DB
      b. Heating: -13°F WB to 61°F WB
      c. Cooling based synchronous: 14°F DB to 81°F DB
      d. Heating-based synchronous: 14°F WB to 61°F WB

M. General features:
   1. The air-conditioning system shall use R410A refrigerant.
   2. The system shall be capable of an automatic refrigerant charge function for use in both the heat mode and cool mode to ensure the proper amount of refrigerant is installed into the system.
   3. Each system shall consist of one, two or three air source outdoor unit modules conjoined together in the field to result in the capacity specified elsewhere in these documents.
   4. Dual and triple frame configurations shall be field piped together using manufacturers designed and supplied Y-branch kits and field provided interconnecting pipe to form a common refrigerant circuit.
   5. System shall employ self-diagnostics function to identify any malfunctions and provide type and location of malfunctions via fault alarms.
   6. Refrigerant circuit configuration for Heat Recovery System
      a. The refrigerant circuit shall be constructed using field provided ACR copper, de-hydrated, piped together with manufacturer supplied Heat Recovery unit(s) and Y-branches connected to multiple (ducted, non-ducted or mixed combination) indoor units to effectively and efficiently control the simultaneous heating and cooling

operation of the VRF system. Other pipe materials shall not be allowed.

7. Each refrigerant pipe, y-branches, elbows, and valves shall be individually insulated with no air gaps. Insulation R-value (thickness) shall not be less than the minimum called for by the local building code, local energy code or as a minimum per manufacture installation requirements. In no case shall the insulation be allowed to be compressed at any point in the system.
   a. All joints shall be glued and sealed per insulation manufactures instructions to make an airtight assembly.
8. Factory installed microprocessor controls in the outdoor unit(s), HR unit(s), and indoor unit(s) shall perform functions to optimize the operation of the VRF system and communicate in a daisy chain configuration between outdoor unit and HR unit(s) and indoor unit(s) via RS485 network. Controls shall also be available to control other building systems as required from the VRF control system. DIO/AIO capabilities shall be available as well as a central controller to perform operation changes, schedules and other duties as required by this specification. Addition of separate building control system shall not be required. Other control devices and sequences shall be as specified in other sections of this project specification.
9. Inverter PCB cooling: cooling of the inverter PCB shall be conducted by way of passive heat transfer via “Heat Pipe” technology and/ or highly conductive sink method to the outdoor ambient for dissipation to the ambient via natural convection and also by way of forced convection when the outdoor condenser fans are running. Additional cooling of the inverter PCB using mechanical devices other than an existing condenser fans shall not be allowed. Further, use of outdoor coil space or sections to cool inverter PCB shall not be permitted.
10. Compressor control: Fuzzy control logic shall establish and maintain target evaporating temperature (Te) to be constant on cooling mode and condensing temperature (Tc) constant on heating mode by Fuzzy control logic to ensure the stable system performance.
11. Flexible Capacity Control: (Demand limiting) The system shall allow for up to 5 steps of flexible capacity control using an LG I/O controller or up to 8 steps of flexible capacity control using a BMS control by others. This FCC shall be employed when electrical demand limiting, nighttime noise reduction or any other flexible capacity control requirement based on any other requirement using contact closures to engage.
12. Initial Test Run (ITR) (Heating) / Fault Detection Diagnosis (FDD) Code: this control mode shall monitor and display positive or negative results of system initial startup and commissioning. It shall monitor the following but not limited to refrigerant quantity charge, auto-charge, stable operations, connection ratios, indoor unit status, error status, number of indoor units connected. This control mode shall not replace the system error monitoring control system.
13. Integration Each system shall be able to integrate via open protocol via BACnet IP, this gateway converts between BACnet IP or Modbus TCP protocol and RS-485 LGAP (LG Aircon protocol) allowing third party control and monitoring of the LG A/C system, or LonWorks gateways. See controls specification for more detailed description of integration and points to be controlled and monitored.
14. Smart load control: Smart load control operation shall be available at any time during or after system commissioning.
15. Smart load control shall be initiated by outdoor air temperature and shall automatically adjust the evaporator target (condenser target for heat) pressure / temperature that the system will operate to in order precisely load match the system to the building load as the outdoor ambient increases or decreases, by varying the compression ratios of the system and increase the operating efficiencies by adjusting the compressor lifts. The system shall poll all indoor units’ data in real time and apply its algorithm to determine the optimal evaporating temperature to satisfy varying loads. Systems that rely on the worst performing zone to reset

the system conditions shall not be sufficient and shall not be allowed.

16. WiFi communication: The outdoor unit shall be WiFi enabled and capable. WiFi shall allow service or maintenance personal access to the complete operating system, via LGMV mobile, without need of tools other than smart phone or tablet. Active live system review, collection of all system data for a field determined duration presented in a .csv file format or Collection of all operating conditions, including all indoor units, valves, sensors, compressor speeds, refrigerant pressures, etc. by snapshot of conditions and placing that snapshot into a power point slide to be reviewed at another time. Systems that require computers, hard wire only connection or other devices to collect, review or record operating conditions shall not be allowed.
17. Indoor unit connectivity: The system shall be designed to accept connection up to 64 indoor units of various configuration and capacity, depending on the capacity of the system.
18. Power and communication interruption: The system shall be capable of performing continuous operation when an individual or several indoor units are being serviced; communication wire cut or power to indoor unit is disconnected. Systems that alarm and/or shut down because of a lack of power to any number of indoor units shall not be acceptable or allowed.
19. Connection Ratios: The maximum allowable system combination ratio shall be 130%. Systems designed with combination ratio above 130% are not acceptable. The total nominal capacity of all indoor units shall be no less than 50% and no more than 130% of outdoor unit's nominal capacity.
20. The outdoor unit refrigerant circuit shall employ for safety a threaded fusible plug.
21. The unit shall be shipped from the factory fully assembled including internal refrigerant piping, inverter driven compressor(s), controls, contacts, relay(s), fans, power and communications wiring as necessary.
22. Each outdoor unit refrigeration circuit shall include, but not limited to, the following components:
    a. Refrigerant strainer(s)
    b. Check valve(s)
    c. Inverter driven, medium pressure vapor injection, high pressure shell compressors.
    d. Heat pipe cooled inverter PCB
    e. Oil separator(s)
    f. Accumulator(s)
    g. 4-way reversing valve(s)
    h. Vapor injection valve(s)
    i. Variable path heat exchanger control valve(s)
    j. Oil balancing control
    k. Oil Level sensor(s)
    l. Electronic expansion valve(s)
    m. Sub-cooler (s)
    n. High and low side Schrader valve service ports with caps.
    o. Service valves

N. Refrigerant Flow Control

1. System shall have a variable flow and path outdoor heat exchanger function to vary the refrigerant flow and volume and path. Control of the variable path circuits shall be based on system operating mode and operating conditions as targeted to manage the efficiency of the system.
2. System shall have a medium pressure gas vapor injection function employed in the heating mode to increase system capacity when the outdoor ambient temperatures are low. The compressor vapor injection flow amount shall be controlled by the VI sub-cooling algorithm

reset by discharge gas temperatures of the compressor.

3. System shall have an active refrigerant control and multi section accumulator that dynamically changes the volume of refrigerant circulating in the system based on operating mode and operating conditions to ensure maximum system efficiency.
4. The compressor design shall be of the high pressure shell scroll type where the internal pressure below the suction valves of the compressor shall be same as discharge pressure. The motor shall be cooled by high pressure gas and as a result oil shall be stable and non-foaming increasing the efficiency of the system.
5. The VRF outdoor unit shall include a factory provided and mounted sub-cooler assembly consisting of a double spiral tube-type sub-cooling heat exchanger and EEV providing refrigerant sub-cooling modulation control by fuzzy logic of EEV and by mode of operation to provide capacity and efficiency as required.
6. System shall have following frame configurations vs. capacity.
   a. 6 to 14 ton units shall be a single frame only.
   b. 16 to 28 ton units shall be dual frame only.
   c. 30 to 42 ton heat recovery units shall be triple frame only

O. Field Supplied Refrigerant Piping Design Parameters

1. The outdoor unit shall be capable of operating at an elevation difference of up to 360 feet above or below the lowest or highest indoor unit respectively without the requirement of field installed sub cooler or other forms of performance enhancing booster devices.
2. The outdoor unit shall be capable of operating with up to 3280 equivalent length feet of interconnecting liquid line refrigerant pipe in the network.
3. The outdoor unit shall be capable of operating with up to 656 actual feet or 738 equivalent length feet of liquid line refrigerant pipe spanning between outdoor unit and farthest indoor unit.
4. The piping system shall be designed with pipe expansion and contraction possibilities in mind. If required expansion devices shall be field designed, supplied and installed based on proper evaluation of the proposed piping design. Piping systems must be installed per manufacturer's published guidelines.
5. Pipe hanger and supports selected should allow for expansion and contraction of the piping system shall not interfere with that movement.

P. Defrost Operations

1. The outdoor unit(s) shall be capable of Intelligent defrost operation to melt accumulated frost, snow and ice that may have accumulated on the outdoor unit heat exchanger. The defrost cycle length and sequence shall be based on outdoor ambient temperatures, outdoor unit heat exchanger temperature, and various differential pressure variables.
2. Defrost Mode Selection: The outdoor unit shall be provided with three field selectable defrost operation modes; Normal, Fast, or Forced.
   a. Normal Defrost operation intended for use in areas of the country with mild winter temperatures and light to moderate humidity levels. The strategy minimizes defrost cycle frequency allowing frozen precipitation to build longer in between cycles. Minimum time between defrost cycles shall be 20 minutes. Intelligent Defrost shall choose between split coil/frame and full system methods to minimize energy consumption and cycle time.
   b. Fast Defrost operation intended for use in areas of the country that experience adverse winter weather with periods of heavy winter precipitation and extremely low temperatures. This strategy shall maximize the systems heating performance and maintain operational efficiency. When the ambient temperature is above 32°F, Intelligent Defrost shall continue to heat until the discharge temperature declines. At temperatures below 32°F, the time between defrost cycles shall be a minimum of 90

minutes. At temperatures below 4°F, a defrost cycle shall occur every two hours to optimize system heating efficiency.

c. Forced Defrost operation shall be available for the service provider to test defrost operations at any weather condition and to manually clear frozen water from the outdoor coil surfaces.

3. Defrost Method Selection: The outdoor unit shall be provided with two field selectable defrost operation methods; Split Coil/Frame and Full System.
   a. Split Coil/Frame method shall be available when Normal Defrost mode is selected. Split Coil method shall be available on all Heat Pump and Heat Recovery single-frame VRF systems. Split Frame defrost shall be available on all Heat Pump and Heat Recovery multi-frame outdoor units.
   b. Split Coil method shall remove ice from the bottom half of the outdoor unit coil first for six minutes, then the bottom half for six minutes. Next the bottom coil shall be heated again for an additional three minutes to remove any frozen water that may have dripped onto the lower coil during the top coil defrost operation.
   c. When Split Coil/Frame method is selected, a Full System defrost shall be occur every third defrost cycle to assure 100% of the frozen precipitation has been removed to maintain efficient performance.
   d. Full System method shall be available as a field selectable option. All outdoor units located in areas of the country where large volumes of frozen precipitation are common, the commissioning agent shall select the Full System defrost method.
4. Indoor Unit Fan Operation During Defrost
   a. During partial defrost operation indoor units operating in cooling or dry mode shall continue normal operation.
   b. During partial defrost operation, indoor units that are commissioned with fans set for continuous operation shall maintain normal fan speed unless the leaving air temperature drops, then the fan speed will be reduced to low speed for the remainder of the defrost cycle.
   c. During full system defrost operation indoor unit fans will cycle off and remain off during the remainder of the defrost cycle.

Q. Oil Management
1. The system shall utilize a high pressure oil return system to ensure a consistent film of oil on all moving compressor parts at all points of operation. Oil is returned to compressor through a separate oil injection pipe directly into the oil sump. Oil returned to the compressor via the suction port of the compressor shall not be allowed.
2. Each compressor shall be provided with an independent centrifugal oil separator, designed to extract oil from the oil/refrigerant gas stream leaving the compressor.
3. The system shall have an oil level sensor in the compressor to provide direct oil level sensing data to the main controller.
4. The system shall only initiate an oil return cycle if the sensed oil level is below oil level target values as determined by the microprocessor.
5. A default oil return algorithm shall automatically initiate the oil return mode if the system detects a failure of the oil sump sensor. A fault code shall be reported by the system.
6. Timed oil return operations or systems that do not directly monitor compressor oil level shall not be permitted.
7. Indoor Unit Fan Operation During Oil Return Cycle
   a. During oil return cycle indoor units operating in cooling or dry mode shall continue normal operation.
   b. During oil return, indoor units that are commissioned with fans set for continuous operation shall maintain normal fan speed unless the leaving air temperature drops,

then the fan speed will be reduced to low speed for the remainder of the oil return cycle.

c. During oil return cycle indoor unit fans will cycle off and remain off during oil return cycle while operating in all modes except 4.07.e.1 and 2.

R. Cabinet

1. Outdoor unit cabinet shall be made of 20 gauge galvanized steel with a weather and corrosion resistant enamel finish. Outdoor unit cabinet finish shall be tested in accordance with ASTM B-117 salt spray surface scratch test (SST) procedure for a minimum of 1000 hours. The test report results with photo images shall be included with submittal documentation.
2. The front panels of the outdoor units shall be removable type for access to internal components.
3. A smaller service access panel, not larger than 7” x 7” and secured by a maximum of (2) screws shall be provided to access the following:
   a. Service tool connection
   b. DIP switches
   c. Auto addressing
   d. Error codes
   e. Main microprocessor
   f. Inverter PCB
4. The cabinet shall have piping knockouts to allow refrigerant piping to be connected at the front, right side, or through the bottom of the unit.

S. Fan Assembly

1. 6 ton frames shall be equipped with one direct drive variable speed propeller fan with Brushless Digitally Controlled (BLDC) motor with a vertical air discharge.
2. 8 to 14 ton frames shall be equipped with two direct drive variable speed propeller fan(s) with BLDC motor(s) with a vertical air discharge.
3. The fan(s) blades shall be made of Acrylonitrile Butadiene Styrene (ABS) material.
4. The fan(s) motor shall be equipped with permanently lubricated bearings.
5. The fan motor shall be variable speed with a maximum operating speed of 1050 RPM.
6. The fan shall have a raised guard to help prevent contact with moving parts.
7. The cabinet shall have option to redirect the discharge air direction from vertical to horizontal with the addition of optional factory provided air guides.
8. The fan controller shall have a DIP switch setting to raise external static pressure of the fan up to 0.32 in-wg to accommodate ducted installations.
9. The fan control shall have a function setting to remove excess snow automatically.

T. Outdoor Unit Coil

1. Shall be comprised of aluminum fins mechanically bonded to copper tubing.
2. The copper tubes shall have inner riffling to expand the total surface of the tube interior.
3. The aluminum fins shall have factory applied corrosion resistant GoldFin™ material with a Hydrophilic topcoat.
4. Coil coating shall be tested in accordance with ASTM B-117 salt spray surface scratch test (SST) procedure for a minimum of 1000 hours. The test report results with photo images shall be included with submittal documentation.
5. Shall have multiple circuits designed for path isolation and variable velocity control.
6. Shall be designed, built, and provided by the VRF outdoor unit manufacturer.
7. The outdoor unit coil, all indoor units and pipe network shall be field tested to a minimum pressure of 550 psig. Manufacturers that do not specify and/or allow field testing at 550 psig shall not be allowed.
8. The outdoor unit coil for each cabinet shall have lanced aluminum fins with a maximum fin

spacing of no more than 14 Fins per Inch (FPI). All the outdoor unit coils shall be a minimum of 3 rows consisting of staggered tubes for efficient air flow across the heat exchanger.

9. The cabinet shall have a factory installed coil guard.

U. Compressor(s)
1. Each 6, 8, 10 ton frames shall be equipped with a single hermetically sealed, inverter driven, High Side Shell (HSS) scroll compressor.
2. 12 and 14 ton frames shall be equipped with dual hermetically sealed, inverter driven, High Side Shell (HSS) scroll compressors.
3. Each inverter driven, HSS scroll compressor shall be capable of operating from 15 Hz up to 150 Hz with control in 0.5 Hz increments in any and all modes (cooling OR heating)
4. Manufacturers that employ speed limiting algorithms designed to limit compressor capacity to lower power amperage draw shall not be permitted.
5. The compressor(s) shall be equipped with a 60 Watt crankcase heater controlled by oil temperature.
6. The compressor shall employ a factory metered charge of Polyvinyl Ether (PVE) oil.
7. The compressor shall be designed for a separate port for oil to be directly returned to the compressor oil sump.
8. The compressor bearing(s) shall have Teflon™ coating.
9. The compressor(s) shall be protected with:
   a. High Pressure switch
   b. Over-current /under current protection
   c. Oil sump sensor
   d. Phase failure
   e. Phase reversal
   f. Compressor shall be capable of receiving injection of medium pressure gas at a point in the compression cycle where such injection shall allow a greater mass flow of refrigerant at lower outdoor ambient and achieving a higher heating capability. The VRF outdoor unit shall have published performance data for heating mode operation down to -13F on both heat pump and heat recovery systems.
10. Standard, non-inverter driven compressors shall not be permitted nor shall a compressor without vapor injection or direct sump oil return capabilities.

V. Inverter Compressor Controller(s)
1. The VRF outdoor unit shall be provided with a separate inverter compressor controller PCB for each compressor. Inverter compressor controllers that host more than one compressor shall not be accepted.
2. The inverter compressor controller shall be designed and programmed to utilize the entire range of operation of the connected compressor during cooling cycle operation and/or heating cycle operation.
3. Inverter compressor controllers programmed to limit the compressors heating or cooling capacity to reduce or limit power consumption is not acceptable.

W. Operational Sound Levels
1. Each single frame outdoor unit shall be rated with an operational sound level not to exceed 59.5 dB(A) when tested in an anechoic chamber under ISO 3745 standard at the highest field selectable heating operating modes available. Such documentation shall be presented in all submittals, manufactures who elect to rate their equipment at other than the highest field selectable conditions shall not be allowed.
2. A field setting shall be available to program the outdoor unit to reduce sound levels at night, when desired, to a selectable level while still able to meet building load requirement.

X. Sensors
1. Each outdoor unit module shall have

a. Suction temperature sensor
b. Discharge temperature sensor
c. Oil level sensor
d. High Pressure sensor
e. Low Pressure sensor
f. Outdoor temperature sensor
g. Outdoor unit heat exchanger temperature sensor

2.02 HEAT RECOVERY UNIT (HRU) (HEAT RECOVERY SYSTEMS ONLY)

A. General
1. HR unit shall be designed and manufactured by the same manufacturer of VRF indoor unit(s) and outdoor unit(s).
2. HR unit casing shall be constructed with galvanized steel.
3. HR unit shall require 208-230V/1-phase/60Hz power supply.
4. HR Unit shall be an intermediate refrigerant control device between the air source outdoor unit and the indoor units to control the systems cooling and heating operation.
5. HR unit shall be engineered to work with a three pipe VRF system comprising of
   a. High Pressure Vapor Pipe
   b. Low Pressure Vapor Pipe
   c. Liquid Pipe
6. HR units' main 3 pipe connections shall be capable of series or parallel pipe configuration.
7. The quantity of HR units that can be piped in series shall be limited to 16.
8. A single string of series piped HR units shall be capable of serving any combination of styles of VRF indoor units with a combined nominal capacity of up to 192MBh.
9. HR unit shall have 2, 3 or 4 ports, each port supporting one or more indoor units with a maximum connected capacity of 54 MBH.
10. Each port shall be capable of operating in cooling or heating independently regardless of the operating mode of any other port on the HR unit or in the system.
11. Each port shall be capable of connecting from 1 to 8 indoor units.
12. Connection to Indoor units totaling greater than 54MBh nominal capacity shall be twinned to two adjacent ports of the HRU using a reverse Y-branch connector supplied by manufacture.
13. HR unit shall be internally piped, wired, assembled, and run tested at the factory.
14. HR unit shall be designed for installation in a conditioned environment per specifications.
15. HR unit shall employ a liquid bypass valve.
16. HR unit shall have (2) two-position refrigerant valves per port.
17. HR unit shall have a balancing valve to control the pressure between the high pressure and low pressure pipe during mode switching to minimize any change-over pressure related sounds.
18. HR unit shall employ an electronic expansion valve to ensure proper sub cooling of the refrigerant.
19. HRU shall contain one double spiral sub-cooling heat exchanger per port.
20. HR unit shall not require a condensate drain or connection.
21. HR unit shall be internally factory insulated.
22. All field refrigerant lines between outdoor unit and HR unit and from HR unit to indoor unit shall be field ACR tubing, insulated per building or energy code and as instructed by the manufacture.
23. The HR unit shall not exceed a net weight of 50 lbs.
24. HRU's shall not exceed a maximum equivalent pipe length of 8.2 feet.
25. The VRF manufacturer shall provide published documentation that specifically allows the

installation of field provided isolation valves on all pipes connected to the Heat Recovery unit to allow the servicing of HR units, refrigerant circuit, or the replacement of HR unit without evacuating the balance of the piping system.

B. Piping Capabilities
   1. The elevation difference between indoor units on heat pump systems shall be 131 feet.
   2. The elevation differences for heat recovery systems shall be:
      a. Heat recovery unit (HRU) to connected indoor unit shall be 49 feet.
      b. HRU to HRU shall be 49 feet.
      c. Indoor unit to indoor unit connected to same HRU shall be 49 feet.
      d. Indoor unit to indoor unit connected to separate parallel piped HRU's shall be 131 feet.
   3. The acceptable elevation difference between two series connected HR units shall be 16 feet.

C. Controls
   1. HR unit(s) shall have factory installed unit mounted control boards and integral microprocessor to communicate with other devices in the VRF system.
   2. HR unit shall communicate with the indoor units via a 2-conductor shielded communications cable terminated using a daisy chain configuration. (see instructions regarding the termination of the shield)
   3. The contractor is instructed to review the Electrical and ATC drawings and specifications for other items or tasks which this contractor is or may be responsible to provide materials and or labor under this contract. Failure to do so will not relieve this contractor of their responsibility to provide such materials and or labor and in no case shall this contractor be further compensated as a result.

2.03 INDOOR UNITS

A. Indoor Units
   1. Ceiling Cassette – 4 Way
   2. Ducted – High Static
   3. Ducted – Low Static (Convertible)

B. Ceiling Cassette – 4 Way
   1. General
      a. Unit shall be manufactured by <LG>.
      b. Unit shall be factory assembled, wired, piped, and run tested.
      c. Unit shall be designed to be installed for indoor application.
      d. Unit shall be designed to mount recessed in the ceiling and has a surface mounted grille on the bottom of the unit.
      e. Unit shall be capable to be installed with heat pump or heat recovery or cooling VRF system.
   2. Casing/Panel
      a. Unit case shall be manufactured using galvanized steel plate.
      b. Unit shall be provided with metal ears designed to support the unit weight on four corners.
      c. Ears shall have pre-punched holes designed to accept field supplied all thread rod hangers.
      d. The unit shall be provided with an off-white Acrylonitrile Butadiene Styrene (ABS) polymeric resin architectural grille.
      e. The grille shall have a tapered trim edge, and a hinged, spring clip (screw-less) return air filter-grille door.
   3. Cabinet Assembly

a. Unit shall have one supply air outlet and one return air inlet.
b. The supply air outlet shall be through a single directional slot diffuser with oscillating motorized guide vane designed to change the airflow direction.
c. The grille shall have a discharge range of motion of 40° in an up/down direction with capabilities of locking the vanes.
d. Unit shall have factory installed motorized louver to provide flow of air in up and down direction for uniform airflow.
e. Unit shall be equipped with factory installed temperature thermistors for
    1) Return air
    2) Refrigerant entering coil.
    3) Refrigerant leaving coil.
f. Unit shall have a factory assembled, piped, and wired electronic expansion valve (EEV) for refrigerant control.
g. Unit shall have a built-in control panel to communicate with other indoor units and to the outdoor unit.
h. Unit shall have the following functions as standard.
    1) Self-diagnostic function
    2) Auto restart function
    3) Auto changeover function (Heat Recovery system only)
    4) Auto operation function
    5) Child lock function
    6) Forced operation
    7) Dual thermistor control
    8) Sleep mode
    9) Fan Assembly
i. The unit shall have a direct driven cross flow tangential Sirocco fan.
j. The fan shall be made of high strength ABS GP-2305 polymeric resin.
k. The fan motor is Brushless Digitally controlled (BLDC) with permanently lubricated and sealed ball bearings.
l. The fan/motor assembly shall be mounted on vibration attenuating rubber grommets.
m. The fan speed shall be controlled using microprocessor based direct digitally controlled algorithm.
n. In cooling mode, the indoor fan shall have the following settings: Low, Med, High, Super high, Power Cool and Auto.
o. In heating mode, the indoor fan shall have the following settings: Low, Med, High, Super High and Auto.
p. The Auto fan setting shall adjust the fan speed to most effectively achieve the set-point.

4. Filter Assembly
    a. The return air inlet shall have a factory supplied removable, washable filter.
    b. The unit shall be equipped with factory supplied secondary plasma filter with no additional external power supply.
    c. The filter access shall be from the bottom of the cabinet.
5. Coil Assembly
    a. Unit shall have a factory built coil comprised of aluminum fins mechanically bonded on copper tubing.
    b. The copper tubing shall have inner grooves for high efficiency heat exchanger.
    c. Unit shall have minimum of 2 rows of coils.
    d. Unit shall have a factory supplied condensate drain pan below the coil.
    e. Unit shall be installed, and wired condensate drain pump capable of providing

minimum 27.5 inch lift from bottom surface of the unit.

f. The drain pump shall have a safety switch to shut off the unit if condensate rises too high in the drain pan.
g. Unit shall have provision of 45° flare refrigerant pipe connections.
h. The coil shall be factory pressure tested at a minimum of 551 psig.
i. All refrigerant piping from outdoor unit or Heat Recovery (HR) unit to indoor unit shall be field insulated.

6. Microprocessor Control
   a. The unit shall have a factory installed microprocessor controller capable of performing functions necessary to operate the system.
   b. The unit shall be able to communicate with other indoor units and the outdoor unit using a field supplied minimum of 18 AWG, 2 core, stranded and shielded communication cable.
   c. The unit controls shall operate the indoor unit using one of the five operating modes:
      1) Auto changeover (Heat Recovery System only)
      2) Heating
      3) Cooling
      4) Dry
      5) Fan only
7. Electrical
   a. The unit electrical power shall be 208-230/1/60 (V/Ph/Hz)
   b. The unit shall be capable of operating within voltage limits of +/- 10% of the rated voltage.
8. Controls
   a. Unit shall use controls provided by the manufacturer to perform all functions necessary to operate the system effectively and efficiently and communicate with the outdoor unit over an RS485 daisy chain.

C. Ducted – High Static
1. General
   a. Unit shall be manufactured by <LG>.
   b. Unit shall be factory assembled, wired, piped, and run tested.
   c. Unit shall be designed to be installed for indoor application.
   d. Unit shall be designed to mount fully concealed above the finished ceiling.
   e. Unit shall have opening to supply air from front horizontal and a dedicated rear horizontal return.
   f. The supply air shall be flanged for field installed ductwork that shall not exceed the external static pressure limitation of the unit.
   g. Unit shall be capable to be installed with heat pump or heat recovery or cooling VRF system.
2. Casing/Panel
   a. Unit case shall be manufactured using galvanized steel plate.
   b. The cold surfaces of the unit shall be covered internally with a coated polystyrene insulating material.
   c. The cold surfaces of the unit shall be covered externally with sheet insulation made of Ethylene Propylene Diene Monomer (M-Class) (EPDM)
   d. The external insulation shall be plenum rated and conform to ASTM Standard D-1418.
   e. Unit shall be provided with hanger brackets designed to support the unit weight on four corners.
   f. Hanger brackets shall have pre-punched holes designed to accept field supplied, all

thread rod hangers.

3. Cabinet Assembly
   a. Unit shall have supply air discharge outlets horizontal and a return air inlet horizontal.
   b. Unit shall be equipped with factory installed temperature thermistors for
      1) Return air.
      2) Refrigerant entering coil.
      3) Refrigerant leaving coil.
   c. Unit shall have a factory assembled, piped, and wired electronic expansion valve (EEV) for refrigerant control.
   d. Unit shall have a built-in control panel to communicate with other indoor units and to the outdoor unit.
   e. Unit shall have the following functions as standard.
      1) Self-diagnostic function
      2) Auto restart function
      3) Auto changeover function (Heat Recovery system only)
      4) Auto operation function
      5) Child lock function
      6) Forced operation
      7) Dual thermistor control
      8) Sleep mode
      9) External static pressure (ESP) control
4. Fan Assembly
   a. The unit shall have two direct driven Sirocco fans.
   b. The fan shall be made of high strength ABS GP-2200 polymeric resin.
   c. The fans shall be mounted on a common shaft.
   d. The fan motor shall be Brushless Digitally controlled (BLDC) with permanently lubricated and sealed ball bearings.
   e. The fan/motor assembly shall be mounted on vibration attenuating rubber grommets.
   f. The fan speed shall be controlled using microprocessor based direct digitally controlled algorithm.
   g. In cooling mode, the indoor fan shall have the following settings: Low, Med, High and Auto.
   h. In heating mode, the indoor fan shall have the following settings: Low, Med, High and Auto.
   i. The Auto fan setting shall adjust the fan speed to most effectively achieve the set-point.
   j. Each of the settings can be field adjusted from the factory setting (RPM/ESP).
   k. Unit shall be designed for high speed air volume against an external static pressure of up to 1.0” water gauge.
5. Filter Assembly
   a. The return air inlet shall have a factory supplied removable, washable filter.
   b. The filter access shall be from the rear of the unit.
   c. <Optional><Return filter box with high-efficiency filter shall be field provided and installed not to exceed external static pressure limitation of the high static ducted indoor unit.>
      1) <The unit shall have provision to mate directly with high efficiency filter box to accommodate 1” or 2” thick field provided MERV rated filter>.
      2) <LG/Dynamic> <supplied Air cleaner shall be compatible with the ducted unit.>
6. Coil Assembly

a. Unit shall have a factory built coil comprised of aluminum fins mechanically bonded on copper tubing.
b. Unit shall have minimum of 2 rows of coils.
c. Unit shall have a factory supplied condensate drain pan below the coil.
d. Unit shall be installed, and wired condensate drain pump capable of providing minimum 27.5 inch lift from bottom surface of the unit.
e. Unit drain pan shall be provided with a secondary drain port/plug allowing pan to be drained for service.
f. The drain pump shall have a safety switch to shut off the unit if condensate rises too high in the drain pan.
g. Unit shall have provision of 45° flare refrigerant pipe connections.
h. The coil shall be factory pressure tested at a minimum of 551 psig.
i. All refrigerant piping from outdoor unit or Heat Recovery (HR) unit to indoor unit shall be field insulated.

7. Microprocessor Control
   a. The unit shall have a factory installed microprocessor controller capable of performing functions necessary to operate the system.
   b. The unit shall be able to communicate with other indoor units and the outdoor unit using a field supplied minimum of 18 AWG, 2 core, stranded and shielded communication cable.
   c. The unit controls shall operate the indoor unit using one of the five operating modes:
      1) Auto changeover (Heat Recovery System only)
      2) Heating
      3) Cooling
      4) Dry
      5) Fan only
8. Electrical
   a. The unit electrical power shall be 208-230/1/60 (V/Ph/Hz)
   b. The unit shall be capable of operating within voltage limits of +/- 10% of the rated voltage.
9. Controls
   a. Unit shall use controls provided by the manufacturer to perform all functions necessary to operate the system effectively and efficiently and communicate with the outdoor unit over an RS485 daisy chain.

D. Ducted – Low Static (Convertible)
1. General
   a. Unit shall be manufactured by <LG>.
   b. Unit shall be factory assembled, wired, piped, and run tested.
   c. Unit shall be designed to be installed for indoor application.
   d. Unit shall be a low profile design with a maximum height of 8 inches.
   e. Unit shall be designed to mount fully concealed above the finished ceiling.
   f. Unit shall have opening for supply air from front horizontal with a rear horizontal return.
   g. Unit shall be capable of field convertible bottom return.
   h. The supply air opening shall be flanged for field installed ductwork that shall not exceed the external static pressure limitation of the unit.
   i. Unit shall be capable to be installed with heat pump or heat recovery or cooling VRF system.
2. Casing/Panel
   a. Unit case shall be manufactured using galvanized steel plate.

b. The cold surfaces of the unit shall be covered internally with a coated polystyrene insulating material.
c. Unit shall be provided with hanger brackets designed to support the unit weight on four corners.
d. Hanger brackets shall have pre-punched holes designed to accept field supplied, all thread rod hangers.

3. Cabinet Assembly
   a. Unit shall have supply air discharge outlets horizontal and one return air inlet horizontal.
   b. Unit shall be equipped with factory installed temperature thermistors for
      1) Return air
      2) Refrigerant entering coil.
      3) Refrigerant leaving coil.
   c. Unit shall have a factory assembled, piped, and wired electronic expansion valve (EEV) for refrigerant control.
   d. Unit shall have a built-in control panel to communicate with other indoor units and to the outdoor unit.
   e. Unit shall have the following functions as standard.
      1) Self-diagnostic function
      2) Auto restart function
      3) Auto changeover function (Heat Recovery system only)
      4) Auto operation function
      5) Child lock function
      6) Forced operation
      7) Dual thermistor control
      8) Sleep mode
      9) External static pressure (ESP) control
4. Fan Assembly
   a. The unit shall have two direct driven Sirocco fans.
   b. The fan shall be made of high strength ABS HT-700 polymeric resin.
   c. The fans shall be mounted on a common shaft.
   d. The fan motor shall be Brushless Digitally controlled (BLDC) with permanently lubricated and sealed ball bearings.
   e. The fan/motor assembly shall be mounted on vibration attenuating rubber grommets.
   f. The fan speed shall be controlled using microprocessor based direct digitally controlled algorithm.
   g. In cooling mode, the indoor fan shall have the following settings: Low, Med, High and Auto.
   h. In heating mode, the indoor fan shall have the following settings: Low, Med, High and Auto.
   i. The Auto fan setting shall adjust the fan speed to most effectively achieve the set-point.
   j. Each of the settings can be field adjusted from the factory setting (RPM/ESP).
   k. Unit shall be designed for low static pressure up to 0.08 inches external static pressure.
5. Filter Assembly
   a. The return air inlet shall have a factory supplied removable, washable filter.
   b. The filter access shall be from the rear of the unit.
6. Coil Assembly
   a. Unit shall have a factory built coil comprised of aluminum fins mechanically bonded

on copper tubing.
b. Unit shall have minimum of 2 rows of coils.
c. Unit shall have a factory supplied condensate drain pan below the coil.
d. Unit shall be installed, and wired condensate drain pump capable of providing minimum 27.5 inch lift from bottom surface of the unit.
e. The drain pump shall have a safety switch to shut off the unit if condensate rises too high in the drain pan.
f. Unit shall have provision of 45° flare refrigerant pipe connections.
g. The coil shall be factory pressure tested at a minimum of 551 psig.
h. All refrigerant piping from outdoor unit or Heat Recovery (HR) unit to indoor unit shall be field insulated.

7. Microprocessor Control
   a. The unit shall have a factory installed microprocessor controller capable of performing functions necessary to operate the system.
   b. The unit shall be able to communicate with other indoor units and the outdoor unit using a field supplied minimum of 18 AWG, 2 core, stranded and shielded communication cable.
   c. The unit controls shall operate the indoor unit using one of the five operating modes:
      1) Auto changeover (Heat Recovery System only)
      2) Heating
      3) Cooling
      4) Dry
      5) Fan only
8. Electrical
   a. The unit electrical power shall be 208-230/1/60 (V/Ph/Hz)
   b. The unit shall be capable of operating within voltage limits of +/- 10% of the rated voltage.
9. Controls
   a. Unit shall use controls provided by the manufacturer to perform all functions necessary to operate the system effectively and efficiently and communicate with the outdoor unit over an RS485 daisy chain.

2.04 CONTROLS

A. Quality Assurance
   1. The units shall be manufactured in a facility registered to ISO 9001 and ISO 14001, which are environmental protection standards set by the International Organization for Standardization (ISO).
   2. All wiring shall be in accordance with the National Electrical Code (NEC).
   3. The units shall be listed by Electrical Testing Laboratories (ETL) and bear the ETL label.

B. Storage and Handling
   1. All VRF controllers shall be stored and protected from weather, extreme temperature, etc., as suggested by the manufacturer. All LG VRF controllers shall be moved, lifted, etc., as suggested by the manufacturer.

C. Controls and Accessories shall be warranted by the manufacturer’s limited warranty for replacement of malfunctioning components and specific software upgrades to meet application engineering needs for one (1) year from the date of original retail purchase.

D. The VRF system shall be installed by a licensed mechanical contractor trained by the VRF equipment manufacturer or installation professional.

E. Commissioning shall be performed by the manufacturer or installation professional.

F. Wired Remote Controller:
1. Overview:
2. The wired remote controller shall be capable of controlling up to sixteen indoor units (one group) as a single zone. The Wired Remote Controller shall be capable of monitoring and controlling the group in terms of on/off, mode of operation, airflow direction, fan speed, space temperature, and space temperature set point based on the available functions of the connected system. Additionally, the Wired Remote Controller shall be capable of providing seven-day programmable scheduling of occupied/unoccupied settings, on/off, mode of operation, set point and fan speed.
3. General:
   a. The wired remote controller shall be compatible with LG Multi V™ VRF indoor units.
   b. The wired remote controller shall communicate to the VRF indoor unit via the VRF RS-485 daisy-chain communication protocol.
   c. The wired remote controller shall have a 5” backlit touchscreen LCD display with screensaver capability.
   d. The wired remote controller shall have an internal time clock and calendar.
   e. The wired remote controller shall be able to control two set point auto operation of indoor units.
   f. The wired remote controller shall be able to display temperature in °F or °C based on user settings.
   g. The wired remote controller shall be able to monitor and control up to sixteen indoor units (one group) as a single zone.
   h. Up to two wired remote controllers shall be connectable to a single group and operate in a master/slave configuration.
   i. The wired remote controller shall be able to limit the temperature set point range for heating and cooling modes.
4. Basic Functions:

Function	Description	Monitor	Control
On/Off	On/Off operation for group	X	X
Mode of Operation	Mode of operation for group (Heat/Cool/Fan/Dry/Auto)	X	X
Set Point	Space temperature set point for group setting. Setting temperature range 64°F to 84°F. Separate heat/cool set point settings for auto mode. *Set Point ranges dependent on operation mode and connected equipment.	X	X
Space Temperature	Display measured space temperature	X	
Fan Speed	Select fan speeds Hi-Mid1-Mid2-Low-Auto	X	X
Airflow Direction	Select air direction settings Auto/Swing/Fixed	X	X
Override control	Ability to set a timed override of indoor units	X	X
Lock setting	Ability to lock out controller operation	X	X

Filter check	Notification to change dirty filter	X	
Temperature setpoint range limit	Ability to limit heating and cooling set point ranges	X	X

Available functions/features may differ based on connected system.

5. Advanced Functions:

Function	Description	Monitor	Control
Schedule	Seven-day programmable schedule. Minimum of five events per day with On/Off, Occupied/Unoccupied, Mode, Set temperature, and Fan Speed selectable per event.	X	X
Yearly Schedule	Programmable by month using weekly schedule	X	X
Holiday Schedule	One time event (user programmable)	X	X
Timed Override	Timed override of Unoccupied settings	X	X
Occupied/Unoccupied Setting	Ability to have different settings for both modes	X	X
Energy Use Display	Display actual operational time and power consumption	X	
Operation Time Limit	Limit the run time of an indoor unit	X	X
Auto Changeover Deadband Adjust	Ability to adjust deadband between indoor unit heating and cooling modes	X	X
Time/Date	Display current time and date	X	X
Auxiliary Heat Control	Ability		
Elevation Grille	Operate elevation grille for indoor unit filter cleaning	X	X
Ventilation	Ability to operate a ventilation kit for indoor units	X	X
Dehumidification	Ability to remove moisture from the air	X	X
Plasma filter	Ability to clean indoor air	X	X
Error Code	Display code upon an indoor unit malfunction	X	
Two set point auto operation	Automatically manage room temperature for heating and cooling	X	X

Available functions/features may differ based on connected system.

6. Electrical:
    1. The remote controller shall be powered via the indoor unit remote controller communication bus. Power shall be 24 VDC.

G. Programmable Remote Controller:

1. Overview:

The programmable wired remote controller shall be capable of controlling up to sixteen indoor units (one group). The programmable wired remote controller shall be capable of monitoring and controlling the group in terms of On/Off, Mode of Operation, Airflow direction,

Fan Speed, space temperature, and space temperature set point based on the available functions of the connected system. Additionally, the programmable wired remote controller shall be capable of providing seven day programmable scheduling of Occupied/Unoccupied settings, On/Off, Mode of Operation, set point and fan speed.

2. General:
   a. The LG Programmable Wired Remote Controller shall be compatible with LG Multi V™ VRF indoor units.
   b. The LG Programmable Wired Remote Controller shall communicate to the VRF indoor unit via the VRF RS-485 daisy chain communication protocol.
   c. The LG Programmable Wired Remote Controller shall have a 4-1/4" backlit LCD display with screen saver capability.
   d. The LG Programmable Wired Remote Controller shall have an internal time clock and calendar.
   e. The LG Programmable Wired Remote Controller shall be able to display temperature in °F or °C based on user settings.
   f. The LG Programmable Wired Remote Controller shall be able to monitor and control up to sixteen indoor units (one group) as a single zone.
   g. Up to 2 LG Programmable Wired Remote Controllers shall be connectable to a single group and operate in a master/slave configuration.
3. Basic Functions:

Function	Description	Monitor	Control
On/Off	On/Off operation for group	X	X
Mode of Operation	Mode of Operation for group (Heat/Cool/Fan/Dry/Auto)	X	X
Set Point	Space temperature setpoint for group. Setting temperature range 64-84°F. Separate Heat/Cool setpoints settings for Auto Mode. *Set Point ranges dependent on operation mode and connected equipment.	X	X
Space Temperature	Display measured space temperature	X	
Fan Speed	Select fan speeds Hi-Mid1-Mid2-Low-Auto	X	X
Airflow Direction	Select air direction settings Auto/Swing/Fixed	X	X
Lock setting	Ability to lock out operation of the controller	X	X
Filter check	Notification to change dirty filter	X	
Dehumidification	Ability to remove moisture from the air	X	X
Temperature setpoint range limit	Ability to limit heating and cooling setpoint ranges	X	X

Available functions/features may differ based on connected system.

4. Advanced Functions:

Function	Description	Monitor	Control
Schedule	7-day programmable schedule Minimum of 5 events per day with On/Off, Occupied/Unoccupied, Mode, Set temperature,	X	X

	and Fan Speed selectable per event.		
Timed Override	Timed override of Unoccupied settings	X	X
Occupied/Unoccupied Setting	Ability to have different settings for both modes	X	X
Energy Use Display	Display actual operational time and power consumption	X	
Operation Time Limit	Limit the run time of an indoor unit	X	X
Auto Changeover Deadband Adjust	Ability to adjust deadband between indoor unit heating and cooling modes	X	X
Set back	Ability to change heating and cooling setpoints	X	X
2 setpoint auto operation	Automatically manage room temperature for heating and cooling	X	
Central Control display	Display if a signal is received from Central Control	X	X
Interlocking	Ability to interlock with 3rd party devices	X	

Available functions/features may differ based on connected system.

5. Electrical:
   a. The remote controller shall be powered via the indoor unit remote controller communication bus. Power shall be 24 VDC.

H. SIMPLE REMOTE CONTROLLER

a. Overview:

The Simple Remote Controller shall be capable of monitoring and controlling up to 16 indoor units (1 group). The Simple Remote Controller shall be capable of controlling the group in terms of On/Off, Mode of Operation, Fan Speed, and space temperature set point based on the available functions of the connected system. Additionally, the Simple Remote Controller Remote Controller will be available with or without Mode of Operation control, and offered in two colors, black or white.

1. General:
   a. The Simple Remote Controller shall be compatible with LG Multi V™ VRF indoor units.
   b. The Simple Remote Controller shall communicate to the VRF indoor unit via included communications cable.
   c. The Simple Remote Controller shall be approximately 2-3/4” W x 4-3/4” H x 9/16” D in size.
   d. The Simple Remote Controller shall have an internal infrared receiver for use with the Handheld Wireless Remote Controller for VRF systems.
   e. The Simple Remote Controller shall be able to display temperature in °F or °C based on user settings.
   f. The Simple Remote Controller shall be able to monitor and control up to sixteen indoor units (one group) as a single zone.
   g. Up to two Simple Remote Controllers shall be connectable to a single group and operate in a master/slave configuration.
   h. The Simple Remote Controller shall be shipped with a communications cable for connection to VRF indoor units.
2. Basic Functions:

Function	Description	Monitor	Control

On/Off	On/Off operation for group	X	X
Mode of Operation	Mode of Operation for group (Heat/Cool/Fan/Dry/Auto)	X	X
Set Point	Space temperature set point for group. Setting temperature range 64°F-84°F depending on operation mode and connected equipment.	X	X
Space Temperature	Display measured space temperature	X	
Fan Speed	Select fan speeds	X	X

Available functions/features may differ based on connected system.

3. Electrical:
   The Simple Remote Controller shall be powered via the VRF indoor units.

B. Remote Temperature Sensor: PQRSTA0

1. Overview:
   The PQRSTA0 Remote Temperature Sensor for LG Multi V™ VRF systems shall be capable of measuring space temperature remotely for LG Multi V™ VRF indoor units.
2. General:
   a. The Remote Temperature Sensor shall be compatible with LG Multi V™ VRF indoor units.
   b. The Remote Temperature Sensor shall communicate to the LG Multi V™ VRF indoor unit via included fifty-foot communications cable.
   c. The Remote Temperature Sensor shall be approximately 2-3/4" W x 4-3/4" H x 9/16" D in size.
   d. The Simple Remote Controller shall be shipped with a communications cable for connection to LG Multi V™ VRF indoor units.
3. Basic Functions:

Function	Description	Monitor	Control
Space Temperature	Measured space temperature.	X	

Available functions/features may differ based on connected system.

C. LG AC SMART IV: PACS4B000

1. Overview:
   The Central Controller shall be capable of monitoring and control of up to 128 indoor units or 130 Input/Outputs points through its touchscreen interface and embedded web browser. The LG AC Smart IV shall provide multiple energy management schemes and control of third-party equipment when paired with associated I/O controllers. Additionally, the LG AC Smart IV Central Controller shall be capable of providing daily, weekly, yearly, and holiday programmable scheduling of Occupied/Unoccupied settings, On/Off, Mode of Operation, set point and fan speed based on the available functions of the connected system.
2. General:
   a. The Central Controller shall communicate to the LG Multi V™ VRF indoor unit via the VRF RS-485 daisy-chain communication protocol.
   b. The Central Controller shall have a 10.2” backlit touchscreen LCD display screen.
   c. The Central Controller shall have web access with user control.
   d. The Central Controller shall be able to generate an operation and error history log with reporting capabilities.
   e. The Central Controller shall be able to control up to 128 indoor units in a group or as

a single zone.

f. The Central Controller shall support two digital input and two digital outputs for device interlock.
g. The Central Controller shall have two set point auto changeover.
h. The Central Controller shall have occupied/unoccupied set point control.
i. The Central Controller shall have remote controller lock (All, Setpoint, Mode, and Fan Speed).
j. The Central Controller shall have error e-mail notification.
k. The Central Controller shall have visual floor plan navigation.

3. Basic Functions:

Function	Description	Monitor	Control
On/Off	On/Off operation for group	X	X
Mode of Operation	Mode of Operation for group (Heat/Cool/Fan/Auto/Dry)	X	X
Set Point	Space temperature setpoint for group. Setting temperature range 64°F-84°F depending on operation mode and connected equipment.	X	X
Space Temperature	Display measured space temperature	X	
Fan Speed	Select fan speeds Hi-Mid1-Mid2-Low-Auto	X	X
Airflow Direction	Select air direction settings Auto/Swing/Fixed	X	X
Group Control	Control and monitor a group or multiple groups	X	X
Operational and Event Log History	Record system operation and fault code history	X	
Language Selection	Choice of multiple languages		X

Available functions/features may differ based on connected system.

4. Advanced Functions:

Function	Description	Monitor	Control
Schedule	Daily, Weekly, Yearly and Holiday programmable schedule Minimum of five events per day with On/Off, Occupied/Unoccupied, Mode, Set temperature, and Fan	X	X
Timed Override	Timed override of Unoccupied settings	X	X
Occupied/Unoccupied Setting	Ability to have different settings for both modes	X	X
Energy Use Display	Display actual operational time and power consumption.	X	X
Operation Run Time Limit	Limit the run time of an indoor unit	X	X
Two setpoint auto operation	Automatically manage room temperature for heating and cooling	X	X
Error E-Mail	Send E-Mail when a system failure has been	X	X

Notification	detected		
Peak/Demand Control	Control and Limit power consumption of external devices	X	X
Temperature setpoint range limit	Ability to limit heating and cooling setpoint ranges	X	X
Remote controller Lock setting	Ability to lock out operation of the controller	X	X

Available functions/features may differ based on connected system.

5. Electrical:
   a. The Central controller shall be powered via 24 VAC or 12 VDC.

D. ADVANCED CONTROL PLATFORM

1. Overview:
   The Advanced Control Platform (ACP) Central Controller shall be capable of controlling up to 256 indoor units or 130 Input/Output points through its embedded web browser. The ACP provides multiple energy management schemes and control of third-party equipment when paired with associated Input/Output controllers. Additionally, the ACP IV Central Controller shall be capable of providing daily, weekly, yearly, and holiday programmable scheduling of Occupied/Unoccupied settings, On/Off, Mode of Operation, set point and fan speed based on the available functions of the connected system.
2. General:
   a. The ACP Central Controller shall communicate to LG Multi V™ VRF indoor units via the VRF RS-485 daisy chain communication protocol.
   b. The ACP Central Controller shall have web browser graphical user interface access with user control.
   c. The ACP Central Controller shall have operation and error history log with reporting capabilities.
   d. The Central Controller shall be able to control up to 256 indoor units in groups or as a single zone.
   e. The ACP Central Controller shall have two set point auto changeover.
   f. The ACP Central Controller shall have occupied/unoccupied set point control.
   g. The ACP Central Controller shall have remote zone controller lockout (Set point, Mode).
   h. The ACP Central Controller shall have error e-mail notification.
   i. The ACP Central Controller shall be able to control up to 64 devices by refrigerant circuit.
3. Basic Functions:

Function	Description	Monitor	Control
On/Off	On/Off operation for group	X	X
Mode of Operation	Mode of Operation for group (Heat/Cool/Fan/Auto/Dry)	X	X
Set Point	Space temperature setpoint for group. Setting temperature range 64°F-84°F depending on operation mode and connected equipment.	X	X
Space Temperature	Display measured space temperature	X	

	through graphical interface		
Fan Speed	Select fan speeds Hi-Mid1-Mid2-Low-Auto	X	X
Airflow Direction	Select air direction settings Auto/Swing/Fixed	X	X
Group Control	Control and monitor a group or multiple groups	X	X
Selectable Temperature	°F or °C		

Available functions/features may differ based on connected system.

4. Advanced Functions:

Function	Description	Monitor	Control
Schedule	Daily, Weekly, Yearly and Holiday programmable schedule Minimum of 5 events per day with On/Off, Occupied/Unoccupied, Mode, Set temperature, and Fan	X	X
Timed Override	Timed override of Unoccupied settings	X	X
Occupied/Unoccupied Setting	Ability to have different settings for both modes	X	X
Energy Use Display	Display actual operational time and power consumption.	X	X
Operation Run Time Limit	Limit the run time of an indoor unit	X	X
Auto Changeover Deadband Adjust	Automatically manage room temperature for heating and cooling	X	X
Web Browser Interface	Graphical web browser interface	X	X

Available functions/features may differ based on connected system.

5. Electrical:
   a. Advanced Control Platform Central Controller Power shall be 24 VAC.

E. LG AC Smart BACNET Gateway: PBACNA000

1. Overview:
   The Smart BACnet Gateway shall be capable of monitoring and control of up to 128 devices (including indoor units, ERV, DI/DOs, DOKITS, AWHPs, AHUs) or 64 devices (including indoor units, ERV, DI/DOs, DOKITS, AWHPs and AHUs) and 9 I/O Modules through its touchscreen interface and embedded web browser. The LG AC Smart BACnet Gateway shall provide multiple energy management schemes and control of third-party equipment when paired with associated I/O Module. Additionally, the LG AC Smart BACnet Gateway shall be capable of providing daily, weekly, yearly, and holiday programmable scheduling of Occupied/Unoccupied settings, On/Off, Mode of Operation, set point and fan speed based on the available functions of the connected system.
2. General:
   a. The AC Smart BACnet Gateway shall communicate to the LG Multi V™ VRF indoor unit via the VRF RS-485 daisy-chain communication protocol.
   b. The AC Smart BACnet Gateway shall communicate to a third-party Building

Automation System via BACnet/IP.

c. The AC Smart BACnet Gateway shall have a 10.2” backlit touchscreen LCD display screen.
d. The AC Smart BACnet Gateway shall have web access with user control.
e. The AC Smart BACnet Gateway shall be able to generate an operation and error history log with reporting capabilities.
f. The AC Smart BACnet Gateway shall be able to control up to 128 indoor units in a group or as a single zone.
g. The AC Smart BACnet Gateway shall support two digital input and two digital outputs for device interlock.
h. The AC Smart BACnet Gateway shall have two set point auto changeover.
i. The AC Smart BACnet Gateway shall have occupied/unoccupied set point control.
j. The AC Smart BACnet Gateway shall have remote controller lock (All, Setpoint, Mode, and Fan Speed).
k. The AC Smart BACnet Gateway shall have error e-mail notification.
l. The AC Smart BACnet Gateway shall have visual floor plan navigation.

3. Basic Functions

Function	Description	Monitor	Control
On/Off	On/Off operation for group	X	X
Mode of Operation	Mode of Operation for group (Heat/Cool/Fan/Auto/Dry)	X	X
Set Point	Space temperature setpoint for group. Setting temperature range 64°F-84°F depending on operation mode and connected equipment.	X	X
Space Temperature	Display measured space temperature	X	
Fan Speed	Select fan speeds Hi-Mid1-Mid2-Low-Auto	X	X
Airflow Direction	Select air direction settings Auto/Swing/Fixed	X	X
Group Control	Control and monitor a group or multiple groups	X	X
Operational and Event Log History	Record system operation and fault code history	X	
Language Selection	Choice of multiple languages		X

Available functions/features may differ based on connected system.

4. Advanced Functions:

Function	Description	Monitor	Control
Schedule	Daily, Weekly, Yearly and Holiday programmable schedule Minimum of five events per day with On/Off, Occupied/Unoccupied, Mode, Set temperature, and Fan	X	X
Timed Override	Timed override of Unoccupied settings	X	X
Occupied/Unoccupied Setting	Ability to have different settings for both modes	X	X
Energy Use Display	Display actual operational time and power consumption.	X	X

Operation Run Time Limit	Limit the run time of an indoor unit	X	X
Two setpoint auto operation	Automatically manage room temperature for heating and cooling	X	X
Error E-Mail Notification	Send E-Mail when a system failure has been detected	X	X
Peak/Demand Control	Control and Limit power consumption of external devices	X	X
Temperature setpoint range limit	Ability to limit heating and cooling setpoint ranges	X	X
Remote controller Lock setting	Ability to lock out operation of the controller	X	X

Available functions/features may differ based on connected system.

5. Electrical:
   a. The AC Smart BACnet Gateway shall be powered via 24 VAC or 12 VDC.

F. LG ACP IV BACNET GATEWAY

1. Overview:
   The LG Advanced Control Platform (ACP) BACnet™ Gateway shall be capable of controlling up to 256 indoor units and 64 outdoor units through its embedded web browser. The ACP BACnet Gateway provides multiple energy management schemes and integrates with third-party Building Automation Systems. Additionally, the LG ACP BACnet Gateway shall be capable of providing daily, weekly, yearly, and holiday programmable scheduling of Occupied/Unoccupied settings, On/Off, Mode of Operation, set point and fan speed based on the available functions of the connected system.
2. General:
   a. The ACP BACnet Gateway shall communicate to the Multi V VRF indoor unit via the VRF RS-485 daisy chain communication protocol.
   b. The ACP BACnet Gateway shall communicate to a third-party Building Automation System via BACnet/IP.
   c. The ACP BACnet Gateway shall have web browser graphical user interface access with user control.
   d. The ACP BACnet Gateway shall have operation and error history log with reporting capabilities.
   e. The ACP BACnet Gateway shall be able to monitor and control up to 256 indoor units in groups or as a single zone.
   f. The ACP BACnet Gateway shall have two setpoint auto changeover.
   g. The ACP BACnet Gateway shall have occupied/unoccupied setpoint control.
   h. The ACP BACnet Gateway shall have remote zone controller lockout (Setpoint, Mode).
   i. The ACP BACnet Gateway shall be BTL certified.
   j. The ACP BACnet Gateway shall be able to support registration as a foreign device.
3. Basic Functions:

Function	Description	Monitor	Control
On/Off	On/Off operation for group	X	X
Mode of Operation	Mode of Operation for group	X	X

	(Heat/Cool/Fan/Auto/Dry)		
Set Point	Space temperature setpoint for group. Setting temperature range 64°F-84°F depending on operation mode and connected equipment.	X	X
Space Temperature	Display measured space temperature through graphical interface	X	
Fan Speed	Select fan speeds Hi-Mid1-Mid2-Low-Auto	X	X
Airflow Direction	Select air direction settings Auto/Swing/Fixed	X	X
Group Control	Control and monitor a group or multiple groups	X	X
Selectable Temperature	Degree °F or Degree °C		

Available functions/features may differ based on connected system.

4. Advanced Functions:

Function	Description	Monitor	Control
Schedule	Daily, Weekly, Yearly and Holiday programmable schedule Minimum of 5 events per day with On/Off, Occupied/Unoccupied, Mode, Set temperature, and Fan	X	X
Timed Override	Timed override of Unoccupied settings	X	X
Occupied/Unoccupied Setting	Ability to have different settings for both modes	X	X
Energy Use Display	Display actual operational time and power consumption.	X	X
Operation Run Time Limit	Limit the run time of an indoor unit	X	X
Auto Changeover Deadband Adjust	Automatically manage room temperature for heating and cooling	X	X
Web Browser Interface	Graphical web browser interface	X	X

Available functions/features may differ based on connected system.

5. Electrical:
   a. Advanced Control Platform (ACP) BACnet Gateway Power shall be 24VAC.

G. LG ADVANCED CONTROL PLATFORM (ACP) LONWORKS GATEWAY

1. Overview:

The LG Advanced Control Platform (ACP) LonWorks ™ Gateway shall be capable of controlling up to 64 indoor units and 16 outdoor units through its embedded web browser. The ACP LonWorks Gateway provides multiple energy management schemes and integrates with third-party Building

Automation systems. Additionally, the LG ACP LonWorks Gateway shall be capable of providing daily, weekly, yearly, and holiday programmable scheduling of Occupied/Unoccupied settings, On/Off, Mode of Operation, set point and fan speed based on the available functions of the connected system.

2. General:
   a. The ACP LonWorks Gateway shall communicate to the Multi V VRF indoor unit via the VRF RS-485 daisy chain communication protocol.
   b. The ACP LonWorks Gateway shall have web browser graphical user interface access with user control.
   c. The ACP LonWorks Gateway shall have operation and error history log with reporting capabilities.
   d. The ACP LonWorks Gateway shall be able to monitor and control up to 64 indoor units in groups or as a single zone.
   e. The ACP LonWorks Gateway shall have two setpoint auto changeover.
   f. The ACP LonWorks Gateway shall have occupied/unoccupied set point control.
   g. The ACP LonWorks Gateway shall have remote zone controller lockout (setpoint, mode).
   h. The ACP LonWorks Gateway shall have error e-mail notification.
3. Basic Functions:

Function	Description	Monitor	Control
On/Off	On/Off operation for group	X	X
Mode of Operation	Mode of Operation for group (Heat/Cool/Fan/Auto/Dry)	X	X
Set Point	Space temperature setpoint for group. Setting temperature range 64°F-84°F depending on operation mode and connected equipment.	X	X
Space Temperature	Display measured space temperature through graphical interface	X	
Fan Speed	Select fan speeds Hi-Mid1-Mid2-Low-Auto	X	X
Airflow Direction	Select air direction settings Auto/Swing/Fixed	X	X
Group Control	Control and monitor a group or multiple groups	X	X
Selectable Temperature	Degree °F or Degree °C		

Available functions/features may differ based on connected system.

4. Advanced Functions:

Function	Description	Monitor	Control
Schedule	Daily, Weekly, Yearly and Holiday programmable schedule Minimum of 5 events per day with On/Off, Occupied/Unoccupied, Mode, Set temperature, and Fan	X	X

Timed Override	Timed override of Unoccupied settings	X	X
Occupied/Unoccupied Setting	Ability to have different settings for both modes	X	X
Energy Use Display	Display actual operational time and power consumption	X	X
Operation Run Time Limit	Limit the run time of an indoor unit	X	X
Auto Changeover Deadband Adjust	Automatically manage room temperature for heating and cooling	X	X
Web Browser Interface	Graphical web browser interface	X	X

Available functions/features may differ based on connected system.

5. Electrical:
   a. LG Advanced Control Platform (ACP) LonWorks Gateway Power shall be 24 VAC.

END OF SECTION

SECTION 23 81 27 - SPLIT-SYSTEM HEAT PUMP

PART 1 - GENERAL

1.01 SUMMARY

A. Section includes split-system air-conditioning and heat-pump units consisting of separate evaporator-fan and compressor-condenser components.

1.02 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.
B. Shop Drawings: 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.

1.03 INFORMATIONAL SUBMITTALS

A. Warranty: Sample of special warranty.

1.04 CLOSEOUT SUBMITTALS

A. Operation and maintenance data.

1.05 QUALITY ASSURANCE

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. ASHRAE Compliance:
   1. Fabricate and label refrigeration system to comply with ASHRAE 15, "Safety Standard for Refrigeration Systems."
   2. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 4 - "Outdoor Air Quality," Section 5 - "Systems and Equipment," Section 6 - " Procedures," and Section 7 - "Construction and System Start-up."
C. ASHRAE/IESNA Compliance: Applicable requirements in ASHRAE/IESNA 90.1.

1.06 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of split-system air-conditioning units that fail in materials or workmanship within specified warranty period.
   1. Warranty Period:
      a. For Compressor: Five year(s) from date of Substantial Completion.
      b. For Parts: One year(s) from date of Substantial Completion.
      c. For Labor: One year(s) from date of Substantial Completion.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Carrier Corporation.
2. Daikin
3. Lennox Industries, Inc.
4. Trane.
5. YORK; a Johnson Controls company.

2.02 INDOOR UNITS (5 TONS OR LESS)

A. Concealed Evaporator-Fan Components:
1. Chassis: Galvanized steel with flanged edges, removable panels for servicing, and insulation on back of panel.
2. Insulation: Faced, glass-fiber duct liner.
3. Refrigerant Coil: Copper tube, with mechanically bonded aluminum fins and thermal-expansion valve. Comply with ARI 206/110.
4. Electric Coil: Helical, nickel-chrome, resistance-wire heating elements; with refractory ceramic support bushings, automatic-reset thermal cutout, built-in magnetic contactors, manual-reset thermal cutout, airflow proving device, and one-time fuses in terminal box for overcurrent protection.
5. Fan: Forward-curved, double-width wheel of galvanized steel; directly connected to motor.
6. Fan Motors:
   a. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements specified in Section 230513 "Common Motor Requirements for HVAC Equipment."
   b. Multitapped, multispeed with internal thermal protection and permanent lubrication.
   c. Wiring Terminations: Connect motor to chassis wiring with plug connection.
7. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.
8. Filters: Permanent, cleanable.
9. Condensate Drain Pans:
   a. Fabricated with two percent slope in at least two planes to collect condensate from cooling coils (including coil piping connections, coil headers, and return bends) and humidifiers, and to direct water toward drain connection.
      1) Length: Extend drain pan downstream from leaving face to comply with ASHRAE 62.1.
      2) Depth: A minimum of 2 inches deep.
   b. Single-wall, galvanized-steel sheet.
   c. Drain Connection: Located at lowest point of pan and sized to prevent overflow. Terminate with threaded nipple on one end of pan.
      1) Minimum Connection Size: NPS 1.5-inch
   d. Pan-Top Surface Coating: Asphaltic waterproofing compound.
   e. Units with stacked coils shall have an intermediate drain pan to collect condensate from top coil.
10. Condensate overflow switch

11. Low leakage Cabinet (Qleak) less than 2%.

2.03 OUTDOOR UNITS -5 TONS OR LESS

A. Air-Cooled, Compressor-Condenser Components:
   1. Casing: Steel, finished with baked enamel in color selected by Architect, with removable panels for access to controls, weep holes for water drainage, and mounting holes in base. Provide brass service valves, fittings, and gage ports on exterior of casing.
   2. Compressor: Hermetically sealed with crankcase heater and mounted on vibration isolation device. Compressor motor shall have thermal- and current-sensitive overload devices, start capacitor, relay, and contactor.
      a. Compressor Type: Scroll.
      b. Two-speed compressor motor with manual-reset high-pressure switch and automatic-reset low-pressure switch.
      c. Refrigerant Charge: R-410A.
      d. Refrigerant Coil: Copper tube, with mechanically bonded aluminum fins and liquid subcooler. Comply with ARI 206/110.
   3. Heat-Pump Components: Reversing valve and low-temperature-air cutoff thermostat.
   4. Fan: Aluminum-propeller type, directly connected to motor.
   5. Motor: Permanently lubricated, with integral thermal-overload protection.
   6. Low Ambient Kit

2.04 ACCESSORIES

A. Control equipment and sequence of operation are specified in Section 230933 Automatic Temperature Control or 230933 Building Automation System
B. Solid-State Thermostat: Wall-mounted programmable, microprocessor-based unit with automatic switching from heating to cooling, preferential rate control, seven-day programmability with minimum of four temperature presets per day, vacation mode, and battery backup protection against power failure for program settings. Automatic-reset timer to prevent rapid cycling of compressor.
C. Refrigerant Line Kits For 5 Tons and Under: Soft-annealed copper suction and liquid lines factory cleaned, dried, pressurized, and sealed; factory-insulated suction line with flared fittings at both ends.
D. Drain Hose: For condensate.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Install units' level and plumb.
B. Install evaporator-fan components using manufacturer's standard mounting devices securely fastened to building structure.
C. Install roof-mounted, compressor-condenser components on equipment support curbs.
D. Equipment Mounting:
   1. Install ground-mounted, compressor-condenser components on cast-in-place concrete equipment base(s). The base shall be a minimum of 4" thick and set on 6"s of crushed stone.
   2. Install ground-mounted, compressor-condenser components on polyethylene mounting base.

3. Comply with requirements for vibration isolation devices specified in Section 230548.13 "Vibration Controls for HVAC."

E. Coordinate the electrical requirements of the unit with the electrical contractor prior to ordering or installing the equipment.
F. Furnish and install all controls and control wiring. Wiring shall be in accordance with the NEC. Control wiring above the roof shall be in galvanized steel conduit with watertight fittings.
G. Installations shall be in accordance with the instructions of the manufacturer and meet all requirements.
H. Protect and be responsible for equipment until accepted in place by the owner.
I. Provide condensate drain and discharge to a suitable discharge point which shall be acceptable to the owner and A/E.
J. Contractor shall interlock the air handling unit controls with the remote condensing unit and electric resistance heaters. Contractor is to furnish and install an air proving switch or current sensor at the air handler's blower and be interlocked with the associated condensing unit and electric resistance heater controls to shut down if power to the blower is disconnected.
K. All filters shall be new at time of acceptance by the owner.

3.02 CONNECTIONS

A. Piping installation requirements are specified in other Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
B. Where piping is installed adjacent to unit, allow space for service and maintenance of unit.
C. Duct Connections: Duct installation requirements are specified in Section 233113 "Metal Ducts." Drawings indicate the general arrangement of ducts. Connect supply and return ducts to split-system air-conditioning units with flexible duct connectors. Flexible duct connectors are specified in Section 233300 "Air Duct Accessories."

3.03 FIELD QUALITY CONTROL

A. Perform tests and inspections.
   1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
B. Tests and Inspections:
   1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
   2. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
   3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
C. Remove and replace malfunctioning units and retest as specified above.
D. Prepare test and inspection reports.
E. Any equipment mars, blemishes, scratches, abrasions, or other surface imperfections shall be sanded, primed, and refinished to match adjacent surfaces.
F. No equipment will be accepted by the owner which has rust, corrosion, or otherwise in progress.
G. Equipment shall not be used for temporary heat unless separately negotiated with the owner.
H. All bare ferrous metal shall be painted prior to acceptance.

3.04 DEMONSTRATION

A. Train Owner's maintenance personnel to adjust, operate, and maintain units.

END OF SECTION

SECTION 23 83 33 - ELECTRIC HEATERS AND HEAT TRACING

PART 1 - GENERAL

1.01 REFERENCE

A. Refer to Section 23 05 00 for requirements which are applicable to this section.
B. Refer to International, NFPA, NEC, and UL requirements for standards relating to these specifications.

1.02 WORK INCLUDED

A. Provide labor, material, equipment, and supervision necessary to install and place into operation all of the equipment specified in this section.

1.03 SUBMITTALS

A. Submit manufacturers shop drawings and catalog data sheets of all items in this section.

1.04 QUALITY ASSURANCE

A. Verify that all equipment is installed in accordance with the manufacturer's instructions.
B. Provide benchmark construction for review of the owner and architect prior to installation of remaining units. Benchmark unit shall, after review and approval, become the standard against which all other units will be matched.

PART 2 - PRODUCTS

2.01 ELECTRIC BASEBOARD

A. U.L. Listed, 250 watt per foot density, full length curtain guard, continuous rug guard, 18 gauge steel front cover.
B. Automatic linear cutout over entire length of heat element.
C. Continuous raceway, either end connection junction box, aluminum finned metal sheath heating element.
D. Remote wall mounted thermostat wired by this contractor.
E. Inside and outside corners as required for installation.
F. Manufactured by Berko, Markel, QMark or preapproved equal

2.02 WALL MOUNTED ELECTRIC HEATERS

A. Unit to be UL listed, 16 gauge front panel, baked enamel finish, fully enclosed fan motor permanently lubricated, with integral thermostat.

B. Units to be by QMark, Markel, Berko or preapproved equal

2.03 CABINET UNIT HEATERS

A. Unit to be UL listed, cold rolled steel enclosure with baked enamel finish, direct drive blower and motor, 2 speed, overheat protection, integral thermostat, and cleanable filters.
B. Manufactured by QMark, Markel, Berko or preapproved equal

2.04 WALL MOUNTED AND PEDESTAL HEATERS

A. Unit to be U.L. listed and of the size and capacity indicated on the drawings.
B. Units shall have top extruded aluminum grille and two finished sides. Heating elements shall be cal-rod type element installed within aluminum tubes mechanically expanded into aluminum fins and suspended between junction boxes, factory installed raceway, and baked enamel finish in color selected by the Architect.
C. Manufacturers; QMark, Markel, Berko or preapproved substitute.

2.05 FAN FORCED WALL HEATERS

A. Unit to be U. L. listed and of the size and capacity indicated on the drawings.
B. Overheat protection, integral thermostat, nickel chromium alloy heating elements, permanently lubricated motor, 3 position switch.
C. Finish to be selected by Architect.
D. Manufacturers: QMark, Markel, Berko, or preapproved substitute.

2.06 ELECTRIC UNIT HEATERS - SUSPENDED

A. Built in or remote thermostat as indicated on the drawings.
B. Mounting brackets.
C. Totally enclosed, permanently lubricated motor.
D. Element steel finned sheath, zinc plated.
E. Auto reset cutout, UL listed.
F. Manufacturer: Markel, Berko, QMark or preapproved equal

2.07 ELECTRIC PIPELINE HEAT TRACING

A. Furnish and install where required by specification or indicated on the drawings, a complete system of electrical heat tracing. The trace shall be a mineral insulated cable of copper or copper alloy sheathed heating element in dielectric refractory material. Piping is to be appropriately marked as required by NEC 427.13.
B. Furnish cable in lengths and wattages required to maintain the pipe above 40 degrees at an outside temperature of 10 degrees. All piping shall be insulated after installation of the heating element. Use 3 watts per ft. for piping up to and including 1 inch in diameter, 4 watts per ft for piping to and including 2 inch, 5 watts per ft. for piping to and including 3 inch, 7 watts per ft. for 4 inch, and 10 watts per ft. for 6 inch. Allow an additional 15 % for valves and fittings.
C. Cable shall be Type MI as manufactured by Chromalox, Raychem or approved substitute and be complete with adjustable thermostat for each location.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Coordinate locations and rough-in requirements with other trades prior to installation.
B. Coordinate electrical requirements with the electrical contractor prior to purchasing equipment. Verify voltages and amperages for feeders.
C. Provide for benchmark construction as described above.
D. Adjust, place in service, and provide instructions, guarantees, and maintenance manuals to the owner.
E. Install electrical heat tracing cable in conformance with the manufacturer's recommendations. Test heating circuits before insulating. Arrange with electrical contractor for electrical power circuits.

END OF SECTION

CONTENTS

DIVISION 26 - ELECTRICAL
DIVISION 28 - ELECTRONIC SAFETY AND SECURITY

DIVISION 26 - ELECTRICAL

SECTION 26 00 00 - STANDARD CONDITIONS FOR ELECTRICAL WORK

PART 1 - GENERAL

1.01 REGULATIONS, CODES, STANDARDS

A. Reference Codes, applicable sections of the following codes and standards shall be considered as binding to the work of this project:

NEMA	National Electrical Manufacturers' Association
NEC	National Electrical Code (NFPA 70) - 2017 Edition
NECA	National Electrical Contractors' Association
NEIS	National Electrical Installation Standards
EGSA	Electrical Generating Systems Association
IBC	International Building Code
NFPA	National Fire Protection Association
IEEE	Institute of Electrical and Electronics Engineers
UL	Underwriter's Laboratories, Inc.
IES	Illuminating Engineering Society
OSHA	Occupational Safety and Health Administration
ANSI	American National Standards Institute
ASTM	American Society for Testing and Materials
FM	Factory Mutual
IRI	Industrial Risk Insurers
ISO	Insuring Services Office
IPCEA	Insulated Power Cable Engineers Assoc.
ADA	Americans with Disability Act
NETA	International Electrical Testing Association

B. All local codes are to be incorporated.
C. The latest adopted codes and latest editions of standards shall be the basis of conformance.
D. Obtain and pay for all permits and inspections, and any associated charges.
E. Inspection Agency Certificate of Inspection to be provided at completion of the work. Inspection by Middle Department Inspection Agency, Inc., or other local inspection agency.
F. Drawings, Contract, General Conditions and Supplementary Conditions form a part of this section, by reference thereto and shall have the same force and effect as if printed herewith in full. Failure to review these sections shall not relieve the Contractor of his responsibility to fully comply with the terms therein.
G. Where the contract documents are more stringent but not in conflict with the applicable codes, the more stringent requirements shall be followed.

1.02 SUBMITTALS

A. The procedure for submissions of shop drawings shall be as specified in Division 1, or as a minimum, as indicated below.
B. Furnish submissions of shop drawings and samples of materials and equipment as indicated in these sections, on the drawings, or as directed by the architect/ engineer. Submissions will be made

in a timely fashion such that adequate time exists to review the drawings, or material, and arrive at the site in accordance with the project schedule.

C. Submissions will not be accepted with work defined as "By Others". Identify contractor by name and with his approval so indicated. Submissions are required prior to purchasing, fabrication, or installation of any material or equipment. Submissions shall be reviewed and certified by the submitting contractor that they are in accordance with the project documents.

D. When requested by the engineer, shop drawings shall be required to be submitted to designated agencies for review and approval prior to submission to the engineer.

E. Contractor shall arrange and pay for all tests and inspections specified herein or required by above agencies and furnish required certificate of inspection to owner.

F. Contractor shall provide performance test data and wiring diagrams of all electrical equipment.

G. Submissions shall include warrantees by the manufacturer for equipment being provided. Submissions for commonly related items such as fixtures, trim, carriers, shall be combined in a single brochure clearly identifying all items being furnished.

H. Shop drawings and submittals shall be checked and stamped by the contractor before submitting. They shall conform to measurements made at the site, the contract requirements, and shall be coordinated with all other trades.

I. Specific models in catalog sheets must be identified as well as all options, voltages, phases, etc. identified to be clear as to what is being provided.

J. Contractor and manufacturers shall be responsible for all physical characteristics of the equipment and field verify with final locations, coordinate with floor plans, confirm service access, clearances, confirm equipment arrangements, electrical disconnect clearances, and pathways/ travel/ access to the final equipment installation locations. Submission of equipment shop drawing will be deemed evidence of compliance with this requirement. If no shop drawing is submitted, contractor shall be fully responsible for a complete installation and assumes all related costs that affects the contractor and other trades.

K. To aid in the preparation of submittals or shop drawings, the engineer can provide the electronic files for use by the contractor. The electronic files will be provided upon execution of the engineer’s electronic file release contract prepared specifically for this project. The electronic files will be released in the format used by the architect and engineer to design the project. If this file format is not compatible with the contractor’s needs, additional charges for providing the changes to the requested file format may be necessary at $150.00 per hour billable to the contractor.

1.03 SUBSTITUTIONS

A. Substitution of other than specified manufacturers shall not be allowed after bid date.

B. Prior approval is required for other manufacturers. If the contractor wishes for alternate materials or equipment to be considered, he must submit information at least ten days prior to the bid date. If acceptable, an addendum will be issued allowing the contractor to utilize the approved alternate.

C. Samples shall be provided when directed by the architect or engineer.

D. If the contractor submits alternate equipment, manufacturers, systems, methods, or materials not specifically identified in the specifications, additional review and investigation time may be required by the engineer. If the engineer determines additional review time is required because of the substitution, then this will be a billable service provided by the engineer at the rate of $150.00 per hour. Also billable will be any redesign time and revisions to drawings should they be necessary for incorporation into the work. Services will be billable to the contractor making such substitutions and will be payable prior to approval, or rejection.

E. If the contractor elects to submit alternate equipment, manufacturers, systems, methods, or materials, not specifically identified in the drawings and specifications, it is the contractor’s responsibility to coordinate the work with other trades and pay for any associated costs with the

substitution or change.

F. Contractor and manufacturers shall be responsible for all physical characteristics of the equipment and field verify with final locations, coordinate with floor plans, confirm service access, clearances, confirm equipment arrangements, electrical disconnect clearances, and pathways/travel/access to the final equipment installation locations. Submission of equipment shop drawing will be deemed evidence of compliance with this requirement. If no shop drawing is submitted, contractor shall be fully responsible for a complete installation and assumes all related costs that affects the contractor and other trades.

1.04 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Deliver materials and equipment in manufacturer's original cartons or on skids.
B. Store materials in dry enclosure out of way of work progress.
C. Protect equipment, fixtures, and lenses after placement.

1.05 REFERENCE

A. Requirements established within the portions of this Project Manual titled Division 1, General Requirements are collectively applicable to the work of this section.
B. Instructions to Bidders, Special Conditions and Addenda as issued are part of this specification.
C. Electrical drawings along with all other project drawings represent the work of this Division.
D. Drawings, Contract, General Conditions and Supplementary Conditions form a part of this section, by reference thereto and shall have the same force and effect as if printed herewith in full. Failure to review these sections shall not relieve the Contractor of his responsibility to fully comply with the terms therein.

1.06 WORK SUMMARY

A. Provide labor, materials, equipment, and supervision necessary to install complete, operating electrical systems as indicated on the drawings and specified herein, including all work at the site and within the proposed construction areas to accomplish the require work.
B. Contractor shall provide all demolition necessary to remove, replace, repair, install new or modify existing work whether it be walls, floors, ceilings, structure, mechanical or electrical required to install his work. Contractor shall replace all work to leave in a finished condition. Pipe, conduit, ductwork, and wiring shall be cut back behind wall surfaces above ceilings and below floor levels so that a patch can be placed over the opening.
C. Demolition:
    1. Contractor shall disconnect and remove luminaires, conduit, wiring, supports, fasteners, fire alarm devices and wiring, battery packs, and controls.
    2. Electrical contractor shall verify all existing conditions prior to commencing work.
    3. Remove branch circuits back to the power source or the nearest device to remain active. Restore all circuits interrupted by the demolition work to maintain circuit continuity.
    4. Label all overcurrent protection devices made "spare" due to demolition. Update all panelboard directories impacted by the demolition.
    5. Relocate existing branch circuits which interfere with new construction whether specifically identified or not. Refer to architectural drawings for new walls, structure, millwork, etc. which may require existing conduit, wire, etc. to be relocated.
    6. It is the intent that power remain active in adjacent areas during the construction. Contractor is to modify existing wiring arrangement to comply.
    7. All equipment and appurtenances removal are to be disposed of properly. Refer to local,

state, and federal requirements.

D. All work shown on the drawings and not expressly mentioned in the specifications and all work specified but not shown on the drawings, but necessary for the proper execution of same shall be performed by the contractor. It is not the intent of the drawings and specifications to describe every feature and detail of the work.
E. No additions to the contract amount will be approved for any materials, equipment, or labor to perform additional work unless it can be clearly shown to be beyond the scope and intent of the drawings and specifications.
F. Provide roof penetrations for electrical work and all associated roof work.
G. Provide 3 phase, 4 wire electrical service of the size as indicated on the drawings at 208Y/120 V with distribution to all equipment 208V, luminaires and general-purpose receptacles at 120V.
H. Provide a power system study. The study is to include short-circuit, protective device evaluation, protective coordination study and arc fault evaluation studies.
I. Provide addressable fire alarm system expansion with battery back-up, speaker/ strobes, pull stations, detectors, strobes, duct detectors, remote annunciator, and all associated controls and appurtenances.
J. Provide exit and emergency luminaires throughout with emergency power supply in addition to normal power.
K. Provide power to HVAC and plumbing equipment as necessary to have complete, operating systems.
L. Provide luminaires throughout, with exterior luminaires at all egress doors.
M. Provide grounding system for facility in accordance with the NEC.
N. Base bid is to provide all panelboards and all feeders as copper conductors. Alternate bid is to provide all as aluminum conductors of equivalent current carrying capacity.
O. Provide code required signage (i.e., NEC 110.34, NEC 700.8, and 695.4 B3).
P. Provide third-party certification of all packaged systems by a Nationally Recognized Testing Laboratory (NRTL) in accordance with OSHA Federal Regulations 29CFR1910.303 and .399 as well as Pamphlet #70 and NEC Article 90.7.
Q. Refer to Commissioning of Systems Specification for additional scope of work.

1.07 SITE INSPECTION

A. Visit site, inspect, and become aware of all conditions which may affect the work. Investigate utilities, protection requirements for adjacent facilities, storage locations, and access to the construction area.
B. Submission of a bid will be deemed evidence of being in compliance with this requirement. Contractor may not request additional costs for existing conditions which were evident from inspection of the site.
C. Before ordering materials or commencing with any work, the contractor shall verify all measurements at the building. Coordination of equipment, materials, spaces, and dimensions are the responsibility of the contractor.

1.08 UTILITY CONNECTION AND CHARGES

A. The contractor shall be responsible for coordination of the work with the Electric Utility Company. Make all arrangements in a timely fashion for connection of the service.
B. The Electrical Contractor shall be responsible for utility connection charges, meter charges, and other installation charges as may be applied by the local utility company.
C. Contact the utility company during the bidding period for connection charges and include same with bid.

D. Provide connections, terminations, handholes, manholes, pads, transformers, vaults, conduits, wiring, and all required materials and labor as may be required by the utility company to obtain service for the facility. Any costs for service work shall be included in the bid.

1.09 DRAWINGS AND SPECIFICATIONS

A. Drawings and specifications are intended to be taken as a whole and each is to supplement the other. It is not intended that all work must be both shown on drawings and specified in the specifications.
B. An item shown on the drawings and not indicated in the specifications is to be understood to be required for the project. An item specified and not shown on the drawings is to be understood to be required for the project.
C. If there is a conflict between the drawings and specifications it is to be understood that the more strict or more expensive interpretation shall govern. Also, if a conflict exists between specification sections or between drawing plans and details, it is to be understood that the more strict or more expensive interpretation shall govern.
D. The architect's or engineer's interpretation of the documents shall be binding upon the contractor. If a question arises, the contractor shall ask for an interpretation prior to bidding and an answer shall be issued as an addendum to all bidders.
E. If a question arises after bidding the architect's and/ or engineer's interpretation shall govern.
F. The drawings are generally diagrammatic and necessary field coordination and adjustment must be provided by the contractor prior to installation. Such deviations to the work to allow for coordination shall be kept to a minimum and any such deviations shall be at no extra cost.

1.10 MINIMUM INTEGRATED EQUIPMENT SHORT CIRCUIT RATING:

A. Where the contract documents indicate secondary service from the utility Company (208/120V, 3 phase, or 480/277V, 3 phase) available short circuit currents including system motor contribution (amperes RMS symmetrical) at the line terminals of the UL service entrance labeled main distribution panelboard or switchboard, shall be in accordance with the following tabulation:

Service Minimum	**Service Entrance**	**Panelboard Rating**	**Transformer Rating**
kVA	%Z	208/ 120V	480/ 277V
75	1.5	14,500	10,000
112.5	1.5	22,000	10,000
125	1.5	29,000	13,000
225	1.5	43,000	19,000
300	1.5	58,000	25,000
500	1.5	96,000	42,000
750	5.5	42,200	18,000
1000	5.5	56,100	24,500
1500	5.5	85,000	37,000
2000	5.5		49,000
2500	5.5		51,000
3000	5.5		73,500

B. The Integrated Equipment short circuit rating of the main distribution panel, or switchboard shall meet or exceed the tabulated minimum values. This shall be construed to mean that the equipment withstands capability (bus-bracing), and interrupting capacities of main and feeder devices, shall

each meet or exceed the tabulated minimum values.

C. Service transformer ratings shall be as indicated on the drawings. If said ratings are not indicated, the contractor shall contact the engineer and/ or utility company for clarification.

D. The only deviations from this tabulation that are permissible shall be the results of a short circuit study (if and as specified in Section 26 05 73 Power System Studies), or documented data from the utility company.

1.11 PROGRESS SCHEDULE

A. Provide a project schedule which shall show start, sequence of each type of work, milestone schedule, and completion of each type of work, with overall completion date.

1.12 COST SCHEDULE

A. Provide a detailed cost breakdown indicating labor and material amounts for various types of work.

B. AIA forms are required for this submission.

1.13 OFFICE

A. The contractor shall set up his job office (desk) where directed by the owner.

1.14 STORAGE

A. Material shall be stored only where directed by the owner.

1.15 SANITARY

A. The contractor will at his own expense, provide and maintain in a sanitary condition, a portable chemical toilet.

B. Toilet will be located where directed by the owner.

PART 2 - PRODUCTS

2.01 GENERAL

A. All materials and equipment shall be new and in present production of major manufacturers.

B. All materials and equipment shall be in conformance with accepted trade standards as a minimum. Where specifications exceed any minimum standard, the specifications shall govern.

C. Reference of equipment in the singular shall be deemed to apply to as many such items as may be required to complete the work.

D. The word “provide” means “furnish and install complete, tested, and adjusted as necessary with all accessories, wiring methods, switching, lenses, mounting hardware, cover plates, hangers and supports”.

2.02 FASTENERS AND SUPPORTS

A. All work shall be securely fastened to building construction.

B. Utilize toggle or machine bolts in hollow construction.
C. Utilize machine screws for steel construction.
D. Utilize expansion shields for masonry construction.
E. Utilize lag bolts for wood construction.
F. All fasteners shall be galvanized or plated with rustproof finish.
G. Maximum load on fasteners shall be at a safety factor of 4:1 for a tested sample.

2.03 MOTOR STARTERS AND CONTACTORS

A. Single-phase manual motor starters with overloads shall be provided under the electrical portion of the work for fractional horsepower motors up to ½ HP.
B. Polyphase motor starters and motor starters above ½ HP shall be furnished under other portions of the work.
C. The starters in A, or B above shall be installed under the electrical portion of the work.
D. Polyphase starters shall be magnetic combination type, across-the-line, electrically operated, electrically held, three-pole assemblies, with arc-extinguishing characteristics, silver-to-silver renewable contacts, three-pole thermal bi-metallic, red “run” pilot light, individual phase protection, with overload heaters matched to motors installed and with four auxiliary contacts, Hand-Off-Auto switch, and control transformer.
E. For single-phase motors above ½ HP provide magnetic combination, single-phase motor starters with overloads, non-fusible disconnect switch, red run pilot light, integral 120 volt control transformer with dual primary fusing, auxiliary contacts.
F. Starters shall be as manufactured by G.E., Cutler Hammer, Siemens, Square D or Allen Bradley.
G. Contactors shall be across-the-line, electrically operated, mechanically held three-pole assemblies for tungsten and ballast luminaire loads. Acceptable manufacturers: GE, Cutler Hammer, Siemens, Square D or Allen-Bradley.
H. Manual motor starters without overloads in NEMA 1 enclosure equal to G. E. Type TC shall be used for the following load:
    1. 30 amperes or less, continuous.
    2. 1 HP or less at 120 volts
    3. 2 HP or less at 240 volts

2.04 MANUFACTURERS’ NAMES

A. Manufacturers’ names are included herein to establish those suppliers who may provide products for this project subject to the requirements of the specifications. Although a manufacturer’s name may appear as an acceptable supplier it is not understood that a standard product is acceptable. Products must also meet the technical, performance, and physical requirements of the project as well as being named in the specification. Any deviations from this must be acknowledged during the bid phase by the supplier, who shall be solely responsible for any and all costs associated with the application of their product(s) in the project.
B. A design cannot be prepared which accommodates the installation of all suppliers and is not intended to do so. If certain modifications must be made to accommodate one particular supplier’s equipment it shall be considered the contractor’s responsibility to arrange for such accommodations and be financially responsible for same.

PART 3 - EXECUTION

3.01 WELDING

A. All electric power for arc welding shall be supplied by the contractor performing the work.

3.02 VEHICLES

A. Vehicle access to the site will be as directed by the owner.

3.03 RUBBISH DISPOSAL

A. Except for items or materials identified to be reused, salvaged, reinstalled, or otherwise indicated to remain property of the owner or tenant, demolished materials shall become the contractor's property and shall be removed, recycled, or disposed from the project site in an appropriate and legal manner.
B. Burning of debris on the site shall not be permitted. All debris, refuse, and waste shall be removed from the premises at regular intervals. No accumulation shall be permitted.

3.04 WORKMANSHIP

A. Maintain all public walks and access ways.
B. Erect and maintain barricades, warning signs, and other protective means as may be directed by the owner for protection of all persons and property from injury or damage.
C. Plug or cap open ends of piping systems and conduit.
D. Stored materials shall be covered to prevent damage by inclement weather, sun, dust, or moisture.
E. Protect all installed work until accepted in place by the owner. Protect luminaires.
F. Do not install plates, covers, and other finished devices until masonry, title, and painting operations are complete, or protect otherwise.
G. Protect all existing or new work from operations which may cause damage such as hauling, welding, soldering, painting, insulation and covering.
H. All devices and exposed raceways are to be plumb and true. All exposed raceways in finished areas are to be coordinated with the architect/engineer prior to installation.

3.05 SCAFFOLDING

A. The contractor shall at his own expense, install, operate, protect, and maintain temporary services such as scaffolding, material hoists, access walks, etc., as may be required.

3.06 SITE UTILITIES

A. The contractor may use the existing water and electric power for temporary construction needs.
B. The owner will direct where these services may be tapped.
C. Those services that are used during construction, but are to remain, shall be refurbished to a new condition before turning back over to the owner.

3.07 CLEAN-UP

A. Remove all visible temporary tags or labels as well as any protective coverings and wrappings from fixtures and equipment.
B. Remove all spots, stains, soil, paint, spackle, and other foreign matter from all finished work.

C. Remove all trash and debris from the premises.

3.08 LUBRICATION

A. Furnish and install and maintain all required lubrication of any equipment operated prior to acceptance by the owner. Lubrication shall be as recommended by the equipment manufacturer.
B. Provide one year's supply of lubricants to owner at date of acceptance.
C. Verify that required lubrication has taken place prior to any equipment start-up.

3.09 EQUIPMENT START UP

A. Verify proper installation by manufacturer or his representative.
B. Advise the architect and engineer two days prior to actual start up.
C. Verify proper operation. Obtain signed statement by manufacturer or his representative that equipment is operating within warranty requirements. Submit statement to the architect and engineer.

3.10 OPERATING INSTRUCTIONS AND MANUALS

A. Properly and fully instruct owner's personnel in the operation and maintenance of all systems and equipment.
B. Ensure that the owner's personnel are familiar with all operations to carry on required activities.
C. Such installation shall be for each item of equipment and each system as a whole.
D. Provide report that instruction has taken place. Include in the report the equipment and/ or systems instructed, date, contractor, owners' personnel, vendor, and that a full operating and maintenance manual has been reviewed.
E. Manual shall include all instructions on operation, maintenance, repair parts list, lubrication requirements, brochures, catalog cuts, wiring diagrams, piping diagrams, control sequences, service requirements, names and addresses of vendors, suppliers, and emergency contacts. Three manuals shall be provided to owner.
F. Submit manuals for review prior to operating instruction period. Manuals shall be 8 1/2" x 11" with hard cover, suitably bound.
G. Provide to the owner any special tools necessary to operate any of the equipment.

3.11 PENETRATION SEALING

A. All penetrations of Natatorium walls, fire walls, smoke walls, and floors shall be sealed around conduits and wiring to prevent the flow of gases or smoke.
B. The sealant shall be foamed in place between the conduit or wiring and the adjacent walls and floors with Dow/ Corning RTV foam or Fire Stop Caulk.
C. All penetrations through roof structure shall be coordinated with other trades to minimize the potential for water seepage and leakage through such penetrations.
D. When electrical boxes are located on opposite side of a fire resistance rated wall assembly are within 2'-0" horizontally of each other, both devices are to be wrapped with Spec Seal Putty Pads as manufactured by Specified Technologies, Inc., or approved equivalent.

3.12 EQUIPMENT SETTING

A. Furnish and install as a minimum, a 0'-4" high concrete pad beneath all floor-mounted equipment.
B. Furnish and install as a minimum, spring vibration isolators under any equipment 10 HP and over

and rubber-in-shear vibration isolation under all equipment less than 10 HP.

C. Reinforce concrete with No. 4 rods 12'-0” on center, both ways.

D. Pad to have 3/4" dowels into concrete at one per four square feet.

3.13 INSTALLATION MOUNTING HEIGHTS

A. To be verified by Architect, but in general shall be as follows (top of device elevation above finished floor):

Lighting switches, controls:	3’-10”
Duplex receptacles:	1’-8”
Duplex receptacles over counters:	0’-8" above countertop
Telephone data wall plate and modular jack, desk phone:	1’-8”
Telephone, data wall plate and modular jack, wall phone:	3’-10”
Special outlets:	As required for equipment
Fire alarm annunciating devices:	85"
Fire alarm manual pull stations:	3’-10”
Clock receptacles:	As indicated on drawings.
CATV wall plates and modular jacks:	1’-8”
CATV wall plates and modular jacks mounted near ceiling:	Coordinate mounting height with Architect.
Thermostats (forward reach):	3’-10”
Thermostats (side reach):	3’-10”
Thermostats with lockable cover:	4’-6”

Requirements of the Americans with Disability Act and/or ANSI A117.1 shall be met.

B. Structural and mechanical details shall be coordinated before roughing in.

3.14 COORDINATION

A. Coordinate with work of other trades prior to installation.

B. Arrange for minor variations for complete coordinated installation. Provide all necessary offsets to install the work and to provide clearances for other trades.

3.15 CUTTING AND PATCHING

A. Provide for cutting and patching for all electrical work.

B. Patching to be performed by tradesmen skilled in that particular trade.

C. Contractor shall patch and repair any existing openings created by the demolition work in floors, walls, partitions, and ceilings not being reused for the new construction.

3.16 BALANCING AND TESTING

A. Electrically balance connected loads in panels.

B. The entire wiring system shall be tested to be free from grounds and faults.

C. Identify all circuits and all phase wiring at terminations.

3.17 EQUIPMENT FURNISHED BY OTHERS

A. This contractor shall make final electrical connections to equipment furnished by other contractors or the owner.
B. Provide electrical service, and disconnect equipment as required by code to supply such equipment.

3.18 EXCAVATION, SHORING, PUMPING, BACKFILLING

A. Perform all excavation required to install the work. Deposit excavated material as so not to create a slide hazard.
B. Maintain excavations free of water.
C. Backfill with clean material and pneumatically tamp in 0’-8” layers. Remove excess material, including rock, from site or as directed by the architect and engineer.
D. Return to original conditions any areas disturbed for excavation.
E. Install all work neatly, trim, and plumb with building lines.
F. Install work in spaces allocated.
G. Cutting and patching shall be performed by skilled tradesmen normally employed for the work involved.

3.19 RECESSES

A. Furnish information to the General Contractor as to sizes and locations of recesses required to install panels, boxes, grilles, and other equipment, and/ or devices which are to be recessed in walls.
B. Make offsets or modifications as required to suite final locations.

3.20 LABELING

A. All equipment panels, controls, safety switches, and devices shall be provided with permanent black laminated micarta white core labels with 3/8” high letters.
B. This shall also apply to all controllers, remote start/ stop pushbuttons, equipment cabinets, and wherever directed by the architect and engineer.
C. This shall not apply to individual room thermostats, and local light switches.

3.21 GUARANTEE

A. All work shall be guaranteed to be free from defects for a period of one year of operation from date of acceptance by the owner unless otherwise specified.
B. Guarantee shall be extended for all non-operational periods due to failure within the guarantee period.

3.22 AS BUILT DRAWINGS

A. At the completion of the work and prior to final payment, the contractor shall furnish a reproducible as-built drawing to the architect and engineer for approval. The drawings shall indicate all work installed and its actual size, and location and identify all systems installed with locations of concealed devices, conduit, piping and other equipment and complete wiring diagrams of all systems. If acceptable, the architect and engineer will submit the as-built drawings to the owner as record drawings. If not acceptable, the architect and engineer return the drawing to the contractor to make corrections as required. The contractor will resubmit for approval.
B. The as-built drawings shall indicate measured dimensions of underground lines and other concealed

work.

C. To aid in the preparation of as-built drawings, the engineer can provide the electronic files for use by the contractor. The electronic files will be provided upon execution of the engineer's electronic file release contract prepared specifically for this project. The electronic files will be released in the format used by the architect and engineer to design the project. If this file format is not compatible with the contractor's needs, additional charges for providing the changes to the requested file format may be necessary at $150.00 per hour billable to the contractor.

3.23 MAIN ELECTRICAL ROOM DRAWING

A. Provide 3/8" = 1'-0" scale drawings of the Main Electrical Room indicating all electrical, mechanical, plumbing, telephone, security, fire alarm and life safety equipment to be installed within this room. Exact dimensions of equipment, pads, etc., are to be indicated. Show two cross sections at important points.
B. Obtain information from other subs as appropriate.
C. Submit for review and approval along with electrical equipment submittals. Equipment will not be approved prior to review of this drawing.

3.24 WORK COMPLETION

A. The contractor shall promptly correct work rejected by the engineer or failing to conform to the requirements of the contract documents, whether discovered before or after Substantial Completion and whether or not fabricated, installed, or completed. Costs of correcting such rejected work, including additional testing and inspections and compensation for the engineer's services and expenses made necessary thereby, shall be at the contractor's expense.

3.25 REQUEST FOR INFORMATION (RFI) REQUIREMENTS

A. All RFI's shall include the following information based on AIA Document G716:
   1. To, From, Project Name, Issue Date, RFI number in sequential order with all other trades, Requested Reply Date.
   2. Provide a description with specification and/or drawing references.
   3. Provide the senders recommendation including cost and/or schedule considerations.
   4. Provide receiver's reply space.
   5. Note an RFI reply is not an authorization to proceed with the work involving additional cost/time.

3.26 SHOP DRAWING REQUIREMENTS

A. The following is a list of required shop drawings for this project.

ELECTRICAL	**DATE REC'D**	**ACTION**	**DATE REC'D**	**ACTION**
Basic Materials and Equipment (Section 26 05 00 and 26 27 00)				
High Voltage Cable and Equipment				
Fusible Switchboard (Section 26 24 13)				

ELECTRICAL	DATE REC'D	ACTION	DATE REC'D	ACTION
Panelboards (Section 26 24 16)				
Bus Duct (Section 26 25 00)				
Safety Switches - (Section 26 28 16)				
Automatic Transfer Switch (Section 26 36 23)				
Secondary Unit Substation (Section 26 11 16)				
Packaged Meter Centers (Section 26 27 13)				
Transformers (Section 26 22 00)				
Surge Suppression (Section 26 43 13)				
Lighting (Section 26 50 00 and 26 09 00)				
Lightning Protection (Section 26 41 13)				
Emergency Power System (Section 26 30 00)				
Static Uninterruptible Power Supply (Section 26 33 53)				
Fire Alarm and Detection Systems (Section 28 30 00)				
Low Voltage Systems (CCTV, Security, DATA, Phone Entry, etc.)				
As-Builts				
Warranties				
Maintenance Manuals				
Instructions				
Ground Test				

END OF SECTION

SECTION 26 01 26 - EXISTING EQUIPMENT TO BE REUSED

PART 1 - GENERAL

1.01 REFERENCE

A. Refer to section 26 00 00 for requirements which are applicable to this section.
B. Refer to National Electrical Testing Association Standards, particularly NETA MTS-1997 and NETA ATS-1999.

1.02 WORK INCLUDED

A. Provide all labor, material, equipment, and supervision necessary to refurbish existing equipment as specified herein and place into operation.
B. All work and accessories required to perform the intended work is to be included in the scope of work.

1.03 QUALITY ASSURANCE

A. Verify that all equipment is installed in accordance with the manufacturer's recommendations.
B. Install systems and equipment in accordance with current applicable codes.
C. Provide adequate supervision of labor force to see that installations are complete and correct.
D. Testing Agency’s Field Supervisor and/ or Technicians are to be certified according to NETA ETT-2000.

1.04 SCOPE

A. It is the intent to totally refurbish existing equipment to as-new operating condition and efficiency. All parts to be made operable, corrosion removed, repainted, adjusted, cleaned, lubricated, and repaired as necessary.
B. Schedule outages with owner to minimize downtown. Have parts and supplies for repairs available beforehand.

PART 2 - PRODUCTS

2.01 PARTS

A. Replacement parts shall be manufactured by the original equipment supplier or approved substitute. Any substitute shall be submitted to the engineer for approval prior to use.

PART 3 - EXECUTION

3.01 PANELBOARDS, SWITCHBOARDS, LOAD CENTERS

A. Visually inspect enclosures, bus, and all cable terminations. Report signs of cable overheating, insulation degradation, excessive moisture, rust, etc.
B. Clean, wire-brush, and paint all corroded and rusted areas with Rustoleum/ Gavanoleum to match existing.
C. Undo cable terminations, as necessary. Clean with approved electrical cleaner and reconnect to manufacturer's recommended torque.
D. Replace existing overcurrent protection devices with new devices of similar kAIC ratings. This applies to all overcurrent protection devices rated 100 Amps, or less, and more than 20 years old.
E. Switchboard fused switches are to be cycled on/ off several times to ensure operability. Lubricate pivot point(s) as necessary, and/ or as recommended by the manufacturer.
F. Provide fuse clamps for each fused switchboard switch exceeding 100 Amps.

3.02 SAFETY SWITCHES

A. Visually inspect enclosure, bus, or cable terminations. Report signs of cable overheating, insulation degradation, excessive moisture, rust, etc.
B. Clean, wire-brush, and paint all corroded and rusted areas with Rustoleum/ Gavanoleum to match existing.
C. Cycle switch(es) on/ off to ensure operability. Lubricate pivot point(s) as necessary as recommended by manufacturer.
D. Replace switch as necessary.

3.03 AUTOMATIC TRANSFER SWITCHES

END OF SECTION

SECTION 26 05 00 - FIRE-STOPPING

PART 1 - GENERAL

1.01 SUMMARY

A. Refer to section 26 00 00 for requirements which are applicable to this section.
B. Refer to International codes.
C. Section includes:
   1. Through-penetration fire stops and smoke-stops for all fire-rated bearing and non-bearing wall and floor assemblies, both blank (empty) and those accommodating penetrating items such as cables, conduits, pipes, ducts, etc.

1.02 REFERENCES

A. American Society for Testing and Materials Standards (ASTM):
   1. ASTM E84: Standard Test Method for Surface Burning Characteristics of Building Materials.
   2. ASTM E814: Standard Test method for Fire Tests of Through-Penetration Fire Stops.
B. Underwriters Laboratories, Inc.:
   1. UL 723 Surface Burning Characteristics of Building Materials
   2. UL 1479 Fire Tests of Through-Penetration Fire Stops.
C. UL Fire Resistance Directory:
   1. Through Penetration Fire Stop Devices (XHJI)
   2. Fire Resistive Ratings (BXUV)
   3. Through Penetration Fire Stop Systems (XHEZ)
   4. Fill, Void, or Cavity Material (XHHW)

1.03 DEFINITIONS

A. FIRE-STOPPING: The use of a material or combination of materials in a fire rated structure (wall or floor) where it has been breached to restore the integrity of the fire rating on that wall or floor.
B. SYSTEM: The use of a specific fire stop material or combination of materials in conjunction with a specific wall or floor construction type and a specific penetrant(s), constitutes a “System.”
C. BARRIER: Any bearing or non-bearing wall or floor that has an hourly fire and smoke rating.
D. THROUGH-PENETRATION: Any penetration of a fire-rated wall or floor that completely breaches the barrier.
E. MEMBRANE-PENETRATION: Any penetration in a fire rated wall that breaches only one side of the barrier.
F. CONSTRUCTION GAPS: any gap, joint, or opening, whether static or dynamic, where the top of a wall may meet a floor; wall-to-wall applications; edge-to-edge floor configurations; floor-to-exterior wall; or any linear breach in a rated barrier. Where movement is required, the fire stopping system must comply with UL2079 for dynamic joints.

1.04 SUBMITTALS

NOTE: A “Certificate of Conformance” from the manufacturers listed in Section “2.02 ACCEPTABLE MANUFACTURERS,” is required with the “Submittal Package” to ensure that the material selected meets all

of the criteria of this specification as set forth in Section “1.05 QUALITY ASSURANCE.”

A. Submit manufacturer’s product literature for each type of fire-stop material to be installed. Literature shall indicate product characteristics, typical uses, performance and imitation criteria, and test data. Submittal shall comply with Section 26 00 00.
B. Material Safety Data Sheets (MSDS): Submit MSDS for each fire-stop product.
C. UL Tested Systems: Submit drawings showing typical installation details for the methods of installation. Indicate which fire-stop materials will be used and thickness(es) for different hourly ratings.
D. Engineering Judgments: Submit manufacturer’s drawings for all non-standard applications where no UL tested system exists. All drawings must indicate the “Tested” UL system upon which the judgment is based to assess the relevance of the judgment to some, known performance.
E. Submit manufacturer’s installation procedures for each type of product.
F. Approved Applicator: Submit document from manufacturer wherein manufacturer recognizes the installer as qualified or submit a list of past projects to demonstrate capability to perform intended work.
G. Upon completion, installer shall provide written certification that materials were installed in accordance with the manufacturer’s installation instructions and details.

1.05 QUALITY ASSURANCE

A. Fire-stopping systems (materials and design):
    1. Shall conform to both Flame (F) and Temperature (T) ratings as required by local building codes and as tested by nationally accepted test agencies per ASTM E814 or UL 1479 fire tests in a configuration that is representative of field conditions.
        a. The F rating must be minimum of one hour but not less than the fire resistance rating of the assembly being penetrated. T rating when required by code authority shall be based on measurement of the temperature rise on penetrating item(s). The fire test shall be conducted with a minimum positive pressure differential of 0.01 inches of water column.
    2. For joints, must be tested to UL 2079 with movement capabilities equal to those of the anticipated conditions.
B. Fire-stopping materials and systems must be capable of closing or filling through openings created by:
    1. The burning or melting of combustible pipes, cable jacketing, or pipe insulation materials, or.
    2. Deflection of sheet metal due to thermal expansion (electrical and mechanical duct work).
C. Fire-stopping material shall be asbestos and lead-free and shall not incorporate nor require the use of hazardous solvents.
D. Fire-stopping sealants must be flexible, allowing for normal pipe movement.
E. Fire-stopping materials shall not shrink upon drying as evidenced by cracking or pulling back from contact surfaces.
F. Fire-stopping materials shall be moisture resistant and may not dissolve in water after curing.
G. All fire-stopping materials shall be manufactured by one manufacturer (to the maximum extent possible).
H. Installation of fire-stopping systems shall be performed by a contractor (or contractors) trained or approved by the fire-stop manufacturer.
I. Material used shall be in accordance with the manufacturer’s written installation instructions.

1.06 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Deliver material in the manufacturer's original, unopened containers or packages with the manufacturer's name, product identification, lot number, UL label and mixing and installation instructions as applicable.
B. Store materials in the original, unopened containers or packages and under conditions recommended by the manufacturer.
C. All fire-stop materials will be installed prior to expiration of shelf life.

1.07 PROJECT CONDITIONS

A. Conform to manufacturer's printed instructions for installation and when applicable, curing in accordance with temperature and humidity. Conform to ventilation and safety requirements.
B. Contractor shall verify the condition of the substrates before starting work.
C. Weather Conditions: Do not proceed with installation of fire-stop materials when temperatures fall outside the manufacturer's suggested limits.
D. Care shall be taken to ensure that fire-stopping materials are installed so as not to contaminate adjacent surfaces.

1.08 SEQUENCING

A. Schedule fire-stopping after installation of penetrants but prior to concealing the openings.
B. Fire-stopping shall precede gypsum board finishing.

1.09 PROTECTION

A. Where fire-stopping is installed at locations which will remain exposed in the completed work, provide protection as necessary to prevent damage to adjacent surfaces and finishes, and protect as necessary against damage from other construction activities.

PART 2 - PRODUCTS

2.01 GENERAL

A. Fire-stopping materials and systems shall meet the requirements specified herein.
B. Architect must approve in writing any alternates to the materials and system specified herein.
C. All fire-stop products and systems shall be designed and installed so that the basic sealing system will allow the full restoration of the thermal and fire resistance properties of the barrier being penetrated with minimal repair if penetrants are subsequently removed.
D. For applications where combustible penetrants are involved, i.e., insulated, and plastic pipe, a suitable intumescent material must be used.

2.02 ACCEPTABLE MANUFACTURERS

NOTE: Inclusion of materials in this specification does not indicate that the listed products have been evaluated for conformance to this specification. Therefore, the user/ contractor must certify in the submittal package, with a "Certificate of Conformance" from the manufacturers listed below, that the material selected meets all of the criteria set forth in Section "1.05 QUALITY ASSURANCE" of this specification.

A. Specified Technologies, Inc. /GE Pensil® (STI), Somerville, NJ 08876, Phone: (800) 992-1180.
B. 3M Fire Protection Products, St. Paul, MN

2.03 MATERIALS

A. Intumescent Fire-stop Sealants and Caulks:
   1. STI SpecSeal SSS100
   2. 3M Fire Barrier Caulk CP25WB+
B. Latex Fire-stop Sealant
   1. STI SpecSeal LC150 Sealant
C. Elastomeric Water-Based Sealant
   1. STI SpecSeal ES100 Elastomeric Sealant
D. Silicone Fire-stop Sealants and Caulks:
   1. STI SpecSeal Pensil 300
   2. 3M Fire Barrier Silicone Sealants
E. Fire-stop Putty:
   1. STI SpecSeal Fire-stop Putty Bars and Pads
   2. 3M Fire Barrier Moldable Putty
F. Fire-stop Collars:
   1. STI Spec Seal Fire-stop Collars
   2. 3M Fire Barrier PPD’s.
G. Wrap Strips:
   1. SpecSeal Wrap Strip
   2. 3M Fire Barrier FS195 Wrap Strip.
H. 2-Part Silicone Fire-stop Foam:
   1. STI SpecSeal Pensil 200
   2. 3M Fire Barrier 2001 Silicone Foam.
I. Fire-stop Mortar:
   1. STI SpecSeal Mortar.
J. Fire-stop Pillows:
   1. STI SpecSeal Pillows
K. Elastomeric Spray:
   1. STI SpecSeal AS Elastomeric Spray
L. Composite Board:
   1. 3M Barrier Sheet Material
M. Accessories:
   1. Forming/Damming Materials: Mineral fiberboard or other type as per manufacturer recommendation.

PART 3 - EXECUTION

CONDITIONS REQUIRING FIRE-STOPPING

A. General:
   1. Provide fire-stopping for conditions specified whether fire-stopping is indicated or not, and if indicated, whether such material is designed as insulation, safing, or otherwise.
B. Through-Penetrations:

1. Fire-stopping shall be installed in all open penetrations and in the annular space in all penetrations in any bearing or non-bearing fire-rated barrier.

C. Membrane-Penetrations:
1. Where required by code, all membrane-penetrations in rated walls shall be protected with fire-stopping products that meet the requirements of third-party time/ temperature testing.

D. Construction Joints/ Gaps:
1. Fire Stopping shall be provided:
a. Between the edges of floor slabs and exterior walls.
b. Between the tops of walls and the underside of floors
c. In the control joint in masonry walls and floors
d. In expansion joints.

E. Smoke-Stopping:
1. As required by the other Sections, smoke-stops shall be provided for through-penetrations, membrane-penetrations, and construction gaps with a material approved and tested for such application.

3.02 EXAMINATION

A. Examine the areas and conditions where fire-stops are to be installed and notify the architect of conditions detrimental to the proper and timely completion of the work. Do not proceed with work until unsatisfactory conditions have been corrected by the contractor in a manner acceptable to the architect.
B. Verify that environmental conditions are safe and suitable for installation of fire-stop products.
C. Verify that all pipe, conduit, cable, and other items which penetrate fire-rated construction have been permanently installed prior to installation of fire-stops.

3.03 INSTALLATION

A. General:
1. Installation of fire-stops shall be performed by an applicator/ installer qualified and trained by the manufacturer. Installation shall be performed in strict accordance with manufacturer's detailed installation procedures.
2. Apply fire-stops in accordance with fire test reports, fire resistance requirements, acceptable sample installations, and manufacturer's recommendations.
3. Unless specified and approved, all insulation used in conjunction with through-penetrants shall remain intact and undamaged and may not be removed.
4. Seal holes and penetrations to ensure an effective smoke seal.
5. In areas of high traffic, protect fire-stopping materials from damage. If the opening is large, install fire-stopping materials capable of supporting the weight of a human.
6. Insulation types specified in other sections shall not be installed in lieu of fire-stopping material specified herein.
7. All combustible penetrants (e.g., non-metallic pipes or insulated metallic pipes) shall be fire-stopped using products and systems tested in a configuration representative of the field condition.

B. Dam Construction:
1. When required to properly contain fire-stopping materials within openings damming or packing materials may be utilized. Combustible damming material must be removed after appropriate curing. Non-combustible damming materials may be left as a permanent component of the fire-stop system.

3.04 FIELD QUALITY CONTROL

1. Prepare and install fire-stopping systems in accordance with manufacturer's printed instructions and recommendations.
2. Follow safety procedures recommended in the Material Safety Data Sheets.
3. Finish surfaces of fire-stopping which are to remain exposed in the completed work to a uniform and level condition.
4. All areas of work must be accessible until inspection by the applicable Code Authorities.
5. Correct unacceptable fire-stops and provide additional inspection to verify compliance with this specification.

3.05 CLEANING

1. Remove spilled and excess materials adjacent to fire-stopping without damaging adjacent surfaces.
2. Leave finished work in neat, clean condition with no evidence of spill overs or damage to adjacent surfaces.

END OF SECTION

SECTION 26 05 19 - SECONDARY UNDERGROUND DISTRIBUTION

PART 1 - GENERAL

1.01 REFERENCE

A. Refer to section 26 00 00 for requirements which are applicable to this section.
B. Refer to the NFPA 70 National Electric Code (NEC).
C. Refer to NEMA, UL and local utility regulations.

1.02 WORK INCLUDED

A. Provide all labor, material, equipment, and supervision necessary to furnish, install, and place into operation secondary underground cable as specified herein.

1.03 SUBMITTALS

A. Submit shop drawings cable.
B. Submit manufacturer’s data sheets of capacity.
C. Submit manufacturer’s certificates of conformance with applicable codes.

1.04 QUALITY ASSURANCE

A. Verify that all equipment is installed in accordance with the manufacturer's warranty requirements.
B. Install systems and equipment in accordance with XXX.
C. Provide adequate supervision of labor force to see that installations are correct.

PART 2 - PRODUCTS

2.01 SECONDARY CABLE SPECIFICATION

A. All secondary cable intended for underground distribution in conduit or direct burial shall have the following minimum acceptable characteristics and performance per Prysmian Cable Corporation, Abrasion Resistant - Supertuf - SL Series Cable:

1. Direct Burial.
2. 600-volt, XLPE insulation, two-layer abrasion resistant Supertuf cross linked polyethylene triplexed cable configuration.
3. Phase conductors: The conductor size shall be minimum #4/0 AWG stranded aluminum alloy type 1350.
4. Neutral conductors: Stranded aluminum, full rated, minimum #4/0 AWG.
5. Conductor sizes for applications above the minimum rating for #4/0 AWG cable shall be sized per NEC article 310.

6. Insulation: Both phase conductors and the neutral conductor shall have an insulation thickness of not less than 80 mils. Two-layer insulation, inner layer of low-density polyethylene, outer layer of black medium/ high density polyethylene.
7. Neutral conductor: The neutral conductor insulation shall be readily identifiable with an extruded yellow stripe.
8. Specifications: UL No. 854, ICEA P-8-570, ASTM B-231.

2.02 SECONDARY PEDESTAL SPECIFICATION

A. Pedestals required for low voltage distribution shall be of the above-ground type and shall be Mo-Ped catalog number MP-186. No exceptions allowed.
B. Each pedestal shall be labeled with an external sign marked “ELECTRIC”.

PART 3 - EXECUTION

3.01 SECONDARY CABLE ACCEPTANCE TEST

A. Acceptance testing of any cable shall be performed with all cable terminations in place but disconnected from the system.
B. Cable testing shall be performed by a certified testing agency approved by the XXX, Board of Public Works.
C. Cables rated 600-volts or less shall not be high potential tested but shall be acceptance tested at 1,000 volts DC for one minute.

WARNING: The application of service voltage or test voltage to a cable may cause a voltage recovery of sufficient magnitude to create a hazard. Extreme care must be taken to discharge the cable properly and completely after completion of testing.

END OF SECTION

SECTION 26 05 26 - GROUNDING AND BONDING SYSTEMS: GENERAL

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.02 SUMMARY

A. This Section includes grounding of electrical systems and equipment. Grounding requirements specified in this Section may be supplemented by special requirements of system described in other Sections.

B. Related Sections include the following:
   1. 26 41 13 - LIGHTNING PROTECTION for additional grounding and bonding materials.

1.03 SUBMITTALS

A. Product Data - For the following:
   1. Ground rods.
   2. Chemical rods.

1.04 Qualification Data: For firms and persons specified in 1.05 QUALITY ASSURANCE Article.

A. Field Test Reports: Submit written test reports to include the following:
   1. Test procedures used.
   2. Test results that comply with requirements.
   3. Results of failed tests and corrective action taken to achieve test results that comply with requirements.

1.05 QUALITY ASSURANCE

A. Testing Agency Qualifications: Testing agency as defined by OSHA in 29 CFR 1910.7 or a member company of the International Electrical Testing Association and that is acceptable to authorities having jurisdiction.
   1. Testing Agency's Field Supervisor: Person currently certified by the International Electrical Testing Association to supervise on-site testing specified in PART 3 - EXECUTION.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
   1. Comply with UL 467.

C. Comply with NFPA 780 and UL 96 when interconnecting with lightning protection system.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Grounding Conductors, Cables, Connectors, and Rods:
      a. Chance/ Hubbell
      b. Copperweld Corp.
      c. Erico Inc.; Electrical Products Group.
      d. Framatome Connectors/Burndy Electrical
      e. Galvan Industries, Inc.
      f. Ideal Industries, Inc.
      g. Kearney/ Cooper Power Systems.
      h. Korns: C.C. Korns Co.; Division of Robroy Industries.
      i. Lyncole XIT Grounding.
      j. O-Z/Gedney Co.; a business of the EGS Electrical Group.\
      k. Raco, Inc.; Division of Hubbell.
      l. Salisbury: W.H. Salibury & Co.
      m. Superior Grounding Systems, Inc.
      n. Thomas & Betts, Electrical

2.02 GROUNDING CONDUCTORS

A. For insulated conductors, comply with Section 26 27 00.
B. Material: Aluminum, copper-clad aluminum, and copper.
C. Equipment Grounding Conductors: Insulated with green-colored insulation.
D. Isolated Ground Conductors: Insulated with green-colored insulation with yellow stripe. On feeders with isolated ground, use colored tape, alternating bands of green and yellow tape to provide a minimum of three bands of green and two band of yellow.
E. Grounding Electrode Conductors: Stranded cable.
F. Underground Conductors: Bare, tinned, stranded, unless otherwise indicated.
G. Bare Copper Conductors: Comply with the following:
   1. Solid Conductors: ASTM B 3.
   2. Assembly of stranded Conductors: ASTM B8.
   3. Tinned Conductors: ASTM B33.
H. Copper Bonding Conductors: As follows:
   1. Bonding Cable: 28 kcmil, 14 strands of #17 AWG copper conductor, 1/4” Ø.
   2. Bonding Conductor: #4 or #6 AWG, stranded copper conductor.
   3. Bonding Jumper: Bare copper tape, braided bare copper conductors, terminated with copper ferrules: 1-5/8" wide and 1/16" thick.
   4. Tinned Bonding Jumper: Tinned-copper tape, braided copper conductors, terminated with copper ferrules: 1-5/8" wide and 1/16" thick.
I. Aluminum Bonding Conductors: As follows:
   1. Bonding Cable: 10 strands of #14 AWG aluminum conductor 1/4" Ø.
   2. Bonding Conductor: #4 or #6 AWG, stranded aluminum conductor.
   3. Bonding Jumper: Aluminum tape, braided bare aluminum conductors, terminated with aluminum ferrules: 1-5/8" wide and 1/16" thick.
J. Ground Conductor and Conductor Protector for Wood Poles: As follows:
   1. #4 AWG aluminum, soft-drawn copper conductor.
   2. Conductor Protector: Half-round PVC or wood molding. If wood, use pressure-treated fir, cypress, or cedar.
K. Grounding Bus: Bare, annealed copper bars of rectangular cross section, with insulators.

2.03 CONNECTOR PRODUCTS

A. Comply with IEEE 837 and UL 467; listed for use for specific types, sizes and combinations of conductors and connected items.
B. Bolted Connectors: Bolted-pressure type connectors, or compression type.
C. Welded Connectors: Exothermic-welded type, in kit form, and selected per

2.04 GROUNDING ELECTRODES

A. Ground Rods: Copper-clad steel.
B. Ground Rods: Section type; copper-clad steel.
   1. Size: 5/8" Ø.
C. Chemical Electrodes: Copper tube, straight or L-shaped, filled with nonhazardous chemical salts, terminated with a #4/0 bare conductor. Provide backfill material recommended by manufacturer.

PART 3 - EXECUTION

3.01 APPLICATION

A. Use only copper conductors for both insulated and bare grounding conductors in direct contact with earth, concrete, masonry, crushed stone, and similar materials.
B. In raceways, use insulated equipment grounding conductors.
C. Exothermic-Welded Connections: Use for connections to structural steel and for underground connections, except those at test wells.
D. Equipment Grounding Conductor Terminations: Use bolted pressure clamps.
E. Grounding Bus: Install in electrical and telephone equipment rooms, in rooms housing service equipment, and elsewhere as indicated.
   1. Use insulated spacer; space 0'-1" from wall and support from wall 0'-6" above finished floor, unless otherwise indicated.
   2. At doors, route the bus up to the top of the door frame, across the top of the doorway, and down to the specified height above the floor.
F. Underground Grounding Conductors: Use tinned copper conductor, #2/0 AWG minimum. Bury at least 2'-0" below grade or bury 1'-0" above duct bank when installed as part of the duct bank.

3.02 EQUIPMENT GROUNDING CONDUCTORS

A. Comply with NFPA 70, Article 250, for types, sizes, and quantities of equipment grounding conductors, unless specific types, larger sizes, or more conductors than required by NFPA 70 are indicated.
B. Install equipment grounding conductors in all feeders and circuits.
C. Install insulated equipment grounding conductor with circuit conductors for the following items, in addition to those required by NEC:
   1. Feeders and branch circuits.
   2. Single-phase motor branch circuits.

3. Three-phase motor branch circuits.

D. Busway Supply Circuits: Install insulated equipment grounding conductor from the grounding bus in the switchgear, switchboard, or distribution panel to equipment grounding bar terminal on busway.

E. Bond metal parts, motor frames, fittings, plumbing pipes, drains, metal conduit, metal surfaces within 5'-0", and all electrical devices and controls within 5'-0".

F. Motors shall be grounded by means of a grounding conductor in the same raceway with the motor feeder connected to the grounding bushing at the motor terminal box and the ground bus in the motor control center or to the incoming conduit grounding bushing of an individually mounted motor starter.

3.03 INSTALLATION

A. Grounding Conductors: Route along shortest and straightest paths possible, unless otherwise indicated. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.

B. Bonding Straps and Jumpers: Install so vibration by equipment mounted on vibration isolation hangers and supports is not transmitted to rigidly mounted equipment. Bond straps directly to the basic structure taking care not to penetrate any adjacent parts. Install straps only in locations accessible for maintenance.

3.04 CONNECTIONS

A. General: Make connections so galvanic action or electrolysis possibility is minimized. Select connectors, connection hardware, conductors, and connection methods so metals in direct contact will be galvanically compatible.
   1. Use electroplated or hot-tin-coated materials to ensure high conductivity and to make contact points closer to order of galvanic series.
   2. Make connections with clean, bare metal at points of contact.
   3. Make aluminum-to-steel connections with stainless-steel separators and mechanical clamps.
   4. Make aluminum-to-galvanized steel connections with tin-plated copper jumpers and mechanical clamps.
   5. Coat and seal connections having dissimilar metals with inert material to prevent future penetration of moisture to contact surfaces.

B. Exothermic-Welded Connections: Comply with manufacturer's written instructions. Welds that are puffed up or that show convex surfaces indicating improper cleaning are not acceptable.

C. Equipment Grounding Conductor Terminations: For #8 AWG and larger, use pressure-type grounding lugs. #10 AWG and smaller grounding conductors may be terminated with winged pressure-type connectors.

D. Noncontact Metal Raceway Terminations: If metallic raceways terminate at metal housings without mechanical and electrical connection to housing, terminate each conduit with a grounding bushing. Connect grounding bushings with a bare grounding conductor to grounding bus or terminal in housing. Bond electrically non-continuous conduits at entrances and exits with grounding bushings and bare grounding conductors, unless otherwise indicated.
   1. Tighten screws and bolts for grounding and bonding 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.

E. Compression-Type Connections: Use hydraulic compression tools to provide correct circumferential pressure for compression connectors. Use tools and dies recommended by connector manufacturer. Provide embossing die code or other standard method to make a visible indication that a connector has been adequately compressed on grounding conductor.

F. Moisture Protection: If insulated grounding conductors are connected to ground rods or grounding buses, insulate entire area of connection and seal against moisture penetration of insulation and cable.

3.05 FIELD QUALITY CONTROL

A. Testing: Engage a qualified testing agency to perform the following field quality-control testing:
   1. After installing grounding system but before permanent electrical circuitry has been energized, test for compliance with requirements.
   2. Test completed grounding system at each location where a maximum ground-resistance level is specified, at service disconnect enclosure grounding terminal, and at ground test wells. Measure ground resistance not less than two full days after the last trace of precipitation, and without the soil being moistened by any means other than natural drainage or seepage and without chemical treatment or other artificial means of reducing natural ground resistance. Perform tests, by the fall-of-potential method according to IEEE 81. (Ensure that the test is performed with all ground-to-neutral bands broken. The grounding system must be completely isolated for the test to be valid.)
   3. Excessive Ground Resistance: If resistance to ground exceeds specified values, notify Engineer promptly and include recommendations to reduce ground resistance.

END OF SECTION

SECTION 26 05 73 - POWER SYSTEM STUDY

PART 1 - GENERAL

1.01 GENERAL

A. Short Circuit Studies, Protective Device Evaluation Studies, Protective Service Coordination Studies and Arc Flash Hazard Studies shall be performed by the switchboard/ switchgear manufacturer. The studies shall be submitted to the Engineer prior to receiving final approval of the distribution equipment shop drawings and/or prior to release of equipment for manufacture.

B. The studies shall include all portions of the electrical distribution system from the utility service at the facility through the utility transformer, main service entrance rated equipment, distribution and branch panelboards, motor control centers, significant motor loads, generators, and all emergency power distribution. Normal system connections and those which result in maximum fault conditions shall be adequately covered in the study.

C. The Short Circuit Study shall be developed in accordance with ANSI C37.5-1969 (R1975), IEEE Standard. 399-1980 and IEEE Standard 141-1976.

1.02 SHORT CIRCUIT STUDY

A. The short circuit study shall be performed with the aid of a digital computer program.

B. The short circuit study input data shall include the utility company's short circuit contribution, resistance and reactance component of the branch impedances, the X/ R ratios, base quantities selected and other source impedances.

C. Short circuit momentary duty values and interrupting values shall be calculated on the basis of assumed three-phase bolted short circuits at each switchgear bus, medium voltage controller, switchboard, low voltage motor control center, distribution panelboard, pertinent branch circuit panel and other significant locations throughout the system (i.e., chillers, fire pumps, elevators, etc.). The short circuit tabulations shall include symmetrical fault currents and X/ R ratios. For each vault location, the total duty on the bus in addition to the individual contribution from each connecting branch shall be listed with its respective X/ R ratio.

1.03 PROTECTIVE DEVICE COORDINATION STUDY

A. A protective device coordination study shall be performed to provide the necessary calculations and logic decisions required to select or check the selection of power fuse ratings, protective relay characteristics of associated current transformers and low voltage circuit breaker trip characteristics and settings. The objective of the study is to obtain optimum protective and coordination performance from these devices.

B. The coordination study shall include all medium and low voltage classes of equipment from the utility incoming line protective device down to and including the largest rated 480-volt and 208-volt motor control center, distribution switchboards, panelboards and individual switches and circuit breakers. The phase and ground over current protection shall be included as well as settings of all other adjustable protective devices.

C. The time-current characteristics of the specified protective devices shall be drawn on Keuffel and Esser log paper. The plots shall include complete titles representative of one-line diagrams and legends, associated utility company's relay or fuse characteristics, significant motor starting

characteristics, complete parameters of transformers, complete operating bands of low voltage circuit breaker trip curves and fuse curves. The coordination plots shall indicate the types of protective devices selected, proposed relay taps, time dial and instantaneous trip settings, transformer magnetizing inrush and ANSI transformer withstand parameters, cable thermal over current withstand limits and significant symmetrical and asymmetrical fault currents. All restrictions of the NFPA 70 National Electrical Code shall be adhered to, and proper coordination intervals and separation of characteristic curves shall be maintained. The coordination plots for phase and ground protective devices shall be supplied on a system basis. A significant number of separate curves shall be used to clearly indicate the coordination achieved.

D. The selection and settings of the protective devices shall be provided separately in a tabular form listing circuit identification, IEEE Device number, current transformer ratios and connections, manufacturer and type, range of adjustment and recommended settings. A tabulation of the recommended power fuse selection shall be provided for the medium voltage fuses where applied in the system. Any discrepancies, areas of coordination conflict or other inadequacies shall be promptly brought to the Engineer's attention.

1.04 PROTECTIVE DEVICE EVALUATION STUDY

A. A protective device evaluation shall be performed to determine the adequacy of power circuit breakers, molded case circuit breakers, switches, automatic transfer switches and fuses by tabulation of all devices and comparing such device ratings with calculated fault currents.

1.05 ARC FLASH EVALUATION STUDY

A. Provide an Arc Flash Hazard Study for the electrical distribution system. The study shall include all medium and low voltage classes of equipment from the utility incoming equipment down to and including all motor control centers, switchboards, panelboards, individual switches and circuit breakers and load centers.

B. The study shall include creation of Arc Flash Hazard Warning Labels. The label shall include the following:
   1. Flash Hazard Protection Boundary
   2. Limited Approach Boundary
   3. Restricted Boundary
   4. Prohibited Boundary
   5. Incident Energy Level
   6. Required Personal Protection Equipment Class
   7. Type of fire rated clothing
   8. Equipment name
   9. Equipment voltage

C. The label shall be printed in color and shall be moisture-proof adhesive backed vinyl.

1.06 REPORTS

A. The results of the power system study shall be summarized in a final report. Six bound copies of the final report shall be submitted to the Engineer.

B. The report shall include the following sections:
   1. Description, purpose, basis and scope of the study and a single line diagram of the portions of the power system which is included in the scope of the study.
   2. Tabulation of circuit breaker, fuse and other protective device ratings compared to calculated short circuit duties with commentary regarding same.

3. Protective device time versus current curves, tabulation of relay and circuit breaker trip settings, fuse selection with commentary regarding same.
4. Fault current calculations including a definition of terms and guide for interpretation of computer printouts.
5. Arc Flash Evaluation Summary Spreadsheet.
6. Arc Flash Hazard Warning Labels.

PART 2 - PRODUCTS NOT USED

PART 3 - EXECUTION

3.01 COORDINATION

A. The power system study is to be performed prior to release of equipment for manufacturer.
B. Electrical contractor is to adjust all circuit breaker trip settings as indicated by the study.
C. Electrical contractor is to ensure proper rating of all equipment prior to installation.
D. Electrical contractor is to install the Arc Flash Hazard Warning Labels.

END OF SECTION

SECTION 26 09 00- LIGHTING CONTROLS

PART 1 - GENERAL

1.01 REFERENCE

A. This section includes manually operated, digital lighting controls with external signal source, relays, and control module.
B. Refer to Section 26 00 00 for other requirements of this section.
C. Source Limitations: Obtain lighting control module and power distribution components through one source from a single manufacturer.
D. Electrical Components, Devices and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
E. Comply with 47 CFR, Subparts A and B, for Class A digital devices.
F. Comply with NFPA 70 National Electrical Code (NEC).
G. Refer to 26 27 00 for other lighting controls (switches, motion sensors, etc.).
H. Provide interior lighting controls to meet the adopted IBC / IECC / ASHRAE 90.1 code.

1.02 WORK INCLUDED

A. Provide all labor, material, equipment, and supervision necessary to furnish and install complete, operating, lighting control system specified herein.
B. All rooms are to be provided with lighting controls. Provide manual switch and code required control devices as appropriate. If controls are not indicated within a space, controls are to be provided for the space in a similar manner as adjacent or similar spaces.

1.03 SUBMITTALS

A. Product Data: For control modules, power distribution components, manual switches and plates, and conductors and cables.
B. Shop Drawings: Detail assemblies of standard components, custom assembled for specific application on this Project.
    1. Outline Drawings: Indicate dimensions, weights, arrangement of components, and clearance and access requirements.
    2. Block Diagram: Show interconnections between components specified in this Section and devices furnished with power distribution system components. Indicate data communication paths and identify networks, data buses, data gateways, concentrators, and other devices to be used. Describe characteristics of network and other data communication lines.
    3. Wiring Diagrams: Power, signal, and control wiring. Coordinate nomenclature and presentation with a block diagram.
C. Coordination Drawings: Submit evidence that lighting controls are compatible with connected monitoring and control devices and system specified in other Sections.
    1. Show interconnecting signal and control wiring and interfacing devices that prove compatibility of inputs and outputs.
    2. For networked controls, list network protocols and provide statements from manufacturers that input and output devices meet inter-operability requirements of the network protocol.
    3. Show equipment locations on floor plans of similar scale as contract documents.

D. Field quality control test reports.
E. Software licenses and upgrades required by and installed for operation and programming of digital and analog devices.
F. Operation and Maintenance Data: For lighting controls to include in emergency, operation, and maintenance manuals.
G. Warranty: Special warranty specified in this Section.

1.04 COORDINATION

A. Coordinate lighting control components to form an integrated interconnection of compatible components.
   1. Match components and interconnections for optimum performance of lighting control functions.
   2. Coordinate lighting controls with HVAC controls. When specifically indicated on lighting control system riser diagram, design display graphics showing building areas controlled; include the status of lighting controls in each area.
   3. Coordinate lighting controls with that in Sections specifying distribution components that are monitored or controlled by power monitoring and control equipment.

1.05 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of lighting controls that fail in materials or workmanship or from transient voltage surges within specified warranty period.
   1. Failures include, but are not limited to, the following:
      a. Failure of software input/output to execute switching or dimming commands.
      b. Failure of modular relays to operate under manual or software commands.
      c. Damage of electronic components due to transient voltage surges.
   2. Warranty Period: Two years from date of Substantial Completion.

1.06 SOFTWARE SERVICE AGREEMENT

A. Technical Support: Beginning with Substantial Completion, provide software support for two years.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Leviton Mfg. Company Inc.
   2. Hubbell Lighting Controls.
   3. Lithonia Lighting; Acuity Lighting Group, Inc.
   4. Lutron Electronics Company, Inc.
   5. ETC Lighting Control Systems.
   6. Watt Stopper (The).

2.02 SYSTEM REQUIREMENTS

A. Expandability: System shall be capable of increasing the number of control functions in the future by 25 percent of current capacity; to include equipment ratings, housing capacities, spare relays, terminals, number of conductors in control cables, and control software.
B. Performance Requirements: Manual switch operation, an internal timing and control unit and external sensors, send a signal to Programmable system control module that processes the signal according to its programming and routes an open or close command to one or more relays in the power-supply circuits to groups of lighting fixtures or other loads.

2.03 CONTROL MODULE

A. Control Module Description: Comply with UL 916 (CSA C22.2, No. 205);
Microprocessor based, solid-state, 365-day timing and control unit. Control units shall be programmable and capable of receiving inputs from indicated sensors and hand-held programmer. Output circuits shall be pilot-duty relays compatible with power switching devices. Output circuits shall include digital circuits arranged to transmit control commands to remote preset dimmers. Modules and their associated control panels shall include the following features:
1. Multichannel output with 12 channels.
2. Multiple inputs and multichannel output arranged for <Insert number> channels.
3. Multiple inputs for occupancy sensors, daylight sensors, and dimming systems with associated daylight sensors.

2.04 POWER DISTRIBUTION COMPONENTS

A. Modular Relay Panel: Comply with UL 508 (CSA C22.2, No. 14) and UL 916 (CSA C22.2, No. 205); factory assembled with modular single-pole relays, power supplies, and accessory components required for specified performance.
1. Cabinet: Steel with hinged, locking door.
a. Barriers separate low-voltage and line-voltage components.
b. Directory: Mounted on back of door. Identifies each relay as to load groups controlled and each programmed pilot device if any.
c. Control Power Supply: Transformer and full-wave rectifier with filtered dc output.
2. Single-Pole Relays: Mechanically held unless otherwise indicated; split-coil, momentary-pulsed type.
a. Low-Voltage Leads: Plug connector to the connector strip in cabinet and pilot light power where indicated.
b. Rated Capacity (Mounted in Relay Panel): 20 A, 125-V ac for tungsten filaments; 20 A, 277-V ac for ballasts.
c. Endurance: 50,000 cycles at rated capacity.
d. Mounting: Provision for easy removal and installation in relay cabinet.

2.05 MATERIALS

A. Power Wiring to Supply Side of Class 2 Power Source: Not smaller than No. 12 AWG, complying with Division 26 27 00 Section "BASIC MATERIALS."
B. Class 1, 2, and 3 Control Cables: Multi-conductor cable with copper conductors as recommended by the manufacturer.
C. Control wiring methods are to be per approved brand and part number of the lighting control manufacturer. No substitutions will be permitted.
D. Manual Controllers: Comply with Division 26 27 00 Section “BASIC MATERIALS.”

PART 3 - EXECUTION

3.01 WIRING INSTALLATION

A. Comply with NECA 1.
B. Wiring Method: Install wiring in raceways except where installed in accessible ceilings.
C. Wiring within Enclosures: Bundle, lace, and train conductors to terminal points. Separate power-limited and non-power-limited conductors according to conductor manufacturer's written instructions.
D. Install field-mounting transient voltage suppressors for lighting control devices in Category A locations that do not have integral line-voltage surge protection.
E. Size conductors according to lighting control device manufacturer's written instructions, unless otherwise indicated.
F. Splices, Taps, and Terminations: Make connections only on numbered terminal strips in terminal cabinets, equipment enclosures, and in junction, pull, and outlet boxes.

3.02 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 assist in field testing. Report results in writing.
B. Perform the following field tests and inspections and prepare test reports:
    1. Test for circuit continuity.
    2. Verify that the control module features are operational.
    3. Check operation of local override controls.
    4. Test system diagnostics by simulating improper operation of several components.

3.03 SOFTWARE INSTALLATION

A. Install and program software with initial settings of adjustable values. Make backup copies of software and user-supplied values. Provide current licenses for software.

3.04 ADJUSTING

A. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting sensors and to assist Owner's personnel in making program changes to suit actual occupied conditions. Provide up to two visits to Project during other than normal occupancy hours for this purpose.

3.05 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain lighting controls and software training for PC-based control systems.

END OF SECTION

SECTION 26 24 16 - PANELBOARDS

PART 1 - GENERAL

1.01 REFERENCE

A. Refer to Section 26 00 00 for additional requirements of this section.
B. Refer to requirements of the NFPA 70 National Electrical Code, UL, and the NFPA.

1.02 WORK INCLUDED

A. Provide all labor, material, equipment, and supervision necessary to furnish and install panelboards as specified.

1.03 SUBMITTALS

A. Submit manufacturers shop drawings of all equipment specified in this section.

1.04 QUALITY ASSURANCE

A. Verify that all equipment is installed in accordance with the manufacturers' warranty requirements.

PART 2 - PRODUCTS

2.01 DISTRIBUTION PANELBOARDS (MDP or PP)

A. GENERAL - Furnish and install distribution and power panelboards as indicated in the panelboard schedule and where shown on the plans. Panelboards shall be equipped with thermal-magnetic, molded case circuit breakers of frame and trip ratings as shown on the schedule.
B. BUSSING ASSEMBLY AND TEMPERATURE RISE - Panelboard bus structure and main lugs or main breaker shall have current ratings as shown on the panelboard schedule. Bus shall be plated copper.
C. CIRCUIT BREAKERS - Circuit breakers shall be equipped with individually insulated, braced, and protected connectors. Circuit breakers shall be flush with each other. Tripped indication shall be clearly shown. Provisions for additional breakers shall be such that no additional connectors will be required to add breakers. Mechanical lugs are to be copper. For 480-volt applications over 1000 Amp, the main breaker is to include electronic trip with LSIG characteristics.
D. EQUIPMENT SHORT CIRCUIT RATING (FULLY RATED) - Each panelboard shall have a short circuit current rating equal to or greater than the integrated equipment rating shown on the panelboard schedule or on the plans. Panelboards shall be marked with their maximum short circuit current rating at the supply voltage and shall be UL listed.
E. ARC ENERGY REDUCTION - Where circuit breakers rated 1200 Amp or higher are installed, provide arch flash mitigation documentation to those authorized to design, install, operated, or inspect the installation. Provide energy-reducing maintenance switching with local status indicator as

means to reduce clearing time of the fuses or the breakers.

F. CABINET - Panelboard assembly shall be enclosed in a steel cabinet. The rigidity and gauge of steel to be as specified in UL Standard 50 for cabinets. The size of wiring gutters shall be in accordance with UL Standard 67. Cabinets to be equipped with latch and tumbler-type lock on door of trim. Doors over 48" long shall be equipped with three-point latch and vault lock. All locks shall be keyed alike. End walls shall be removable. Fronts shall be of code gauge steel. Baked enamel finish electro-deposited over cleaned phosphatized steel.

G. SAFETY BARRIERS - The panelboard interior assembly shall be dead front with panelboard front removed. Main lugs or main breakers shall have barriers on five sides. The barrier in front of the main lugs shall be hinged to a fixed part of the interior. The end of the bus structure opposite the mains shall have barriers.

H. UL LISTING - Panelboards shall be listed by Underwriters Laboratories and shall bear the UL label. When required, panelboards shall be suitable for use as service equipment.

I. NAMEPLATES - Provide laminated black phenolic resin with white core with 3/16” high engraved lettered nameplates for each circuit breaker to indicate the feeder, panelboard and equipment served. Mounted, with plated screws, adjacent to or on front of the breaker.

J. Panelboards shall be by Square D, Siemens, Cutler Hammer or ABB Group.

2.02 LIGHTING & RECEPTACLE PANELS (LP or RP)

A. GENERAL - Furnish and install circuit breaker lighting panelboards as indicated in the panelboard schedule and where shown on the plans. Panelboards shall be equipped with thermal-magnetic molded case circuit breakers with frame and trip ratings as shown on the schedule.

B. CIRCUIT BREAKERS - Shall be quick-make, quick-break, thermal-magnetic, trip indicating and have common trip on all multipole breakers. Trip indication shall be clearly shown by the breaker handle taking position between "ON" and "OFF" when the breaker is tripped. Branch circuit breakers feeding convenience outlets shall have sensitive instantaneous trip settings of not more than ten times the trip rating of the breaker to prevent repeated arcing shorts resulting from frayed appliance cords. Single pole 15 and 20 Amp circuit breakers shall be UL listed as "Switching Breakers" at 120-volt AC and carry the SWD marking. UL Class A ground fault circuit protection shall be provided on 120-volt AC branch circuits as specified on the plans or panelboard schedule. This protection shall be an integral part of the branch circuit breaker which also provides overload and short circuit protection for branch circuit wiring. Tripping of a branch circuit breaker containing ground fault circuit interruption shall not disturb the feeder circuit to the panelboard. A single pole circuit breaker with integral ground fault circuit interruption shall require no more panelboard branch circuit space than a conventional circuit breaker. A UL listed combination arc fault circuit interrupter (AFCI) shall be provided for all 120-volt, 15 or 20 Amp branch circuits as indicated on the plans or panelboard schedule or as required by the National Electrical Code. This protection shall be an integral part of the branch circuit breaker which also provides overload and short circuit protection for the branch circuit wiring. This breaker shall require no more panelboard branch circuit space than a conventional circuit breaker. Connections to the bus shall bolt-on.

C. PANELBOARD BUS ASSEMBLY - Bus bar connections to the branch circuit breakers shall be the "distributed phase" or "phase sequence" type. Single phase, three-wire panelboard bussing shall be such that any two adjacent single pole breakers are connected to opposite polarities in such a manner that two pole breakers can be installed in any location. Three phase, four-wire bussing shall be such that any three adjacent single pole breakers are individually connected to each of the three different phases in such a manner that two or three pole breakers can be installed at any location. All current carrying parts of the bus assemble shall be plated copper. Main ratings shall be shown in the panelboard schedule or on the plans.

D. WIRING TERMINALS - Terminals for feeder conductors to the panelboard mains and neutral shall

be UL listed as suitable for the type of conductor specified. Terminals for branch circuit wiring, both breaker and neutral, shall be UL listed as suitable for the type of conductor specified.

E. CABINETS AND FRONTS - The panelboard bus assemble shall be enclosed in a steel cabinet. The size of the wiring gutters and gauge of steel shall be in accordance with NEMA and UL Standards. The box shall be fabricated from galvanized steel or equivalent rust resistant steel.

Fronts shall include doors and have flush, cylinder tumbler-type locks with catches and spring-loaded stainless steel door pulls. Doors shall be mounted with completely concealed steel hinges. Fronts shall not be removable with door in the locked position. A circuit directory frame and card with a clear plastic covering shall be provided on the inside of the door. Fronts shall be of code gauge steel.

F. EQUIPMENT SHORT CIRCUIT RATING (FULLY RATED) - Each panelboard shall have a short circuit current rating equal to or greater than the integrated equipment rating shown on the panelboard schedule or on the plans. Panelboards shall be marked with their maximum short circuit current rating at the supply voltage and shall be UL listed.

G. UL LISTING - Panelboards shall be listed by Underwriters Laboratories and bear the UL label. Equal panelboards may be provided by Square D, G.E., Cutler Hammer, or Siemens.

PART 3 - EXECUTION

3.01 PANELS

A. Panelboards are to be mounted in accordance with National Electrical Code Article 240.24 unless noted otherwise.
B. Provide labeling and complete, typed directories.
C. Ductwork or piping shall not pass over panels.
D. Space shall be clear 3’-0" in front of panel floor to structural slab or roof above.
E. All conduit entering the panel shall have a screwed hub with an insulated bushing and no sharp
F. edges.
   1. Wires shall be labeled and neatly arranged in the wiring gutters with wires cut to proper lengths and neatly racked.
G. Electronic grade panels shall have feeder neutrals rated at 200% to maintain the UL listing of the panel and be provided with isolated ground conductor back to service entrance or feeder transformer.

3.02 GROUNDING

A. All panels shall be grounded to the building equipment grounding system per National Electrical Code Article 408.40. Ground resistance shall not exceed the National Electrical Code values.

END OF SECTION

SECTION 26 27 00 - BASIC MATERIALS AND EQUIPMENT FOR METAL RACEWAY SYSTEMS

PART 1 - GENERAL

1.01 REFERENCE

A. Refer to Section 26 00 00 for additional requirements of this section.
B. Refer to NECA 1-2000 for general installation requirements.

1.02 SUBMITTALS

A. Submit shop drawings and manufacturer’s catalog sheets of all specified items unless waived by the engineer.
B. Submit switches and receptacles as a minimum.

PART 2 - PRODUCTS

2.01 RIGID METAL CONDUIT (GRS)

A. Material; Steel, Zinc coated Federal Specification WW-C-581d, ANSI C801.
B. Fittings; Malleable iron, Threaded
C. NEC; Article 344
D. Application; Indoor, above ground, enamel coated, all occupancies not subject to severe corrosive influences.
E. Manufacturer; Hubbell, Allied Tube and Conduit Corp. or approved equal.

2.02 ELECTRICAL METALLIC TUBING (EMT)

A. Material; Galvanized steel, U.L. labeled, Federal Specification ANSI C80.3.
B. Fittings; Threadless compression type for up to 1-1/ 4", set screw for 1-1/ 2" and larger. Installation in accordance with Article 358 of the National Electrical Code and U.L. general information card #FJMX.
C. NEC; Article 358
D. Application; Exposed and concealed work not subject to physical damage.
E. Manufacturer; Hubbell, Allied Tube and Conduit Corp. or approved equal.

2.03 FLEXIBLE METAL TUBING (FMT)

A. Material; Hot dipped galvanized interlocking convolutions of steel tape in circular cross section. Federal Specification AA-55810
B. Fittings; Hot dipped galvanized steel
C. NEC; Article 344
D. Application; All areas other than wet locations, hoistways, hazardous locations, below ground, and areas with exposure to oil, gasoline, or other materials having an adverse effect on rubber.

E. Manufacturer; Electri-flex Company Liquatite Type BR, Hubbell, Allied Tube and Conduit Corp., AFC.

2.04 RIGID NON-METALLIC CONDUIT (SCHEDULE 40 PVC)

A. Material; U.L. 651, ANSI/ NEMA TC-2, Federal Military Specification WC-1094A, 90 °C wire rated and sunlight resistant.
B. Fittings; PVC, same as above.
C. NEC; Article 352
D. Application; In walls, floors, ceilings, wet locations, underground, and locations subject to severe corrosive influences.
E. Manufacturer; Carlon Schedule 40 electrical conduit or approved equal.

2.05 LIQUATITE FLEXIBLE METAL CONDUIT

A. Material: Hot dipped galvanized interlocking convolutions of steel tape in circular cross section with PVC jacket.
B. Fittings: Hot dipped galvanized steel.
C. NEC Article 350 (LFMC)
D. Application: All areas other than elevator hoistways, hazardous locations and where subject to physical damage.
E. Manufacturers: Electriflex Company Liquatite Type LT, Hubbell, Allied Tube and Conduit Corp., AFC.

2.06 CONDUCTORS

A. Type; THHN, 98% conductivity copper, 600-volt, dry locations. Type THWN for wet locations. Conductors shall be U.L. listed.
B. Equipment terminations for circuits rated 100 Amps or less (#14 AWG - #2 AWG) shall be rated 60 °C (140 °F). Equipment termination for circuits rated over 100 Amps (#1 or larger) shall be rated 75 °C (167 °F). Refer to NEC for allowable exceptions. 90 °C (194 °F) rated conductors shall be used as indicated on the drawings or as indicated within these specifications.
C. Solid copper conductors for #10 and #12 wire size. #8 and larger are to be stranded copper.
D. Separate green ground conductor for all 480-volt circuits including branch, homerun, and feeders.
E. All conductors shall be color coded as follows:
120/ 208 Volt Systems

Phase A	Black
Phase B	Red
Phase C	Blue
Neutral	Grey or Natural White

F. Minimum size conductor shall be #12 AWG except that #14 AWG shall be used for control wiring. All circuit conductors shall be run in the same raceway system.
G. A grounding conductor shall be provided to each electrical device in accordance with the National Electrical Code.
H. Conductor sizes are to be as indicated on the drawings and/ or as specified in this specification.
I. Conductors are not to be installed in raceways until construction is advanced to allow conductors to be installed completely without damage to conductors and there is not possibility of water or other contaminants entering the raceway system. Conductors shall be installed between convenient terminating points.
J. An approved pulling compound shall be used to assist in pulling of conductors.

K. Aluminum Alloy Conductors for Distribution Feeder Applications:
   1. Distribution feeder conductor's sizes #6 AWG to 1000 Kcmil may be copper (Base Bid) or aluminum alloy (Alternate). Aluminum alloy conductors are to be compact standard conductors of a recognizable Aluminum Association 8000 Series aluminum alloy conductor material (AA-8000 series alloy). AA-8000 series alloy conductor must be Alcan Cable Stabiloy or approved equal.
   2. Compliance with the elongation requirement per Table 10.1 of UL Standard 1581 for stranded AA-8000 series aluminum alloy conductors shall be determined on wires taken from the conductor after stranding by manufacturer.
   3. Insulation:
      a. For use in raceways: Type XHHW-2, temperature rating 90 °C.
      b. For use in cable trays: Sizes #1/ 0 AEG and larger. Type XHHW-2, temperature rating 90o C and marked: "SUN RES", "VW-1"", "GASOLINE AND OIL-RESISTANT II", "FOR CT USE".

L. Manufacturers: Alpha Wire, Southwire, Tamaqua Cable, Triangle Wire & Cable, American Insulated Wire, BICC or General Cable.

2.07 JUNCTION BOXES

A. Material; Galvanized steel, accessible.
B. Manufacturers; Keystone, Hubbell, Penn Panel and Box Co.
C. NEC; Article 314

2.08 OUTLET AND SWITCH BOXES

A. Material; Galvanized steel with knockouts to suit raceway system.
B. Manufacturer; Crouse Hinds Co., Steel City Div., Raco Inc., or approved equal.

2.09 WALL PLATES - METAL- COMMERCIAL SPECIFICATION GRADE

A. Wall plates shall be standard size, metal, commercial grade.
B. Plates shall be provided for all switches, receptacles, blanks, telephone, and special purpose outlets.
C. Plates must be of modern design having rounded edges and corners and be complete with color-matched mounting screws.
D. Plates must be of one design throughout the building and shall conform to UL, CSA, and NEMA standards.
E. Engraving shall be done by plate manufacturer in accordance with the schedule.
F. Acceptable Manufacturers: Cooper Wiring Devices, Pass & Seymour, Hubbell, Leviton.

2.10 WALL PLATES - STAINLESS STEEL - TYPE 302 - CORROSIVE/ DAMPNESS/ FOOD SERVICE DUTY

A. Wall plates shall be Pass and Seymour Sierra Series "S", Type 430 Stainless Steel, or "S-N" line Type 302 Stainless Steel or equal and will conform to UL and NEMA standards.
B. Plates must be provided for all switches, receptacles, blanks, telephone and special purpose outlets.
C. Plates shall be of a modern design, having rounded edges and corners and be complete with finish-matching mounting screws.
D. Engraving shall be done by plate manufacturer in accordance with the schedule.
E. Plates must be of one design throughout the building.
F. Acceptable Manufacturers: Cooper Wiring Devices, Pass & Seymour, Hubbell, and Leviton.

2.11 RECEPTACLES - STANDARD DUTY - COMMERCIAL/ SPECIFICATION GRADE

A. All thermoplastic nylon body construction.
B. Impact-resistant nylon face.
C. One-piece triple-wipe brass power contact.
D. Available with side and back wire capable of accepting #14 - #10 AWG copper or copper-clad wire.
E. Terminal compartments isolated from each other for positive conductor containment.
F. Automatic grounding clip assures grounding to metallic boxes.
G. Easily accessible break off tabs to facilitate split circuit wiring.
H. Plated steel strap for corrosion resistance.
I. Combination Phillips/ slotted head screws backed out for ease of installation.
J. In compliance with UL 498.
K. Pre-wired pigtail connectors that accommodate Federal Specification Receptacles are approved. Must be crimped and welded terminal right angle application within the connector.
L. Receptacle shall be Federal Specification, WC896 compliant. Marking should be clearly identifiable on face or strap.
M. Acceptable Manufacturers: Cooper Wiring Devices, Pass & Seymour, Hubbell, and Leviton.
N. Leviton 5362/ 5361, 20 Amp, ivory, white, grey, black, brown or almond.

2.12 RECEPTACLES - DECORA - SPECIFICATION GRADE

A. Impact-resistant nylon face.
B. One-piece, triple-wire brass power contacts.
C. Corrosion resistant, plated, wrap-around steel strap locked into assembly to prohibit strap from bending away from body.
D. Terminal compartments isolated from each other for positive conductor containment.
E. Available in hospital grade & specification grade.
F. Heavy-duty compact design for easier installation and long-lasting performance.
G. Automatic grounding clip standard for positive ground to metal boxes.
H. All devices fit standard #26 opening wall plate.
I. Side and back wire accepts #14 - #10 AWG.
J. In compliance with UL 498.
K. Pre-wired pigtail connectors that accommodate Federal Specification Receptacles are approved. Must be crimped and welded terminal right angle application within the connector.
L. Receptacle shall be Federal Specification, WC896 compliant. Marking should be clearly identifiable on face or strap.
M. Acceptable manufacturers: Cooper Wiring Devices, Pass & Seymour, Hubbell, and Leviton.
N. Leviton 16352, 20 Amp, white, ivory, grey, black, or almond.

2.13 GROUND FAULT CIRCUIT INTERRUPTING RECEPTACLES - STANDARD GRADE

A. Side or screw pressure plate back wire with #14 or #12 AWG solid or y-stranded copper wire.
B. Extra-long strap.
C. High-impact resistant thermoplastic construction.
D. Ground screw with a wire guide channel.
E. Dual-direction test and reset buttons.
F. Line and load terminations supplied backed out, and ready to wire.
G. Two back wire holes per terminal.
H. Ultrasonic welding of face to back body.

I. Mis-wire label applied to load terminals.
J. GFCI receptacle are to have SafeLock protection. If critical components are damaged and ground fault protection is lost or if mis-wired, power to receptacle is disconnected.
K. Class A rated GFCI
L. 1-1/ 2 HP rating on Motor Control GFCI switch (2081 series).
M. Button colors match the device face.
N. Supplied with matching wall plate.
O. In compliance with UL-943, UL-498, UL-508.
P. Pre-wired pigtail connectors that accommodate Federal Specification receptacles are approved. Must be crimped and welded terminal right angle application within the connector.
Q. Receptacle shall be Federal Specification, WC896 compliant. Marking should be clearly identifiable on face or strap.
R. Acceptable Manufacturers: Cooper Wiring Devices, Pass & Seymour, Hubbell, and Leviton.
S. Leviton 6898, 20 Amp, ivory, white, almond, or mahogany.

2.14 TAMPER RESISTANT RECEPTACLES - COMMERCIAL

A. Thermoplastic shutter for reliable tAmper-resistant design.
B. High-impact thermoplastic face and body.
C. One-piece Brass Alloy grounding system.
D. High performance copper alloy contacts assure the highest degree of blade retention.
E. Ground contacts are encapsulated in thermoplastic body.
F. Side or back wiring accepts #10, #12 or #14 AWG copper.
G. Eight hold back wiring for convenient feed thru wiring.
H. In compliance with UL-498.
I. Pre-wired pigtail connectors that accommodate Federal Specification receptacles are approved. Must be crimped and welded terminal right angle application within the connector.
J. Receptacle shall be Federal Specification, WC896 compliant. Marking should be clearly identifiable on face or strap.
K. Acceptable manufacturers: Cooper Wiring Devices, Pass & Seymour, Hubbell, and Leviton.
L. Leviton 8300-SG, 20 Amp, ivory, white, grey, red or brown.

2.15 TAMPER RESISTANT RECEPTACLES - DECORA

A. Thermoplastic shutter for reliable tAmper-resistant design.
B. High-impact thermoplastic face and body.
C. One-piece Brass Alloy grounding system.
D. High performance copper alloy contacts assure the highest degree of blade retention.
E. Ground contacts are encapsulated in thermoplastic body.
F. Side or back wiring accepts #10, #12 or #14 AWG copper.
G. 8-hold back wiring for convenient feed thru wiring.
H. In compliance with UL-498.
I. Pre-wired pigtail connectors that accommodate Federal Specification Receptacles are approved. Must be crimped and welded terminal right angle application within the connector.
J. Receptacle shall be Federal Specification, WC896 compliant. Marking should be clearly identifiable on face or strap.
K. Acceptable manufacturers: Cooper Wiring Devices, Pass & Seymour, Hubbell, and Leviton.
L. Leviton 16262-SG, 20 Amp, ivory, white, red or orange.

2.16 ISOLATED GROUND RECEPTACLES - COMMERCIAL/ SPECIFICATION GRADE

A. All thermoplastic body construction.
B. Impact-resistant nylon face.
C. One-piece triple-wipe brass power contact.
D. Available with side wiring only & side and back wire models capable of accepting #14 - #10 AWG copper or copper-clad wire.
E. Terminal compartments isolated from each other for positive conductor containment.
F. Automatic grounding clip assures grounding to metallic boxes.
G. Easily accessible break off tabs to facilitate split circuit wiring.
H. Plated steel strap for corrosion resistance.
I. Combination Phillips/ slotted head screws backed out for ease of installation.
J. In compliance with UL 498, NEMA WD-1.
K. Pre-wired pigtail connectors that accommodate Federal Specification Receptacles are approved. Must be crimped and welded terminal right angle application within the connector.
L. Receptacle shall be Federal Specification, WC896 compliant. Marking should be clearly identifiable on face or strap.
M. Acceptable Manufacturers: Cooper Wiring Devices, Pass & Seymour, Hubbell, and Leviton.
N. Leviton 8300-IG, 20 Amp, orange.

2.17 ISOLATED GROUND RECEPTACLES - DECORA - HOSPITAL AND SPECIFICATION GRADE

A. Impact-resistant nylon face.
B. One-piece, triple-wire brass power contacts.
C. Corrosion resistant, plated, wrap-around steel strap locked into assembly to prohibit strap from bending away from body.
D. Terminal compartments isolated from each other for positive conductor containment.
E. Available in hospital grade & specification grade.
F. Heavy-duty compact design for easier installation and long-lasting performance.
G. Automatic grounding clip standard for positive ground to metal boxes.
H. All devices fit standard #26 opening wall plate.
I. Side and back wire accepts #14 - #10 AWG.
J. In compliance with UL 498.
K. Pre-wired pigtail connectors that accommodate Federal Specification Receptacles are approved. Must be crimped and welded terminal right angle application within the connector.
L. Receptacle shall be Federal Specification, WC896 compliant. Marking should be clearly identifiable on face or strap.
M. Acceptable manufacturers: Cooper Wiring Devices, Pass & Seymour, Hubbell, and Leviton.
N. Leviton 16362 - IG, 20 Amp, orange.

2.18 TOGGLE SWITCHES - COMMERCIAL DUTY SPECIFICATION GRADE

A. One-piece brass alloy contact arm.
B. Thermoset body and cover for superior heat resistance.
C. High strength polycarbonate toggle resists breaking and chipping under heavy abuse.
D. Available with side wire or side and back wire models capable of accepting #14 - #10 AWG copper or copper-clad wire.
E. Cam designed for fast make with positive break action to minimize arcing and prolong switch life.
F. Heavy-duty toggle bumpers for smooth and quiet operation.
G. Oversized silver alloy contacts for longer dependable switch life.
H. Plated steel strap for corrosion resistance.

I. Combination Phillips/ slotted head screws backed out for ease of installation.
J. In compliance with UL 20.
K. Switches shall be Federal Specification WC596 compliant. Marking should be clearly identifiable on face or strap.
L. Acceptable Manufacturers: Cooper Wiring Devices, Pass & Seymour, Hubbell, and Leviton.
M. Leviton CS120-2/ CS320-2/ CS420-2, 20 Amp, 120/ 277 V, ivory, white, black, grey, or almond.

2.19 ROCKER SWITCHES - SPECIFICATION GRADE

A. Impact-resistant thermoplastic nylon back body and frame.
B. Cushioned nylon paddle assures smooth, quiet, long-term operation.
C. Unique single rocking butterfly contact provides long term consistent performance with significantly fewer moving parts.
D. Internal back and side wire capability for easy installation with #14 – 10 AWG stranded or solid copper/ copper clad wire. Terminals made of high conductivity brass and serrated for maximum wire gripping.
E. Color-coded back bodies for positive identification of switch rating.
F. Silver alloy contacts integrally formed to the butterfly actuator assures reliable performance.
G. Integral auto ground clip for positive ground to metal boxes.
H. Brass binding head terminal screws are combination Phillips/ slotted. All terminal screws backed out, ready to install.
I. In compliance with UL 20.
J. Switches are to be Federal Specification, WC596 compliant. Marking should be clearly identifiable on face or strap.
K. Acceptable Manufacturers: Cooper Wiring Devices, Pass & Seymour, Hubbell, and Leviton.
L. Leviton 5621-2/ 5623-2/ 5624-2, 20 Amp, 120/ 277V ivory, white, black, grey, almond.

2.20 LIGHTED ROCKER SWITCHES - SPECIFICATION GRADE

A. Impact-resistant thermoplastic back body and frame.
B. Cushioned thermoplastic paddle assures smooth, quiet, long-term operation.
C. Unique single rocking butterfly contact provides long term consistent performance with significantly fewer moving parts.
D. Internal back & side wire capability for easy installation with #14 - 10 AWG stranded or solid copper/ copper clad wire. Terminals made of high conductivity brass and serrated for maximum wire gripping.
E. Color-coded back bodies for positive identification of switch rating.
F. Silver alloy contacts integrally formed to the butterfly actuator assures reliable performance.
G. Integral auto-ground clip for positive ground to metal boxes.
H. Brass binding head terminal screws are combination Phillips/ slotted. All terminal screws backed out, ready to install.
I. In compliance with UL 20.
J. Switches are to be Federal Specification, WC596 compliant. Marking should be clearly identifiable on face or strap.
K. Acceptable manufacturers: Cooper Wiring Devices, Pass & Seymour, Hubbell, and Leviton.
L. Leviton 5631-2/ 5633-2/ 5659-2/ 5649-2, 20 Amp 120/ 277V, ivory, white, brown, black, red, grey, or light almond.

2.21 AC MOTOR RATED SWITCH

A. 30 Amp and/ or 40 Amp, 600 V AC rated.
B. Double-pole or triple-pole, single-throw.
C. UL 508, UL 94 (flammability) Listed.
D. All molded parts are made of thermoplastic material to assure superior resistance to repeated impact, chemical degradation, extreme temperature fluctuations, tracking and arcing.
E. Positive-contact design enhances fast make/ slow break mechanism by minimizing bounce and arcing upon contact closure and teasing upon separation.
F. Free-travel toggle design protects closed contacts from accidental disengagement and contact teasing.
G. Silver alloy contacts provide maximum conductivity and prolonged service life.
H. Side and back wire terminal screws accept up to #10 AWG solid copper wire.
I. For standard #8 AWG wire, remove terminal clamp and use ring terminal.
J. Oversized #10, triple-combination, vibration-resistant terminal screws.
K. Mounting yoke is made from nickel-plated brass for superior corrosion resistance.
L. Insulating barriers between terminal screws provide isolation from each phase.
M. Devices are permanently marked with catalog number, Amperage, voltage, and horse-power ratings to assist with identification.
N. Large toggle provides positive actuation, even when operated with gloved hand.
O. Leviton MS302 (30 Amp, 2-Pole), MS 303 (30 Amp, 3-Pole), MS402 (40 Amp, 2-Pole) or MS403 (40 Amp, 3-Pole) or equivalent by Cooper Wiring Devices, Hubbell or Pass & Seymour.

2.22 DIMMER SWITCHES - DECORA SLIDE TYPE- SPECIFICATION GRADE

A. Maximum ratings are for continuous full load.
B. RFI suppression built in.
C. Extra-heavy use models supplied with matching cover.
D. Leviton 80800/ 80800-3/ 81000/ 81000-3/ 82000/ 82000-3, 800 watt, 1,000 watt, 2,000 watt - 120V, 277V.
E. Acceptable manufacturers: Cooper Wiring Devices, Pass & Seymour (Titan Series), Hubbell, Leviton.
F. Full on bypass.
G. Ivory, white, or grey.
H. Pre-set on-off switch.

2.23 SURFACE METAL RACEWAY AND WIREWAY

A. Provide surface metal raceway system complete with all fittings, wiring, devices, etc. Surface raceway are to have baked enamel finish.
B. These raceways are permitted only in dry locations where not subject to severe physical damage and must have metal not less than .04” thick. Do not use in hoistways and in any hazardous classified areas.
C. The number, type, and size of conductors permitted in raceway are to be clearly marked on raceway or on shipping label.
D. Splices and taps may be made providing raceway has an accessible removable cover.
E. Wireway made of 14-gauge sheet metal forming a square trough with hinged cover and complete with couplings, 90°. elbows, tees, junction boxes, end plates, and supports may be used for surface wiring at load centers and other locations to the extent permitted by the NEC.
F. Wireways in sizes 2-1/2" x 2-1/2" up to 12" x 12" square may be used; however, no conductor larger than that which the wireway is designed is to be installed therein. Wireway is to not contain more than 30 current carrying conductors at any cross-section and the sum of cross-sectional areas of all

contained conductors at any cross-section is to not exceed 20% of the interior cross-sectional area of wireway.

G. Wireways are to be treated with rust resistant primer and finished with gray, baked enamel.

2.24 MC CABLE

A. Type; UL listed Type MC Cable with galvanized steel armor outer casing, color coded circuit conductors, insulated green grounding conductor. Each conductor insulated with thermoplastic insulation.
B. NEC; Article 330, 518 and to comply with Federal Specification J-C-30B.
C. Manufacturers: AFC Cable Systems MC, Alean Cable, BICC, Tamaqua Cable.

2.25 FIRE ALARM MC CABLE

A. Type; UL listed Type MC Cable with galvanized steel armor outer casing, bare grounding conductor, color-coded circuit conductors. Each conductor insulated with thermoplastic insulation.
B. NEC; Article 760 and to comply with Federal Specification J-C-30B.
C. Manufacturer: AFC Cable Systems Fire Alarm Cable or approved equal.

2.26 SECURITY PLATES

A. Receptacle, switch, telephone, and GFI plates in secure areas are to be made of minimum 14-gauge one piece die formed cold rolled steel.
B. Baked white enamel finish, polyester powder, five-stage pre-treatment, 85% glass, minimum 2H hardness.
C. Back plate 10-gauge prime galvanized steel with four threaded holes. Security screws Torx T-20.
D. U.L. Listed.
E. Manufacturers: Hubbell.

2.27 INDOOR OCCUPANCY SENSORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Hubbell Lighting.
   2. Leviton Mfg. Company Inc.
   3. Lithonia Lighting; Acuity Lighting Group, Inc.
   4. Novitas, Inc.
   5. RAB Lighting, Inc.
   6. Sensor Switch, Inc.
   7. TORK.
   8. Watt Stopper (The).
   9. Pass & Seymour
B. General Description: Wall- or ceiling-mounting, solid-state units with a separate relay unit.
   1. Operation: Unless otherwise indicated, turn luminaires on when covered area is occupied and off when unoccupied; with a time-delay for turning luminaires off, adjustable over a minimum range of one to 15 minutes.
   2. Sensor Output: Contacts rated to operate the connected relay, complying with UL 773A. Sensor shall be powered from the relay unit.
   3. Relay Unit: Dry contacts rated for 20 Amp ballast load at 120- and 277-V AC, for 13 Amp tungsten at 120 V AC, and for 1 HP at 120 V AC. Power supply to sensor shall be 24 VDC, 150 mA, Class 2 power source as defined by NFPA 70.

4. Mounting:
   a. Sensor: Suitable for mounting in any position on a standard outlet box.
   b. Relay: Externally mounted through a 1/2" knockout in a standard electrical enclosure.
   c. Time-Delay and Sensitivity Adjustments: Recessed and concealed behind hinged door.
5. Indicator: LED, to indicate when motion is being detected during testing and normal operation of the sensor.
6. Bypass Switch: Override the on function in case of sensor failure.
7. Automatic Light-Level Sensor: Adjustable from 2 - 200 FC; keep luminaires off when selected illuminance level is present.

C. PIR Type: Ceiling mounting; detect occupancy by sensing a combination of heat and movement in area of coverage.
1. Detector Sensitivity: Detect occurrences of 0’-6" minimum movement of any portion of a human body that presents a target of not less than 3’-0” square feet.
2. Detection Coverage (Room): Detect occupancy anywhere in a circular area of 1,000 square feet when mounted on an 8’-0”" high ceiling.
3. Detection Coverage (Corridor): Detect occupancy within 90'-0” when mounted on a 10'-0” high ceiling.

D. Ultrasonic Type: Ceiling mounting; detect occupancy by sensing a change in pattern of reflected ultrasonic energy in area of coverage.
1. Detector Sensitivity: Detect a person of average size and weight moving not less than 1’-0” in either a horizontal or a vertical manner at an approximate speed of 1’-0” per second.
2. Detection Coverage (Small Room): Detect occupancy anywhere within a circular area of 600 square feet when mounted on an 8’-0” high ceiling.
3. Detection Coverage (Standard Room): Detect occupancy anywhere within a circular area of 1,000 square feet when mounted on an 8’-0” high ceiling.
4. Detection Coverage (Large Room): Detect occupancy anywhere within a circular area of 2,000 square feet when mounted on an 8’-0” high ceiling.
5. Detection Coverage (Corridor): Detect occupancy anywhere within 90’-0” when mounted on a 10’-0” high ceiling in a corridor not wider than 14’-0”.

E. Dual-Technology Type: Ceiling mounting; detect occupancy by using a combination of PIR and ultrasonic detection methods in area of coverage. A 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 0’-6” minimum movement of any portion of a human body that presents a target of not less than 3’-0” square feet and detect a person of average size and weight moving not less than 1’-0” in either a horizontal or a vertical manner at an approximate speed of 1’-0” per second.
3. Detection Coverage (Standard Room): Detect occupancy anywhere within a circular area of 1000 square feet when mounted on an 8’-0” high ceiling.

PART 3 - EXECUTION

3.01 WIRING DEVICES

A. Lighting outlet boxes to have fixture studs – 3/8”.

B. Exterior boxes shall be gasketed and watertight.
C. Switch and device plates to be mounted with all four corners touching adjacent surface.
D. All devices to be installed true and plumb.
E. Switch plates and receptacles shall not be placed back-to-back in adjacent rooms. Offset locations a minimum of 0’-3” to restrict noise transfer. This shall also apply to TV outlets, telephone outlets, data outlets.
F. All devices on opposite side of a fire resistance rated wall assembly are to be separated by a horizontal distance of not less than 2’-0”.
G. Ground-fault circuit-interrupters are to be provided on all outdoor receptacle circuits, receptacle circuits within toilet and bathrooms, areas in close proximity to water, and wherever else indicated on the drawings or required by Code. While-in-use type covers are to be used in exterior wet locations.
H. Tamper resistant receptacles are to be installed in day care areas, pediatric health care, psychiatric care as well as where indicated on the drawings. Refer to NEC 406.12 and 517.18 (C).
I. Arc-fault circuit-interrupters shall be provided on all 15 Amp and 20 Amp receptacle branch circuits in dwelling unit bedrooms.
J. Dimmer switch devices shall be appropriately sized for derating when a minimum of two or more are ganged together in a common wall box.

3.02 WIRING METHODS

A. Exposed interior wiring, panel feeders, home runs, equipment feeders; EMT. EMT conduit shall be securely fastened at intervals not exceeding 10’-0” and within 3'-0” of all boxes. NOTE: Exposed means all wiring which is not installed within walls, above suspended ceilings, or within a pre-manufactured raceway. Any raceway that is to be exposed in a finished area is to be coordinated with the architect/ engineer prior to installation.
B. Concealed branch circuiting above suspended ceilings, and in stud partitions; MC Cable. MC Cable shall be securely fastened at intervals not exceeding 4’-6”, and within 1’-0" of all boxes or fittings. All home runs are to be in EMT.
C. Wiring in concrete slabs or decks is not permitted unless approved by the architect or structural engineer.
D. Exposed exterior wiring; Intermediate rigid conduit.
E. Wiring below concrete slabs in earth; PVC conduit. * Provide GRS conduit sweep elbow through concrete slab.
F. Service wiring; PVC conduit encased in 0’-2" of reinforced concrete from utility transformer or pole to the building (below slab is not required to be encased).
G. Concrete encasement; 0’-2" minimum cover around each conduit requiring encasement. Reinforcement consisting of 4" x 4" No. 4 wire mesh on top level of conduit.
H. Emergency feeder from generator set (if outside building) to building; PVC conduit encased in 0’-2" of concrete, IMC within building.
I. Minimum conduit size is 3/4"Ø.
J. Flexible connections to all motors. Maximum length of flexible conduit is to be 3’-0".

3.03 RACEWAY SYSTEMS

A. All secondary wiring is to be installed in rigid metal conduit, electrical metallic tubing, or MC Cable as specified in these Specifications.
B. Electrical metallic tubing shall be employed in lieu of rigid metal conduit in all locations except:
    1. Underground
    2. In gravel, cinder, concrete, or other sub-base floor construction. PVC may be used under floor.

3. Horizontal runs in concrete floor slabs. PVC may be used in slabs.
4. Where subject to possible mechanical injury
5. In masonry construction below finished grade. PVC may be used.
6. Vertically in poured concrete walls.
7. For service work
8. For main distribution feeders

C. All raceway components shall be fastened at intervals not exceeding 8'-0".
1. Conduits shall not fasten or come in contact with piping of other trades as installed in this building.
2. Conduit is to be separated by a distance not less than 0’-6” from any water, steam or gas lines as may be installed in the building.

D. Conduits and raceway systems are not to be run concealed in walls, partitions, and floor slabs. Conduit which must be exposed is to be arranged as to not pass in front of windows, doors, access panels, access doors, sky lights, HVAC equipment access for coil removal or filter removal or required service clearances.

E. Pulling fittings are to be provided for any conduit run which exceeds 200’-0 in length.

F. All high voltage conduits (all conduit serving equipment over 600-volts) are to be painted red and labeled “HIGH VOLTAGE” on 10'-0” intervals. This does not apply to conduit below grade.

G. All exposed fire alarm conduits are to be painted red, unless directed otherwise by the architect. This is to include the 120-volt feed to the control panel. Junction boxes are to be labeled “FIRE ALARM.”

H. All emergency circuits (MC Cable and conduit) are to be painted red unless directed otherwise by the architect. Junction boxes are to be labeled “EMERGENCY XXXV.” Appropriate voltage is to be indicated.

I. All conduits and raceway components installed under this Section for completion by others are to be provided with a pull wire affixed at both ends of conduit.

J. Insulating bushings are to be used on all conduit terminations entering enclosures, boxes, and panels to protect the conductor from damage during installation.

3.04 POWER WIRING

A. Wire between motors, starters, disconnects and source.

B. Verify proper motor rotation. Check for smooth operation.

C. Furnish and install weatherproof disconnects, as indicated.

D. All panel feeders are to be run in EMT raceway system.

E. All wiring to roof top units, fans, and HVAC units is to be completely installed between panel, disconnect switches and motor or unit connections.

F. Disconnects are to be mounted adjacent to electrical and mechanical equipment. Indoor installations are to utilize NEMA 1 enclosures. Outdoor installations are to utilize NEMA 3R enclosures.

3.05 GROUNDING

A. All electrical equipment and systems are to be grounded.

B. Grounding system is to consist of a ground bus bar connected to a driven ground rod. Utilize ground type clamp fitting.

C. All connections to conduit, equipment and devices are to be made with compression type connections.

D. The grounding system is to comply with the NEC.

E. All outside luminaires and poles are to be grounded.

F. All equipment and devices are to be grounded in accordance with the manufacturer’s recommendations.

G. The ground system is to have a resistance of 25 ohms or less in compliance with the NEC. Utilize the fall of point method.
H. Furnish a ground system test report at the completion of the work.
I. Substation area grounding is to be in accordance with local utility company standards.

END OF SECTION

SECTION 26 28 16 - SAFETY SWITCHES - GENERAL DUTY

*** Residential, light commercial.**

PART 1 - GENERAL

1.01 REFERENCE

A. Refer to section 26 00 00 for requirements which are applicable to this section.
B. Refer to NFPA and in particular National Electrical Code.
C. Refer to NEMA, UL, and IEEE Standards.

1.02 WORK INCLUDED

A. Provide all labor, material, equipment, and supervision necessary to furnish and install and place into operation safety switches where indicated on the drawings and specified herein.

1.03 SUBMITTALS

A. Submit manufacturer's shop drawings of devices.

1.04 QUALITY ASSURANCE

A. Verify that all equipment is installed in accordance with the manufacturer's warranty requirements.
B. Install systems and equipment in accordance with the National Electrical Code and local codes having jurisdiction.
C. Provide adequate supervision of labor force to see that installations are correct.

PART 2 - PRODUCTS

2.01 GENERAL DUTY SAFETY SWITCHES

A. APPLICATION DATA
30 Amp-600 Amp
240-volts AC
NEMA 1 - General Purpose, painted sheet steel
NEMA 3R - Rainproof, painted galvanized steel
Standard - Non time delay fuse
Maximum - Time delay (dual element) fuse
B. CONSTRUCTION
Visible blades
Handle attached to box, not cover
Handle position indicates "ON" or "OFF"
Top hinged cover on NEMA 3R

Operating mechanism is quick-make, quick-break
Plated current carrying parts
Provisions for padlocking the switch in the "OFF" position
Class R fuse kits for field installation

C. NEUTRAL AND GROUNDING
Provisions for field installation of insulated, groundable neutral
Ground kits for field installation

D. TERMINALS
UL listed for Al or Cu wires
UL listed for 60°C, or 75°C wires

E. FUSE CLIPS
Spring reinforced
Plated

F. APPLICATION
Fusible - Class H or Class R
Not fusible

G. NEMA STANDARDS
KS1 - 1975

H. UL LISTING
UL 98 Enclosed Switches
Maximum HP ratings

I. UL LISTED SHORT CIRCUIT RATING:
100,000 rms symmetrical amperes with proper rejection kit and Class R fuses 10,000 rms symmetrical amperes with Class H fuses

J. Acceptable Manufacturers:
1. Siemens
2. Cutler Hammer
3. ABB Group
4. Square D

PART 3 - EXECUTION

3.01 SAFETY SWITCHES

A. Furnish and install safety switches on all motors which do not have integral equipment disconnect devices, local starters and/ or where indicated on the drawings.
B. Furnish and install fused safety switches where indicated on the drawings.
C. Safety switches shall be installed to meet the area classification as to standard, hazardous, rainproof, etc.
D. Safety switches shall be installed securely to building structure or be provided with supplemental support steel such as angle iron or uni-strut when required to locate on other than building structure.
E. All safety switches shall be grounded.

END OF SECTION

SECTION 26 41 13 - LIGHTNING PROTECTION (ADD ALTERNATE)

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, shall apply to this Section.

1.02 SUMMARY

A. This Section includes lightning protection for each building.
B. Provide a complete design layout with details for review.

1.03 SUBMITTALS

A. Product Data: For air terminals and mounting accessories.
B. Shop Drawings: Detail lightning protection system, including air-terminal locations, conductor routing and connections, and bonding and grounding provisions. Include indications for use of raceway and data on how concealment requirements will be met.
C. Qualification data for firms and persons specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include data on listing or certification by nationally recognized testing laboratory (NRTL) or trade association.
D. Certification, signed by Contractor, that roof adhesive for air terminals is approved by manufacturers of both the terminal assembly and the single-ply membrane roofing material.
E. Field inspection reports indicating compliance with specified requirements.

1.04 QUALITY ASSURANCE

A. Installer Qualifications: Engage an experienced installer who is NRTL listed or who is certified by LPI as a Master Installer/ Designer.
B. Listing and Labeling: As defined in NFPA 780, Article 2-2, "Definitions."
C. Provide UL Master Label.
D. Provide LPI certification of system.
E. Provide ETL Master Label indicating system complies with specified requirements.

1.05 COORDINATION

A. Coordinate installation of lightning protection with installation of other building systems and components, including electrical wiring, supporting structures, and building materials, metal bodies requiring bonding to lightning protection components, building finishes, and roof systems.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. A-C Lightning Security, Inc.
   2. Automatic Lightning Protection.
   3. Harger Lightning Protection, Inc.
   4. Heary Bros. Lightning Protection Co. Inc.
   5. Independent Protection Company, Inc.
   6. Robbins Lightning, Incorporated.
   7. Thompson Lightning Protection, Inc.
   8. Warren Lightning Rod Company
   9. Preferred Lightning Protection
   10. East Coast Lightning Equipment, Inc.

2.02 LIGHTNING PROTECTION SYSTEM COMPONENTS

A. Comply with UL 96.
B. Select material classification of NFPA 780; see Table 2 in the Evaluations. NFPA requires Class II air terminals to be solid.
C. Roof-Mounting Air Terminals: NFPA Class I or II as appropriate, solid copper, unless otherwise indicated.
   1. Single-Membrane, Roof-Mounting Air Terminals: Designed for single-membrane roof materials.
D. Stack-Mounting Air Terminals: Solid copper.
E. Ground Rods, Ground Loop Conductors, and Concrete-Encased Electrodes: Comply with Division 26 Section "GROUNDING AND BONDING" and standards referenced in this Section.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Install lightning protection components and systems according to UL 96A, LPI-175, and NFPA 780.
B. Conceal the following conductors:
   1. System conductors.
   2. Down conductors.
   3. Interior conductors.
   4. Conductors within normal view from exterior locations at grade within 200’-0” (60 m) of the building.
   5. Notify Architect at least 48 hours in advance of inspection before concealing lightning protection components.
C. Cable Connections: Use approved exothermic-welded connections for all conductor splices and connections between conductors and other components, except those above single-ply membrane roofing.
D. Air Terminals on Single-Ply Membrane Roofing: Comply with adhesive manufacturer's written instructions.
E. Bond extremities of vertical metal bodies exceeding 60’-0” (18 m) in length to lightning protection components.

F. A counterpoise installation based on requirements in Division 26 Section "GROUNDING AND BONDING" may be used as a ground loop required by NFPA 780, provided counterpoise conductor meets or exceeds minimum requirements in NFPA 780.
   1. Bond ground terminals to counterpoise conductor.
   2. Bond grounded metal bodies on building within 12’-0” (3.6 m) of ground to counterpoise conductor.
   3. Bond grounded metal bodies on building within 12’-0” (3.6 m) of roof to interconnecting loop at eave level or above.

G. Bond lightning protection components with intermediate-level interconnection loop conductors to grounded metal bodies of building at 60’-0” (18 m) intervals.

3.02 CORROSION PROTECTION

A. Do not combine materials that can form an electrolytic couple that will accelerate corrosion in the presence of moisture unless moisture is permanently excluded from junction of such materials.

B. Use conductors with protective coatings where conditions would cause deterioration or corrosion of conductors.

3.03 FIELD QUALITY CONTROL

A. Periodic Inspections: Engage an LPI inspector to perform periodic inspections during construction and at its completion, according to LPI-177.

B. UL Inspection: Apply for inspection by UL as required to obtain a UL Master Label for system.

C. ETL Inspection: Engage an ETL inspector to inspect completed system for compliance with specified requirements.

END OF SECTION

SECTION 26 43 13 - SURGE SUPPRESSION

PART 1 - GENERAL

1.01 REFERENCE

A. Refer to Section 26 00 00 for requirements which are applicable to this section.
B. Refer to National Electrical Code.
C. Refer to UL, ANSI, IEEE, and NEMA Standards.
D. Refer to Computer Business Manufacturer's Association (CBEMA), Information Technology Industry Council (ITIC) and International Electrotechnical Commission (IEC) for clamping voltage tolerance guidelines for sensitive equipment.

1.02 WORK INCLUDED

A. Provide all labor, material, equipment, and supervision necessary to install and place into operation surge suppression where indicated on drawings and/or specifications.

1.03 SUBMITTALS

A. Submit shop drawings, product data, and manufacturer's installation instructions.
B. The surge suppression submittal shall also include:
   1. Dimensional drawing of each suppressor type indicating mounting arrangements.
   2. UL 1449 Third Edition documentation (SCCR, VPR, MCOV, I-n).
C. All Surge Protective Devices shall be of the same manufacturer.

1.04 QUALITY ASSURANCE

A. Verify that all equipment is installed in accordance with the manufacturer's warranty requirements.
B. Install equipment with accordance with National Electrical Code.
C. Provide adequate supervision of labor force to see that installations are correct.
D. Surge protection devices shall be manufactured in the USA, by a company normally engaged in the design and manufacture of such devices for at least ten years.

1.05 SAFETY AGENCY APPROVALS

A. Suppressers shall be listed in accordance with UL 1449 3rd Edition documentation, standard for safety, surge protective devices and meet requirements in UL 1283 for electromagnetic interference filters.

PART 2 - PRODUCTS

2.01 SERVICE ENTRANCE

A. Surge protection devices shall be installed at all service entrances of each building and/ or as shown on the riser diagram.
B. Suppressers shall be tested per ANSI/IEEE C62.45.
C. Wye systems shall have suppression elements between each phase conductor and the system neutral, between each phase conductor and the system ground and between the neutral conductor and ground (true 10-mode protection).
D. Each phase shall have a minimum of two modules. The surge modules shall be fused at a minimum rating of 30 Amp. Modules and fuses shall be field replaceable. Fuses shall be surge suppression fuses. (Ferraz Shawmut VPS Series)
E. Visible indication of proper suppresser connection and operation shall be provided. The indicator shall consist of an LED array. No single LED or neon indicators will be used.
F. The surge protection device shall be equipped with an audible alarm that shall actuate when any part of the surge circuitry has been damaged. A silence button shall be provided with the alarm.
G. The suppressor shall exhibit Sine Wave Tracking circuitry and shall provide high frequency noise filtering up to 50dB attenuation (100 kHz-100 MHz).
H. Suppressors shall meet or exceed the following criteria:
    1. Minimum single impulse current rating (L-N + L-G): 160,000 Amp per phase, 80 kA per mode.
    2. Incorporate hybrid circuitry.
    3. UL 1449 3rd Edition voltage protection ratings shall not exceed the following:

VOLTAGE	L-N	L-G	N-L	L-L	MCOV
120/208	800	800	800	1200	150
277/480	1200	1200	1200	2000	320

I. Suppressors shall exhibit redundant protection for each phase and consist of solid-state components and shall operate bi-directionally.
J. Suppressor shall be equipped with a surge counter with a reset and battery backup.
K. Suppressor short circuit current rating shall meet or exceed that of the service panelboard.
L. Total Protection Solutions (Joslyn) Surge Track ST160 or approved equivalent by Advanced Protection Technologies, Inc., Siemens, ABB Group, Eaton, Square D, or LEA International.

2.02 SECONDARY DISTRIBUTION INTEGRATED SUPPRESSION PANELS:

A. Surge Protective Devices shall be installed in secondary distribution panels as shown on the riser diagram.
B. Suppressor shall be tested per ANSI/IEEE C62.45.
C. Wye systems shall have suppression elements between each phase conductor and the system neutral, between each phase conductor and the system ground and between the neutral conductor and ground (true 10-mode protection).
D. Visible indication of proper suppressor connection and operation shall be provided.
E. The surge protective device shall be equipped with an audible alarm that shall actuate when any part of the surge circuitry has been damaged. A silence button shall be provided with the alarm.
F. The suppressor shall exhibit Sine Wave Tracking circuitry. The surge suppressor shall have suppression circuitry that is field replaceable without disturbing the conduit or enclosure.
G. Suppressors shall meet or exceed the following criteria:
    1. Minimum single impulse current rating (L-N + L-G): 80,000 amperes per phase, 40kA per mode.
    2. UL Clamping voltage shall not exceed the following:

VOLTAGE	L-N	L-G	N-L	L-L	MCOV

120/208	800	800	800	1200	150
277/480	1200	1200	1200	2000	320

H. Suppressors shall consist of solid-state components and operate bi-directionally. The manufacturer of the surge panel shall offer either a surface or flush cover, as required by the job conditions.
I. Suppressor short circuit current rating shall meet or exceed that of the panelboard.
J. Total Protection Solutions (Joslyn) Surge Track ST80 or approved equivalent by Advanced Protection Technologies, Inc., LEA International, Siemens, GE, Eaton, or Square D.

PART 3 - EXECUTION

3.01 SERVICE ENTRANCE

A. Install one primary suppressor at each utility service entrance. Follow manufacturer's installation instructions.
B. Suppressor shall be installed on the load side of the service entrance.
C. Conductors between suppressor and point of attachment shall be at least #6 AWG stranded copper conductor or larger. The conductors shall be kept as short and straight as possible. Lead length of connecting conductors shall be within 3’-0”.
D. Suppressor's ground shall be bonded to the service entrance ground.

3.02 SECONDARY DISTRIBUTION PANELS

A. Install one secondary suppressor at each distribution panel location or as indicated on the riser diagram. Follow manufacturer's installation instructions.
B. Suppressor shall be installed on the service panel, per the manufacturer's installation instructions. Contractor shall install circuit breaker in panel to attached surge panel to electrical distribution system if necessary.
C. Conductors between suppressor and point of attachment shall be at least #6 AWG stranded copper conductor or larger. The conductors shall be kept as short and straight as possible. The maximum length of connecting wiring shall not exceed 1’-6”. Pre-wired suppressors with conductors smaller than #6 wire are not acceptable.
D. Suppressor’s ground shall be connected to the distribution panel ground.

3.03 CERTIFIED TESTS

A. The surge suppresser manufacturer shall provide certified test results on the actual product being shipped to the job site. The test results shall be certified by an officer or engineer of the company as being performed on the product after manufacture.
B. The test conducted shall be per ANSI/IEEE C62.45. The units shall be tested in all modes listed in this specification.

3.04 WARRANTY

A. The surge suppresser shall warrant the surge protective devices and supporting components against defects in material and workmanship for a minimum period of five years.

3.05 TESTING

A. Perform field quality control testing under the supervision of the manufacturer's factory authorized service representative.

3.06 DEMONSTRATION

A. Engage a factory authorized service representative to train owner's personnel to adjust, operate, and maintain equipment.

END OF SECTION

SECTION 26 50 00 - LIGHTING

PART 1 - GENERAL

1.01 REFERENCE

A. Refer to Section 26 00 00 for other requirements of this Section.
B. All work to conform to the NFPA 70 National Electrical Code.
C. Provide interior lighting controls to meet the adopted IBC / IECC / ASHRAE 90.1 code. Refer to Specification Section 26 09 00 for additional requirements.
D. Refer to standards of the Illuminating Engineering Society.
E. All exit and emergency lighting shall comply with NFPA Life Safety Code 101, ADA, and other local codes as may apply.

1.02 SCOPE

A. Furnish and install a complete and operating lighting system, including all luminaires, wiring, lamps, and 0-10V dimmable LED drivers.
B. All lighting outlets shall have a luminaire. If a luminaire designation is missing, furnish and install a luminaire in similar use in the project.
C. All luminaires shall have a home run. If these are omitted on the drawings the contractor shall allow for a home run to the nearest appropriate panel.
D. All rooms are to be provided with lighting controls. Provide manual switch and code required control devices as appropriate. If controls are not indicated within a space, controls are to be provided for the space in a similar manner as adjacent or similar spaces.
E. Provide exit and emergency lighting as required by Code in all spaces to meet requirements of the AHJ. Allow for ten additional luminaires to be installed where directed by the AHJ.

1.03 MOUNTING

A. The contractor shall be responsible for selecting mounting arrangements of luminaires to suit the construction or ceiling types. Contractor or his agent shall review architectural drawings to establish ceiling types prior to preparing shop drawings for submission. It is NOT to be understood that the luminaire schedule accounts for the mounting types. Frequently ceiling types are changed after the luminaire schedule has been completed.
B. Luminaires shall be mounted on structurally secure supports. The contractor shall provide miscellaneous steel supports to span between structural elements to provide a base of support for the luminaires at the locations shown on the drawings. Refer to architectural and structural drawings for locations of beams, joists, purlins, etc.
C. Exterior luminaires shall be mounted with anchor bolts of suitable size secured into concrete bases. The mounting arrangement shall be capable of withstanding a continuous wind of 100 MPH with gales to 130 MPH. EPA of luminaire shall be rated with pole to provide required performance.

1.04 APPROVALS

A. Furnish shop drawings and catalog cuts of all luminaires for review by the engineer prior to ordering.
B. Provide samples of any luminaire or luminaires when requested by the owner, architect, or engineer.

C. Provide a point-by-point lighting level calculation for parking areas, areas when requested by the engineer, and for high profile areas (i.e., main lobbies, atriums, pools, gymnasiums, etc.), when an alternate manufacturer or luminaire is being presented for approval. Calculation shall be provided by the manufacturer or the local manufacturer's representative. Footcandle levels are to be indicated at a maximum of 10'-0" intervals (exterior) or 5'-0" intervals (interior). A drawing is to be provided at the same scale as the contract documents.

PART 2 - PRODUCTS

2.01 LUMINAIRE REQUIREMENTS

A. Luminaires shall be complete with wiring, lamp holders, lamps, reflectors, glassware, canopies, shades, bases, pendants, etc.
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. Luminaires shall be wired with type AF luminaire wire.
D. Plastic lenses shall not be used. Provide either virgin acrylic, high impact polycarbonate or tempered glass or as specified in the luminaire schedule. Lens thickness shall be a minimum of 1/8".
E. Any exposed luminaire housing surface, trim frame, door frame and lens frame shall be free of light leaks either between luminaire components or between luminaire and adjacent surface.
F. Variations in finishes are unacceptable in the same piece. Variations in finishes of adjoining components are acceptable if they are within the range of approved Samples and if they can be and are assembled or installed to minimize contrast.
G. Hinged door closure frames shall operate smoothly and easily without binding when installed and latches shall function easily by finger action without the use of tools.
H. Recessed luminaires installed in an insulated ceiling shall be listed for use in insulated ceilings.
I. Luminaires in damp areas shall be gasketed, vapor tight, and fabricated with aluminum instead of steel. These luminaires shall have pressure clamping devices in lieu of latches.
J. Luminaires located in other harsh environments are to be of suitable construction and finish for the intended environment in addition to the requirements listed in the Lighting Luminaire Schedule.
K. All luminaire lenses shall, from the manufacturer, be shipped within a protective covering, i.e. plastic bag, paper wrapped, to prevent dust, dirt, smudges prior to final acceptance.
L. Drivers shall be easily serviceable when installed and shall not be mounted to removable reflectors or wire way covers.
M. Luminaires shall have a minimum CRI of 80 and a CCT of 3500 K.
N. Luminaires shall have a rated lamp life of 50,000-hours to L70.
O. Luminaires shall be dimmable from 100% to 10% of maximum output.

2.02 LED DRIVERS

A. Shall be internal.
B. Shall be designed for ten-year operational life.
C. Shall be designed to withstand electrostatic discharges according to IEC 61000-4-2.
D. Shall be furnished with poke-in wire trap connectors, color coded to ANSI standard C82.11.
E. Shall operate from a line voltage range of 108-305-volts, 50/60 Hz.
F. Input current shall have Total Harmonic Distortion (THD) of less than 20% with a power factor of >.90% to comply with ANSI standard C82.11

G. Shall meet UL 8750, UL 1012, and UL 1310 as applicable in NFPA compliant installations.
H. Shall have no visible output change at ±10% line voltage input.
I. Shall have a Class A sound rating (inaudible at 27dBA ambient noise level).
J. Shall have a universal input voltage (120-277V/ 50-60Hz).
K. Shall be Underwriters Laboratories (UL) Listed (Class P) and CSA Certified where applicable and rated for use in air handling spaces.
L. Shall carry a five-year warranty from the date of manufacture for operation at a case temperature of 75°C or less. When operated at a case temperature between 75°C and 85°C, the warranty shall be three years from the date of manufacture.

2.03 LED EQUIVILANT LAMPS

A. LED: ENERGY STAR Certified, NRTL compliant, FM Global compliant. Recessed luminaires shall comply with NEMA LE4, CRI: 80, CCT: 3500 K. Lamps dimmable from 100% to 10% of maximum light output, 50,000-hour lamp rated life, internal driver must be UL Listed, dimmable with any standard dimmer switch, smooth, flicker-free dimming.
B. Manufacturers; Philips, Feit, Sylvania, GE, Archipelago.
C. Contractor is to coordinate lamp color for all luminaires. Lamp color is to be similar in all spaces.

2.04 EMERGENCY LIGHTING UNITS

A. General requirements: Self-contained units, thermoplastic enclosure, comply with UL 924. Units include the following features:
   1. Battery: Sealed, maintenance-free, lead-acid type with minimum ten-year nominal life and special warranty, 12-volt, remote capacity as required.
   2. Charger: Fully automatic, solid-state type with sealed transfer relay.
   3. Operation: Relay automatically turns lamp on when 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, and battery is automatically recharged and floated on charger.
   4. Wire Guard: Where indicated, heavy-chrome-plated wire guard arranged to protect lamp heads or luminaires.
   5. Integral Time Delay Relay: Arranged to hold unit on for fixed interval after restoring power after an outage. Provides adequate time delay to permit high-intensity-discharge lamps to restrike and develop adequate output.
   6. Test switch and LED pilot light
   7. Self-diagnostic circuitry.
B. Manufacturers: Emergi-Lite, Dual-Lite, Chloride

2.05 EMERGENCY LED POWER SUPPLY UNIT

A. Integral Type: Self-contained, modular, battery-inverter unit factory mounted within luminaire body. Comply with UL 924.
   1. Test Switch and Light-Emitting Diode Indicator Light: Visible and accessible without opening luminaire or entering ceiling space.
   2. Battery: Sealed, maintenance-free, nickel-cadmium type with minimum ten-year nominal life.
   3. Charger: Fully automatic, solid-state, constant-current type.
   4. Operation: Relay automatically energizes lamp from unit when normal supply circuit voltage drops to 80% of nominal voltage or below. When normal voltage is restored, relay disconnects lamp and battery is automatically recharged and floated on charger.

5. Light output:
   a. Minimum 1,400 lumens for LED luminaires.

2.06 EMERGENCY LIGHTING INVERTER

A. Remote Type. Self-contained, modular, battery-inverter. Comply with UL 924, NFPA 101, and installed per the National Electrical Code.
B. The sensing/ transfer equipment shall consist of a transfer relay and solid-state switch. Total transfer from standby to emergency operation shall be accomplished in less than one second after loss or interruption of normal AC power.
C. The battery charger shall include a ferro resonant transformer and a full wave rectifier. It shall be of solid-state construction and shall provide three rates of charge. The charger shall incorporate a digital, solid-state timer which periodically allows an automatic equalizing charge to be applied to the batteries.
D. The solid-state DC-to-AC inverter shall have a ferro resonant output transformer which provides 120-volt, or 277-volt +/- 5% of single phase, 60Hz +/- 1Hz emergency power. The design shall yield a sinusoidal output waveform with maximum 10% Total Harmonic Distortion. Efficiency shall be not less than 75%.
E. Designed system protection shall include a Low Voltage Battery Disconnect feature, short-circuit protection, current-limiting feature, and overload protection of 130%.
F. Batteries shall be lead-calcium.
G. Supervisory instrumentation and controls shall include, but not be limited to, battery DC voltmeter, output AC voltmeter, AC utility power "on" light, emergency power "on" light, system test switch to simulate normal AC power failure, high charge indicator light and charge current ammeter.
H. The entire system shall be enclosed in a heavy-gauge, commercial-grade steel cabinet, enamel-finished in beige hammer tone and including hinged, lockable doors. The cabinet shall be free-standing or wall-mounted, and batteries shall be positioned below the modular electronics for easy maintenance.
I. Manufacturers; IOTA, DUAL LITE, Bodine, Emergi-Lite/ ABB, or equal.

2.07 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. Refer to Luminaire Schedule on drawings.
B. Internally lighted Signs:
   1. Lamps for AC Operation: LEDs, 50,000 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% 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.

PART 3 - EXECUTION

3.01 LUMINAIRES

A. All recessed LED troffers (2' x 2', 2' x 4', and 1’ x 4') and recessed luminaires weighing up to 20 lbs. are to be installed in grids with mounting clips and with grid secured at diagonal corners of luminaire to the building structure. (4' x 4') luminaires to be secured at four corners.
B. Recessed luminaires between 20 and 50 pounds are to have, in addition to above, 12-gauge steel safety chains at opposite corners hung slack from the building structure. Luminaires above 50 pounds to be independently supported directly from the structure with approved hangers and angular sway bracing according to manufacturer’s installation guidelines.
C. Surface mounted and pendant luminaires under 15 pounds can be supported directly from the outlet box when all of the following apply: screws pass through round holes and not key slots in the luminaire body, the outlet box is attached to a main ceiling runner, and the outlet box is supported vertically from the building structure.
D. Surface luminaires between 15 and 50 pounds shall be bolted to the ceiling independent of the outlet box. Luminaires over 50 pounds shall be secured to the building structure using a manufacturer’s approved mounting method.
E. Luminaires to be set plumb.
F. Provide 6’-0” flexible leads on recessed luminaires to allow for easy removal.
G. Recessed luminaires shall be set with mounting frames.
H. Coordinate final location of all luminaires with other disciplines to avoid interferences and potential obstructions as the work progresses.
I. Luminaires used for temporary lighting during construction shall be removed, cleaned, and re-installed prior to acceptance of the lighting system.
J. Luminaires shall be cleaned and free of all dirt, dust, smudges, and surface imperfections just prior to final acceptance.
K. Luminaires which are recessed in a fire rated ceiling shall be provided with an enclosure around the luminaire which shall maintain the fire rating integrity of the ceiling system. The installation of the enclosure shall meet the requirements of the authority having jurisdiction. The luminaire shall be insulation rated for higher temperature operation.
L. All recessed or surface mounted luminaires on or in sloped ceilings shall have sloped ceiling adapters to allow for vertical light distribution.

3.02 SWITCHING

A. Provide lighting control switch legs to wall switches for all luminaires except for those operated by integral switches.
B. Provide 3-way or 4-way control where indicated and for rooms with more than one entrance.
C. Provide a single time clock, contactors and relays as indicated on the drawings and as necessary for site lighting and parking lot lighting control.
D. Provide interior lighting controls to meet IBC 2015/IECC 2015/ ASHRAE 90.1. Refer to Specification Section 26 09 00 for additional requirements.

END OF SECTION

SECTION 26 60 00 - SERVICE AND DISTRIBUTION

PART 1 - GENERAL

1.01 ELECTRICAL CHARACTERISTICS

A. Secondary Service: 120/208 V, 3 phase, 4 wire.
B. Secondary Distribution: 120/208 V, 3 phase, 4 wire.
C. Lighting Branch Circuits: 120 V, 1 phase, 2 wire.
D. Power Branch Circuits: 208 V, 3 phase, 3 wire.

1.02 ELECTRIC SERVICE

A. Primary electric service shall be provided by contractor from utility pole underground via pull hole at property line to transformer. Secondary shall be provided by contractor from transformer to building service entrance gear. Contractor shall furnish and install all work required by the utility company for service.
B. Contractor shall coordinate his schedule with the utility for completion of the installation and energization of the services.
C. Contractor shall provide metering conduit between current transformer and final location of meter as determined by the utility company.

1.03 REFERENCE

A. Refer to Section 26 00 00 for additional requirements of this section.
B. Refer to requirements of the National Electrical Code and the utility company.

PART 2 - PRODUCTS

2.01 UNDERGROUND SERVICE

A. U. L. listed Schedule 40 PVC conduit underground encased in 2" of reinforced concrete. Reinforcement shall include 4" x 4" No. 4 wire mesh on top level of conduit.
B. Seal both ends of conduits with duct seal.
C. Coupling shall be watertight.
D. All service conduits shall be encased in concrete envelope.

2.02 SECONDARY SERVICE CABLE

A. Copper conductors, 75 degrees C, 600V, thermoplastic insulation and neoprene outer jacket, U. L. listed. Type THWN.
B. Manufacturers: Triangle, General Cable, Southwire.

2.03 PRIMARY DUCT

A. 5" duct as recommended by Utility Company.

PART 3 - EXECUTION

3.01 SERVICE

A. Underground excavation shall be open cut, trenching to appropriate depth.
B. Conduit shall not rest on rock or boulders.
C. Backfill in 12" layers and pneumatically tamp.
D. Sod disturbed grass areas.
E. Provide new concrete or asphalt walks, curbs, driveways to match adjacent and original surfaces.
F. Provide a concrete encasement of service conduits from utility pole or transformer to the building.
G. Primary cable and duct shall be installed from transformer location to utility pole as designated by Utility Company, by the Electrical Contractor.
H. Provide 10' of slack in cable for Utility Company connections.

3.02 POWER WIRING

A. Wire between motors, starters, disconnects and source.
B. Verify proper motor rotation.
C. Furnish and install weatherproof disconnects, as indicated.
D. All panel feeders shall be run in EMT raceway system.
E. All wiring to roof top units, fans, equipment, and H&V units shall be installed complete between panels and disconnect switches, and motors.
F. Disconnects shall be mounted adjacent to electrical and mechanical equipment. Indoor installations shall utilize NEMA 1 enclosures. Outdoor installations shall utilize NEMA 3R enclosures.

3.03 GROUNDING

A. All electrical equipment and systems shall be grounded.
B. Grounding system shall consist of a ground bus bar connected to a driven ground rod. Utilize ground type clamp fitting.
C. All connections to conduit, equipment and devices shall be made with compression type connections.
D. The grounding system shall comply with the NEC.
E. All outside lighting fixtures and poles shall be grounded.
F. All equipment and devices shall be grounded in accordance with the manufacturer’s recommendations.
G. The ground system shall have a resistance of 25 ohms or less in compliance with the NEC.
H. Furnish a ground system test report at the completion of the work.
I. Substation area grounding shall be in accordance with Utility Company standards.

END OF SECTION

SECTION 28 30 00 - FIRE ALARM AND DETECTION SYSTEMS - ADDRESSABLE - SPEAKER

*** All of these items refer to high rise applications**

PART 1 - GENERAL

1.01 REFERENCE

A. Refer to Section 26 00 00 for requirements which are applicable to this section. All work required is not limited to this section.

1.02 WORK INCLUDED

A. Provide labor, material, equipment, and supervision necessary to install a complete electrically supervised microprocessor based, fully addressable type system as outlined in this section.
B. Equipment by Edwards is acceptable provided that design criteria is satisfied.
C. It is the intent of this specification and accompanying drawings to require the contractor and/or supplier of equipment and devices to provide a complete code compliant system which will obtain, as a minimum, the approval of the AHJ. Different suppliers may have devices which differ between each other and as such all devices necessary for approval shall be included in the scope of work whether specifically identified or not.
D. Speakers shall be audible and intelligible as required by code in all spaces above ambient. Devices provided by manufacturers shall be selected to provide audibility with either additional speakers or higher dB devices as necessary to achieve such approval.
E. Strobes shall be visible as required by code in all spaces to meet requirements of the AHJ.
F. All fire alarm system components are to be appropriately rated for the environment in which they are being installed. The fire alarm vendor is responsible for UL Listed device selections. Consideration shall be given to, but not be limited to, ambient temperature, water infiltration, dust infiltration, and humidity.
G. In order to meet the approval of the AHJ, it may be necessary to add additional devices that are not indicated on the drawings. The contractor is to allow for 10 additional devices and wiring.

1.03 SUBMITTALS

A. Product Data: For each type of product, including furnished options and accessories.
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. Include voltage drop calculations for notification-appliance circuits.
    5. Include battery-size calculations.
    6. 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.
    7. Include performance parameters and installation details for each detector.

8. Verify that each duct detector is listed for complete range of air velocity, temperature, and humidity possible when air-handling system is operating.
9. Include floor plans to indicate final outlet locations showing address of each addressable device. Show size and route of cable and conduits and point-to-point wiring diagrams.

C. General Submittal Requirements:
1. Submit drawings to the local authority for permit and approval. Submit approved drawings to consulting engineers and to owner's insurance company and obtain approval prior to construction. All requirements for above approval are to be included with the work.
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.

1.04 FUNCTIONAL DESCRIPTION OF SYSTEM

A. Control of System: By the FACP.
B. System Supervision: Automatically detect and report open circuits, shorts, and grounds of wiring for initiating device, signaling line, and notification-appliance circuits.
C. Priority of Signals: Automatic alarm response functions resulting from an alarm signal from one zone or device are not altered by subsequent alarm, supervisory, or trouble signals. An alarm signal is the highest priority. Supervisory and trouble signals have second- and third-level priority. Higher-priority signals take precedence over signals of lower priority, even when the lower-priority condition occurs first. Annunciate and display all alarm, supervisory, and trouble signals regardless of priority or order received.
D. Noninterference: A signal on one zone shall not prevent the receipt of signals from other zones.
E. System Reset: All zones are manually resettable from the FACP after initiating devices are restored to normal.
F. Transmission to Remote Alarm Receiving Station: Automatically route alarm, supervisory, and trouble signals to a remote alarm station by means of a digital alarm communicator transmitter and telephone lines.
G. System Alarm Capability during Circuit Fault Conditions: System wiring and circuit arrangement prevent alarm capability reduction when an open circuit, ground or wire-to-wire short occurs, or an open circuit and a ground occur at the same time in an initiating device circuit, signal line circuit, or notification-appliance circuit.
H. Loss of primary power at the FACP initiates a trouble signal at the FACP and the annunciator. An emergency power light is illuminated at both locations when the system is operating on the secondary power supply.
I. Basic Alarm Performance Requirements: Unless otherwise indicated, operation of a manual station, automatic alarm operation of a smoke or flame or heat detector, or operation of a sprinkler flow device initiates the following:
1. Notification-appliance operation (exterior bell/strobe only operates with sprinkler flow devices).
2. Identification at the FACP and the remote annunciator of the device originating the alarm.
3. Transmission of an alarm signal to the remote alarm receiving station.
4. Unlocking of electric door locks in designated egress paths.
5. Release of fire and smoke doors held open by magnetic door holders.
6. Recall of elevator(s).
7. Shutdown of fans and other air-handling equipment serving zone when alarm was initiated.
8. Closing of smoke dampers in air ducts of system serving zone where alarm was initiated.
9. Activate stair pressurization system.

10. Recording of the event in the system memory.
11. **Recording of the event by the system printer.

J. Alarm Silencing System Reset and Indication: Controlled by switches in the FACP (and the remote annunciator).
1. Silencing-switch operation halts alarm operation of notification appliances and activates an "alarm silence" light. Display of identity of the alarm zone or device is retained.
2. Subsequent alarm signals from other devices or zones reactivate notification appliances until silencing switch is operated again.
3. When alarm-initiating devices return to normal and system reset switch is operated, notification appliances operate again until alarm silence switch is reset.

K. Smoke detection for zones or detectors with alarm verification initiates the following:
1. Audible and visible indication of an "alarm verification" signal at the FACP.
2. General alarm if the alarm is verified.
3. Cancellation of the FACP indication and system reset if the alarm is not verified.

L. Remote Detector Sensitivity Adjustment: Manipulation of controls at the FACP causes the selection of specific addressable smoke detectors for adjustment, display of their current status and sensitivity settings, and control of changes in those settings. Same controls can be used to program repetitive, scheduled, automated changes in sensitivity of specific detectors. Sensitivity adjustments and sensitivity-adjustment schedule changes are recorded in system memory and are printed out by the system printer.

M. Removal of an alarm-initiating device or a notification appliance initiates the following:
1. A "trouble" signal indication at the FACP and the annunciator for the device or zone involved.
2. Transmission of trouble signal to remote alarm receiving station.

N. FACP Alphanumeric Display: Plain-English-language descriptions of alarm, supervisory, and trouble events; and addresses and locations of alarm-initiating or supervisory devices originating the report. Display monitoring actions, system and component status, system commands, programming information, and data from the system's historical memory.

PART 2 - PRODUCTS

2.01 CONTROL PANEL

A. Fire Alarm Control Panel shall be surface mounted where shown on the drawings, with the following items.

UL Listed
Modular, microprocessor-based
Addressable locations of all devices
Zoned Visual Alarm and Trouble Indicators
Automatic Ground Detection
Lamp Test
Supervisory Voltage and Current Meters
Double Supervision
Field Programmable Fan Relays
Supervise Signal Circuit Modules
Annunciator Contacts by Zone
Dead Front Construction
Battery backup

Voice Communications System
Single and dual channel audio
Built-in selectable tones
Spoken voice coding
Digitized voice/tone generation
Automatic or manual audio control
Separate evacuation, drill, all clear messages
Audio control board
Audio amplifiers to support the speakers indicated
Modem communicator for remote monitoring.
*Fire Fighters' telephone control module

2.02 SMOKE DETECTORS

A. Furnish and install where shown on the drawings UL listed smoke detectors. Detector shall be solid state photoelectric type and shall operate on the light scattering, photo diode principle. Detector shall have an integral fixed temperature heat detector rated at 135 degrees F.
B. Detector shall be analog-addressable type, individually monitored at the FACP for calibration, sensitivity and alarm condition, and individually adjustable for sensitivity from the FACP.

2.03 SPEAKER/STROBE

A. Combination device with factory integrated audible and visible devices in a single-mounting assembly. Speaker shall be high range units rated 2 to 15 W. Strobe shall be Xenon strobe light with clear lens and rated light output of 110 candela.

2.04 ANNUNCIATOR

A. Description: Duplicate annunciator functions of the FACP for alarm, supervisory, and trouble indications. Also duplicate manual switching functions of the FACP, including acknowledging, silencing, reset, and test
   1. Mounting: Flush cabinet, NEMA 250, Class 1.
B. Display Type and Functional Performance: Alphanumeric display same as the FACP. Controls with associated LEDs permit acknowledging, silencing, resetting, and testing functions for alarm, supervisory, and trouble signals identical to those in the FACP.

2.05 FIRE ALARM STATIONS

A. Fire Alarm Stations shall be semi-flush mounted, non-code break glass type, finish shall be red with white letters.
B. Stations shall be addressable.

2.06 HEAT DETECTORS

A. Heat Detectors, furnished and installed where indicated on the drawings, shall be combination type, actuated by either a fixed temperature of 135 degrees F or rate of rise of temperature that exceeds 15 degrees F per minute.
B. Detectors shall be analog-addressable type, individually monitored at the FACP for calibration, sensitivity and alarm condition, and individually adjustable for sensitivity from the FACP.

2.07 DUCT SMOKE DETECTORS

A. Furnish where indicted on the drawings or required elsewhere in the specifications air duct smoke detectors. Duct smoke detectors are to be furnished by the electrical contractor, installed by the mechanical contractor and wired to the fire alarm system by the electrical contractor. They shall integrate photoelectric, ionization and heat sensing technologies for optimum detection accuracy and to prevent unwanted alarms. Auxiliary contacts shall be provided to shut down the air handling unit fan. The detector shall output to a remote alarm indicator.
B. Detectors shall be analog-addressable type, individually monitored at the FACP for calibration, sensitivity and alarm condition, and individually adjustable for sensitivity from the FACP.

2.08 TELEPHONE AUTO DIALER

A. Furnish and install where indicated on the drawings or required elsewhere in the specifications a digital type telephone auto dialer. The dialer shall call and notify a preprogrammed telephone number when in the alarm mode.

2.09 KITCHEN HOOD INTERLOCK

A. Furnish and install an interlock with the Kitchen Hood Extinguishing System which shall alarm the system if the Kitchen Hood goes into alarm.

2.10 REMOTE DEVICE LOCATION-INDICATING LIGHTS AND IDENTIFICATION PLATES

A. Device shall contain LED indicating light near each smoke detector that may not be readily visible, and each sprinkler water-flow switch and valve-tamper switch. Light is connected to flash when the associated device is in an alarm or trouble mode. Lamp is flush mounted in a single gang wall plate. A red, laminated, phenolic-resin identification plate at the indicating light identified, in engraved white letters, device initiating the signal and room where the smoke detector or valve is located. For water-flow switches, the identification plate also designates protected spaces downstream from the water-flow switch.

2.11 MAGNETIC DOOR HOLDERS

A. Units are equipped for wall or floor mounting as indicated and are complete with matching door plate. Electromagnet shall require no more than 3 W to develop 25 lb. holding force.
B. Material and finish shall match door hardware.
C. Units are to be rated for 24VAC or DC operation

2.12 ADDRESSABLE INTERFACE DEVICE

A. Device shall be Microelectronic monitor module listed for use in providing a multiplex system address for listed fire and sprinkler alarm-initiating devices with normally open contacts.
B. Integral Relay shall be capable of providing a direct signal to the elevator controller to initiate elevator recall or to a circuit-breaker shunt trip for power shutdown.

2.13 GUARDS FOR PHYSICAL PROTECTION

A. Description: Welded wire mesh of size and shape for the manual station, smoke detector, gong, or other device requiring protection.

1. Factory fabricated and furnished by the manufacturer of the device.
2. Finish: Paint of color to match the protected device.

2.14 SOUNDER BASE

A. Audible device to which smoke detector is mounted. 94 dBA average sound output is to be synchronized throughout.

2.15 CARBON MONOXIDE DETECTOR

A. Digitally profiled Metal Oxide Semiconductor type sensor.
B. 0 to 200 ppm detection range.
C. Audible alarm (85 dB).
D. LED indicators.
E. White powder coat finish over steel housing.
F. Used with monitoring module.
G. 5,000 sq. ft. Coverage area.

2.16 EXTERIOR BELL AND STROBE

A. Weatherproof device(s) with factory integrated audible and visible devices in a single mountain assembly. Bell shall be 24 V (nominal) which produces 83 dB measured at 10 feet. Strobe shall be Zenon type with clear lens and rated light output of 75 candela or as required by the local Fire Marshal. Strobe shall be provided with clear weatherproof guard for physical protection and heater system to assure operation to -40°F.

PART 3 - EXECUTION

3.01 SYSTEM OPERATION

A. Operation of any manual or automatic device shall cause all signals and strobes to sound. The annunciator will identify the specific location of the alarm initiation. Control and contacts for the building system shall function as required. Door hold opens shall be released. Door locks will be opened.

3.02 WIRING

A. All wiring shall be run in conduit in exposed areas or Fire Alarm MC Cable in concealed spaces and shall be installed as recommended by the system manufacturer. Provide deduct alternate for use of type FPLP plenum rated fire alarm cable.
B. Initiating device circuits are to be Class B (2 wire using NO contact initiating devices and an end of line resistor).
C. Notification appliance circuits shall have polarized devices wired in parallel and be equipped an end of line resistor.

3.03 EQUIPMENT INSTALLATION

A. Smoke detectors indicated on the drawings shall be located in the occupied space. A similar device layout shall be duplicated above suspended ceilings and/or below raised floors as outlined in NFPA 72.
B. Connect the FACP with a disconnect switch with lockable handle or cover. Provide circuit label as per NFPA 72 requirements.
C. Manual Pull Stations: Mount semi-flush in recessed back boxes.
D. Water flow Detectors and Valve Supervisory Switches: Connect for each sprinkler valve station required to be supervised. Connect to exterior bell/strobe (bell/strobe only operates with water flow).
E. Ceiling-Mounted Smoke Detectors: Not less than 4 inches from a side wall to the near edge. For exposed solid-joist construction, mount detectors on the bottom of joists. On smooth ceilings, install not more than 30 feet apart in any direction.
F. Wall-Mounted Smoke Detectors: At least, 4 inches, but not more than, 12 inches below the ceiling.
G. Smoke Detectors near Air Registers: Install no closer than 60 inches.
H. Duct Smoke Detectors: Comply with manufacturer's written instructions.
    1. Verify that each unit is listed for the complete range of air velocity, temperature, and humidity possible when air-handling system is operating.
    2. Install sampling tubes so they extend the full width of the duct.
I. Device Location-Indicating Lights: Locate in public space near the device they monitor.
J. FACP and Auxiliary Booster Panels: Surface mount with tops of cabinets not more than 72 inches (1830 mm) above the finished floor. Provide smoke detection for room in which the panel is located.
K. Annunciator: Install with the top of the panel not more than 72 inches (1830 mm) above the finished floor.
L. Provide separate zone for each floor, not to exceed 20,000 sq. ft., length not to exceed 200 ft. in any direction.
M. Provide where indicated on drawings, 15 cd horn/strobes or strobes in non-sleeping rooms up to 20' x 20'. Provide 30 cd horn/strobes or strobes in non-sleeping room up to 30' x 30'. Provide 110 cd in all other spaces where indicated on drawings.
N. Sounder bases are to be used for all smoke detectors within sleeping areas.
O. Exterior Bell and Strobe: Install on exterior wall above the Fire Department sprinkler connection at a height of 12' unless directed otherwise by the local Fire Marshal. Coordinate with fire protection contractor.
P. For all magnetic door hold-open devices, a smoke detector is to be provided within 5' of each doorway on both sides of the doorway. Coordinate with architect/owner for magnetic door holder material, finish and mounting.

3.04 FIRE DEPARTMENT COMMUNICATOR

A. System shall operate between Fire Command Station and telephone jacks located in every elevator, at every elevator lobby, and at each floor landing in all exit stairways.
B. Fire Command Station is to be located at the main front entrance. Station is to contain the following:
    1. Voice/alarm system control.
    2. Fire Department Communication system control.
    3. F.A.A.P.
    4. Emergency power annunciator panel.
    5. Elevator emergency power controller.

3.05 SERVICE

A. A service contract shall be made available to the owner after the one-year warranty expires.
B. A complete set of reproducible as-builts, showing installed wiring and color coding and wire tag notations for exact locations of all installed equipment, specific interconnections between all equipment shall be provided for the system.

3.06 TESTING

A. Perform test of system according to procedures outlined in NFPA 72. Correct deficiencies as necessary. Provide written record of inspections, tests, and test results in the form of a test log.

END OF SECTION