
PROJECT MANUAL

EMA PROJECT NO. 1 001 0710 001

NOVEMBER 10, 2023

**2024 HVAC RENOVATIONS
LA VEGA INDEPENDENT SCHOOL DISTRICT
WACO, TEXAS**

**TODD GOODEN
DEPUTY SUPERINTENDENT**

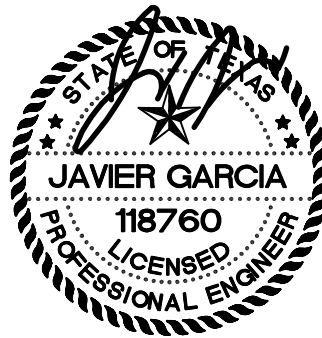
**ENGINEER:
EMA ENGINEERING & CONSULTING
328 SOUTH BROADWAY AVENUE
TYLER, TEXAS 75702
903-581-2677**

REGISTRATION NO. F-893

SEALS PAGE

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2024 HVAC RENOVATIONS
LA VEGA INDEPENDENT SCHOOL DISTRICT
WACO, TEXAS



11/10/2023

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DIVISION 26 ELECTRICAL

DIVISION 0 - BIDDING AND CONTRACT REQUIREMENTS

SECTION 00 02 00 - INVITATION TO BID

PROJECT: 2024 HVAC RENOVATIONS
LA VEGA INDEPENDENT SCHOOL DISTRICT

PROJECT NUMBER: 1 001 0710 001

BID DATE AND TIME: December 7, 2023, 2:00 P.M.

Opening Of Bids: La Vega Independent School District
400 East Loop 340
Waco, Texas 76705

ENGINEER: EMA Engineering & Consulting
328 South Broadway Avenue
Tyler, Texas 75702 (Phone: 903-581-2677)

The La Vega ISD Board of Trustees has selected competitive sealed proposals as the project delivery/contract method to be used for this project.

Competitive Sealed Proposals are requested for the ***2024 HVAC Renovations at La Vega Independent School District***.

2024 HVAC Renovations at La Vega Independent School District scope of work includes: mechanical, electrical, and plumbing renovations.

Sealed proposals will be received by La Vega ISD at the following location: 400 East Loop 340 Waco, Texas 76705. Proposals received after bid date and time will not be accepted. All interested parties are invited to attend. Proposals will be opened publicly and read aloud.

Electronic drawings and specifications may be obtained from La Vega Website - <https://www.lavegaisd.org/departments/business-office>

Bid Security in the amount of 5% of proposal must accompany each bid in accordance with the Instructions to Bidders. The successful bidders shall provide Payment and Performance Bonds.

All Contractors shall comply with prevailing wage rates in accordance with the civil statutes of the State of Texas and Department of Labor.

The Owner reserves the right to waive irregularities and to reject any or all Bids. The La Vega Independent School District reserves the right to separate or eliminate any item it deems necessary to accommodate budgetary and/or operational requirements. The La Vega Independent School District also reserves the right to reject any or all Bids or parts of the Bids, and waiver all formalities, and to award this Bid in the best interest of the La Vega Independent School District. The La Vega School District also reserves the right to award to other than the lowest bidder under statutory mandate 2267.055 Government Code.

The General Contractor shall be a Mechanical Contractor and shall have been in business seven continuous years under the company bidding this project. Specific related school experience is required. All Bidders shall visit the job site before submitting bid. Bid Bond, Performance Bond, and Labor and Material Payment Bond are required of the General Contractor.

The Mechanical Contractor shall be required to provide Bid Bond and Payment and Performance Bond as specified herein.

See qualifications of Mechanical Contractor in specifications.

The Bid Security will not be returned until all bonds are provided.

The successful bidder shall be required to attend the pre-construction conference prior to the beginning of the work.

Bidders shall submit a detailed schedule of construction as well as a staffing plan. Bidders shall define contingency measures if there are delays in equipment orders that prevent the project completion on schedule.

SELECTION CRITERIA: In accordance with Texas Education Code as amended, La Vega Independent School District shall evaluate all proposals based on a combination of factors that the District determines provides the best value to the District including:

1. The purchase price; (50 Points)
2. The reputation of the vendor and of the vendor's goods or services; (20 Points)
3. The quality of the vendor's goods or services; (10 Points)
4. The vendor's past relationship with the district; (7 Points)
5. Specific experience in public schools of the scope of the proposed project; (3 Points)
6. Financial stability and strength of proposer; (5 Points)
7. Overall familiarity with district facilities and needs, pre-proposal conference, etc. (5 Points)

A Pre-Bid Conference will be held November 28, 2023, at 10:00 A.M. at La Vega Elementary School (3100-Wheeler St, Waco, TX 76705) in La Vega Independent School District. It is highly recommended that companies submitting proposals attend.

La Vega ISD encourages the participation of qualified historically underutilized businesses.

La Vega Independent School District
Todd Gooden
Deputy Superintendent
Waco, Texas

SECTION 00 10 00

INSTRUCTIONS TO BIDDERS

IN THIS ENTIRE DOCUMENT, THE TERM "BID" SHALL MEAN "PROPOSAL" AND THE TERM "BIDDER" SHALL MEAN "PROPOSER".

1. Defined Terms.

Terms used in these Instructions to Bidders which are defined in the Standard General Conditions of the Construction Contract (No. 1910-8, 1996 ed.) have the meanings assigned to them in the General Conditions. The term "Bidder" means one who submits a Bid directly to Owner, as distinct from a sub-bidder, who submits a bid to a Bidder. The term "Successful Bidder" means the lowest, qualified, responsible and responsive Bidder to whom Owner (on the basis of Owner's evaluation as hereinafter provided) makes an award. The term "Bidding Documents" includes the Advertisement or Invitation to Bid, Instructions to Bidders, the Bid Form, and the Contract Documents (including all Addenda issued prior to receipt of Bids).

2. Electronic Copies of Bidding Documents.

2.1. Bidders may obtain complete sets of the Bidding Documents electronically from the link provided in the INVITATION TO BID (Section 00 02 00-1) and from the Plan Rooms.

2.2. Complete sets of Bidding Documents must be used in preparing Bids, neither Owner nor Engineer assume any responsibility for errors or misinterpretations resulting from the use of incomplete sets of Bidding Documents.

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

3. Qualifications of Bidders.

3.1 The Mechanical Contractor (Bidder) shall have been in business for seven continuous years under the company name bidding this project. Specific related school experience is required. See additional qualifications/requirements in paragraph 15 in this section.

3.2. 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. Conditional Bids will not be accepted. The successful Bidder will be required to execute an Agreement Between Owner and Contractor, which together with the other Contract Documents shall form the Contract.

3.2.1. In order for a bidder to be eligible to receive consideration on this project, he must, if requested by Owner, pre-qualify his capabilities on the basis of financial status, experience and type of work previously completed. Forms: Pre-qualification data must be typewritten (one copy). All information will be held in strictest confidence. The submission of pre-qualification data will not be required of a bidder, providing that bidder has submitted adequate qualification information that has been approved for previous school work with La Vega Independent School District. In the "Award of Contracts", consideration will be given to past performance of bidders.

3.3. Bidders shall submit with the proposal a notarized Contractor's Qualification Statement on A.I.A. Document A305 regarding the qualifications of the bidder. Provide seven references (minimum) of related public school work. Include project, school contact (name/address/phone number), and Engineer (name/address/phone number). Section 16.0 pertaining to the firm's audited financial statement may be withheld until such time it is specifically requested in writing by the Engineer or Owner. If requested, Bidder shall submit financial ability to carry on the work until such time as to receive the first payment on their contract, to finance the work between payments until contracts are complete and accepted, and to finance the warranty work.

3.3.1. Bidders shall also obtain and submit, within 24 hours of the receipt of a written request from the Engineer or Owner, notarized Contractor's Qualification Statements on AIA Document A305 regarding the qualifications of the major subcontractors proposed for use in the work. Section 16.0 pertaining to the firm's audited financial statement may be withheld until such time it is specifically requested in writing by the Engineer or Owner.

3.3.2. Bidders shall submit in writing with the proposal, on the form provided with the Proposal Form, the names of Subcontractors proposed for use in the work.

4. Examination of Contract Documents and Site.

4.1. It is the responsibility of each Bidder before submitting a bid, to (a) examine the Contract Documents thoroughly, (b) visit the site to become familiar with local conditions that may affect cost, progress, performance, or furnishing of the Work, (c) consider federal, state and Local Laws and Regulations that may affect cost, progress, performance or furnishing of the Work, (d) study and carefully correlate Bidder's observations with the Contract Documents, and (e) notify Engineer of all conflicts, errors or discrepancies in the Contract Documents. Bidders and Sub-Bidders shall promptly notify the Engineer of any ambiguity, inconsistency or error which they may discover upon examination of the Bidding Documents or of the site and local conditions. Contractors will not be given extra payments for conditions which can be determined by examining the site and documents.

4.2. Information and data reflected in the Contract Documents with respect to Underground Facilities at or contiguous to the site is based upon information and data furnished to Owner and Engineer by owners of such Underground Facilities or others, and Owner does not assume responsibility for the accuracy or completeness thereof unless it is expressly provided otherwise.

4.3. Provisions concerning responsibilities for the adequacy of data furnished to prospective Bidders on subsurface conditions, Underground Facilities and other physical conditions, and possible changes in the Contract Documents due to differing conditions appear in Paragraphs 4.2 and 4.3 of the General Conditions.

4.4. Before submitting a Bid, each Bidder will, at Bidder's own expense, make or obtain any additional examinations, investigations, exploration, tests and studies and obtain any additional information and data which pertain to the physical conditions (surface, subsurface and Underground Facilities) at or contiguous to the site or otherwise which may affect cost, progress, performance or furnishing of the Work in accordance with the time, price and other terms and conditions of the Contract Documents.

4.5. On request in advance, Owner will provide each Bidder or Sub-Bidder access to the site to conduct explorations and tests as each Bidder deems necessary for submission of a bid. Bidder or Sub-Bidder shall fill all holes, clean up and restore the site to its former condition upon completion of such explorations.

4.6. The lands upon which the Work is to be performed, rights-of-way and easements for access thereto and other lands designated for use by Contractor in performing the Work are identified in the Contract Documents. All additional lands and access thereto required for temporary construction facilities or storage of materials and equipment are to be provided by Contractor.

4.7. The submissions of a Bid will constitute an incontrovertible representation by Bidder that Bidder has complied with every requirement of this Article 4, that without exception the Bid is premised upon performing and furnishing the Work required by the Contract Documents and such means, methods, techniques, sequences or procedures of construction as may be indicated in or required by the Contract Documents, and that the Contract Documents are sufficient in scope and detail to indicate and convey understanding of all terms and conditions for performance and furnishing of the Work.

5. Interpretations and Addenda.

5.1. All questions about the meaning or intent of the Contract Documents are to be directed to the Engineer in writing. Interpretations or clarifications considered necessary by the Engineer in response to such questions will be issued by Addenda mailed, faxed, or delivered to all parties known by the Engineer as having received a complete set of the Bidding Documents. Questions received less than ten days prior to the date for opening of Bids may not be answered. Only questions answered by formal written Addenda will be binding. Oral and other interpretations or clarifications will be without legal effect. The Owner and Engineer will not be responsible for oral clarifications.

5.2. Addenda may also be issued to modify the Bidding Documents as deemed advisable by Owner or Engineer.

5.3. Each Bidder shall ascertain prior to submitting his bid that he has received all Addenda issued, and he shall acknowledge their receipt in his Bid.

6. Bid Security.

6.1. Bids shall be accompanied by a cashier's check or certified check drawn upon a state bank in the amount not less than five percent (5%) of bid payable without recourse to the La Vega Independent School District or a bid bond in the same amount from a reliable surety company licensed to do business in the State of Texas and listed in the current Federal Register, as a guarantee that the bidder will enter into a contract and execute payment and performance bond within fifteen (15) days after notice of award of the contract to him.

6.2. Bid Bonds may be submitted on the form(s) normally used by the Bidders Surety. The bond must be accompanied by a current copy of the power of attorney authorizing the attorney-in-fact who executes the bond. The Surety Company must be authorized to do business under a Certificate of Authority issued by the State of Texas and hold Certificates of Authority as an acceptable Surety on the current Department of the Treasury Listing as found in the Federal Register.

7. Contract Time.

The numbers of days within which, or the dates by which, the Work is to be substantially completed and also completed and ready for final payment (the Contract Time) are set forth in the Bid Form and the Agreement.

8. Substitute or "Or-Equal" Items.

The materials and equipment described in the Bidding Documents establish a standard of required function, dimension, appearance and quality to be met by any proposed substitution. Each such request shall include the name of the material or equipment for which it is to be substituted and a complete description of the proposed substitute including drawings, cut sheets, performance and test data and any other information necessary for an evaluation. A statement setting forth any changes in other materials, equipment or Work that incorporation of the substitute would require shall be included. The burden or proof of the merit of the proposed substitute is upon the Bidder. The Engineer's decision of approval or disapproval of a proposed substitution shall be final. Substitution of products to be equal to those specified herein will be considered only when the following requirements have been met:

A complete list of proposed substituted products, in duplicate, shall be submitted to the Engineer. Submittals shall be received by the Engineer as required in Divisions 1, 2, 15, and 16. Submittals shall provide satisfactory products which are, in fact, equal in quality, performance, maintainability, demonstrated reliability, complexity, user friendliness, and demonstrated support service to those specified herein.

9. Subcontractors, Suppliers and Others.

9.1. The Bidder will be required to establish to the satisfaction of the Engineer and the Owner the reliability and responsibility of the persons or entities proposed to furnish and perform the Work described in the Bidding Documents.

9.2. Prior to the award of the Contract, the Engineer will notify the Bidder in writing if either the Owner or the Engineer, after due investigation, has reasonable objection to any such proposed person or entity. If the Owner or Engineer has reasonable objection to any such proposed person or entity, the Bidder may, at his option, (1) withdraw his Bid, or (2) submit an acceptable substitute person or entity with an adjustment in his bid price to cover the difference in cost occasioned by such substitution. The Owner may, at his discretion, accept the adjusted bid price or he may disqualify the Bidder. In the event of either withdrawal or disqualification, under this Subparagraph, bid security will not be forfeited, notwithstanding the provisions of Paragraph 12.2.

9.3. Persons and entities proposed by the Bidder and to whom the Owner and the Engineer have made no reasonable objection under the provisions of Subparagraph 9.2 must be used on the Work for which they were proposed and shall not be changed except with the written consent of the Owner and the Engineer.

9.4. No Contractor shall be required to employ any Subcontractor, Supplier, other person or organization against whom Contractor has reasonable objection.

10. Bid Form.

10.1. The Bid Form is included with the Bidding Documents.

10.2. All blanks on the Bid Form must be completed in ink or by typewriter.

10.3. Where so indicated by the make-up of the bid form, sums shall be expressed in both words, and figures, and in case of discrepancy between the two, the amount written in words shall govern.

10.4. Any interlineation, alteration or erasure must be initialed by the signer of the Bid.

- 10.5. All requested Alternates shall be bid. If no change in the Base Bid is required, enter "No Change".
- 10.6. Each copy of the Bid shall include legal name of the Bidder and a statement that the Bidder is a sole proprietor, a corporation, or some other legal entity. Each copy shall be signed in ink by the person or persons legally authorized to bind the Bidder to a contract. A Bid by a corporation shall further give the state of incorporation and have the corporate seal affixed and attested by the secretary or the assistant secretary. A Bid submitted by an agent shall have a current power of attorney attached certifying the agent's authority to bind the Bidder. Bids by partnerships must be executed in the partnership name and signed by a partner, whose title must appear under the signature and the official address of the partnership must be shown below the title.
- 10.7. All names must be typed or printed below the signature.
- 10.8. The Bid shall contain an acknowledgment of receipt of all Addenda (the numbers of which must be filled in on the Bid Form).
- 10.9. The address and telephone number for communications regarding the Bid must be shown.
11. Submission of Bids.
- 11.1. Bids, Bid Security, and other documents required to be submitted shall be submitted at the time and place as advertised in the Invitation to Bid.
- 11.2. Each Bid must be submitted on an unaltered proposal form furnished by the Engineer and addressed as provided in the Invitation to Bid.
- 11.3. Each bid must be submitted in a sealed envelope bearing on the outside (lower left corner) the name of the bidder, his address, the type of work, and the name of the project for which the bid is submitted and the bid number. If forwarded by mail, the sealed envelope containing the bid must be enclosed in another envelope addressed as specified in paragraph 11.2. above with the notation "Bid Enclosed" on the face of it. Identify project, bid date, bid number, and bid time on outside of the envelope. No responsibility will be attached to any officer for the premature opening of a bid not properly addressed and identified.
- 11.4. Bids shall be deposited at the designated location prior to the time and date for receipt of Bids indicated in the advertisement or Invitation to Bid, or any extension thereof made by Addendum. Bids received after the time and date for receipt of Bids will be returned unopened.
- 11.5. The Bidder shall assume full responsibility for timely delivery at the location designated for receipt of Bids. Any bid forwarded by mail should be mailed in sufficient time to be received at the opening date and time.
- 11.6. Oral, faxed, telephonic or telegraphic Bids are invalid and will not receive consideration.
- 11.7. Each Bidder by making his Bid represents that:
- 11.7.1. The Bidder has read and understands the Bidding Documents and their Bid is made in accordance therewith.
- 11.7.2. The Bidder has visited the site, has familiarized themselves with the local conditions under which the Work is to be performed and has correlated their observations with the requirements of the proposed Contract Documents.

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

12. Modification and Withdrawal of Bids.

12.1. Bids may be modified or withdrawn by an appropriate document duly executed (in a manner that a Bid must be executed) and delivered to the place where Bids are to be submitted at any time prior to the opening of Bids.

12.2. A Bid may not be modified, withdrawn or canceled by the Bidder during the stipulated time period following the time and date designated for the receipt of Bids, and each Bidder so agrees in submitting his Bid.

13. Opening of Bids.

Properly identified bids received on time will be publicly opened and read aloud. An abstract of the amounts of the base Bids and major alternates (if any) will be made available to Bidders.

14. Bids to Remain Subject to Acceptance.

All bids remain subject to acceptance for sixty days after the day of the Bid opening.

15. Award of Contract.

15.1. The Contract will be awarded to the lowest and/or best qualified responsible Bidder as determined by the Owner. The Owner reserves the right to accept any of the bids, or parts of the bids submitted or to reject all bids, or parts of the bids, and to waive any irregularities or informalities in any bid as the Owner's interests are best served. The Owner reserves the right to separate or eliminate any item(s) it deems necessary to accommodate budgeting and/or operational requirements. The Owner also reserves the right to award to other than the lowest bidder under statutory mandate 271.027(b) Local Government Code. In determining who is the lowest and/or best qualified responsible Bidder, in addition to price, the Owner shall consider:

15.1.1. The quality, availability, and adaptability of the supplies, materials, equipment and contractual services, to the particular use required and possession of the necessary facilities, equipment, and bonding; previous performance; promptness, history of completions.

15.1.2. The number and scope of conditions attached to the proposal.

15.1.3. The experience, ability, capacity and skill of the Bidder to perform the Contract or perform the service required.

15.1.4. Whether the Bidder can perform the Contract or provide the service promptly, or within the time required, without delay or interference.

15.1.5. The character, responsibility, integrity, honesty, reputation, and experience of the Bidder.

15.1.6. The quality of performance of previous contracts or services.

15.1.7. The previous and existing compliance by the Bidder with law as relating to the Contract or service.

15.1.8. Any previous or existing noncompliance by the Bidder with specification requirements relating to time of submission of specific data such as samples, drawings, certificates, or other information.

15.1.9. The sufficiency of the financial resources and ability of the Bidder to perform the Contract or provide the service. Financial capacity; business judgment.

15.1.10. The ability of the Bidder to provide future maintenance, repair parts, and service for use of the subject of the Contract.

15.1.11. The compliance of the bids with the prescribed requirements, and such alternates, and other data, as may be requested in the Bid Form or prior to the Notice of Award.

15.1.12. Education/School Facility Experience of Mechanical Contractor.

15.1.13. Meeting the published specifications.

15.1.14. Any other factor which could reasonably be asserted as being relevant to successful performance; as well as the safety record of the bidder, 271.0275 Local Government Code.

15.2. Owner may conduct such investigations as Owner deems necessary to assist in the evaluation of any Bid to establish the responsibility, qualifications and financial ability of Bidders, proposed Subcontractors, Suppliers and other persons and organizations to perform and furnish the Work in accordance with the Contract Documents to Owner's satisfaction within the prescribed time.

15.3. If the Contract is to be awarded, it will be awarded to the lowest Bidder whose evaluation by Owner indicates to Owner that the award will be in the best interests of the Project. The Owner shall have the right to accept Alternates in any order or combination, unless otherwise specifically provided and to determine the low Bidder on the basis of the sum of the Base Bid and the Alternates accepted.

15.4. If the contract is to be awarded, Owner will give the Successful Bidder a Notice of Award within sixty days after the day of the Bid opening.

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

16. Performance Bond & Payment Bond.

16.1. Contractor shall furnish a Performance and Payment Bond for 100% of the value of the work. The Performance and Labor and Material Payment Bond(s) shall be prepared on a form acceptable to the Owner and must identify compliance with the provisions of Article 5160 of the Revised Civil Statutes of Texas and state that all liabilities of the bond(s) shall be determined in accordance with the provisions of said Article. The Surety Company must be authorized to do business under a Certificate of Authority issued by the State of Texas and hold Certificates of Authority as an acceptable Surety on the current Department of the Treasury listing as found in the Federal Register. The bond company's main headquarters shall be in the continental United States.

Mechanical Contractor shall provide bonds. General Contractor shall deliver these bonds to Engineer for transmittal to the Owner.

16.2. The bidder shall deliver the required bonds to the Owner no later than the date of execution of the Contract.

16.3. The cost of the Bonds and Securities shall be included in the bid.

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

17. Form of Agreement Between Owner and Contractor.

17.1. The agreement for the work will be written on EJCDC Document 1910-8-A-1 (1996 Edition), Standard Form of Agreement Between Owner and Contractor on The Basis of A Stipulated Price. Payments will be made according to Owner policy. The contract between the Owner and the Contractor shall provide for progress payment on 95% of the labor performed and materials built into the work. Requests for payments shall be submitted to the Engineer. After completion date no partial or progress payments will be paid until all work is 100% complete and accepted by Owner and Engineer.

18. Sales Tax.

The materials incorporated in this project will be exempt from the limited sales, excise and use tax of the State of Texas, all in accordance with Ruling No. 9 as amended.

19. Prevailing Rates of Wages.

The La Vega Independent School District has ascertained the General Prevailing rate of Per Diem Wages for each craft or type of workman or mechanic, and has also ascertained the prevailing rate for legal holiday and overtime work. The successful Bidder and any subcontractor(s) under him shall pay no less than the aforesaid rates. Nothing herein shall prevent the payment of an amount greater than such rates. The provisions of Article 5159a of the Texas Revised Civil Statutes Annotated as presently in effect or hereafter amended, are incorporated herein by reference in their entirety. The Bidders by submitting their respective proposals acknowledge the penalty provisions therein, and the successful Bidder for himself and each Subcontractor under him shall keep an accurate record showing the name, social security number, occupation by specific trade classification and level as set out in the General Prevailing Rate of Per Diem Wage, hours worked, and actual wages and other benefits paid to each laborer, workman, mechanic and other person covered by said Article 5159a, and shall provide the Owner with Certification thereof with each request for Payment.

20. Indemnification.

20.1. The Bidder does hereby agree that, if awarded the Contract, he shall indemnify and hold harmless the La Vega ISD and the Board of Trustees, its members, and employees and agents and consultants of the District from all suits and actions of every nature and description brought against them or any of them growing out of any contract, or contracts, written or oral, entered into between the District and the successful Bidder, whether covered by insurance or not, and further, that upon the awarding of the Contract to the successful Bidder in accordance with these specifications this agreement of indemnification shall automatically become effective.

20.2. The successful Bidder shall defend any and all suits brought against the District by any employee or other person (whether employed by the Bidder or not) for damage to property and/or injury to persons (including death) alleged or claimed to have been caused by or through the performance of the Bidder of the Work, and shall indemnify and hold harmless the District and the District's Consultants from and against any and all claims arising out of Work performed by the

Bidder, including damage to the building and other property of the District and including all damage for the obstruction of private driveways, streets, and alleys, and all cost expenses of suits and reasonable attorney's fees, whether covered by insurance or not. In the event of any such injury (including death) loss or damage (or claim or claims thereof) the successful Bidder shall give immediate notice thereof to the District.

20.3. The successful Bidder will be required to provide insurance as set forth in the specifications and the Contract between the Owner and Contractor. However the indemnification required as set forth in the Contract Documents will be effective without regard to the availability of insurance to the Contractor. Liability to the Contractor is not limited to the availability of insurance or to the limits that are specified therein. These provisions of indemnification are in addition to and not in lieu of, the general conditions, the supplementary conditions or any amendments thereto as set forth in the general Contract.

21. Compliance with Antitrust Laws.

By submitting a proposal, each bidder thereby certifies that neither he/she nor the firm, corporation, partnership, or institution represented by the Bidder, or anyone acting for such firm, corporation, or institution has violated the Antitrust Laws of this state codified in Section 15.01 st. seq. of the Texas Business and Commerce Code, or the Federal Antitrust Laws, nor communicated directly or indirectly the proposal or bid made to any competitor or any other person or entity in such line of business.

22. Each and every Contractor and Subcontractor shall maintain all required insurance, including full workers' compensation coverage during the life of the Contract and until La Vega Independent School District has assumed the necessary insurance coverage. The Contractor's insurance company shall be licensed to do business in the State of Texas and maintain home offices in the Continental United States. Insurance Company must also be listed in the Federal Register, Part II, Circular 570, latest edition. Insurance Company must have an A.M. Best Rating of B+ VI or better.

23. Do not commence work under this contract until all insurance has been approved by La Vega Independent School District. Submit one (1) copy of coverage policies.

24. La Vega Independent School District shall issue an official La Vega Independent School District Purchase Order to the successful contractor. A duplicate copy of the Purchase Order will serve as an acknowledgment form and provisions will be made on this form for the Contractor to sign and return to the Purchasing Department within five (5) days of postmark date.

25. All operating and maintenance manuals, bulletins, instruction brochures, guarantees, etc., shall be given to the Engineer.

26. Pre-Bid Contractor Inspection: All contractors shall identify themselves at the school office PRIOR to touring the site.

27. Use of any tobacco products on any school campus or in any school building is prohibited pursuant to La Vega Independent School District Policy DH-LOCAL, CKD-LOCAL, and GKA-LOCAL, effective August 1, 1993.

28. The Owner's representative is James Langlotz, Director of Maintenance, La Vega ISD, 3101 Latimer St, Waco, TX 76705 (Phone: 254-299-6850).

29. The addresses of the sites are as follows:

La Vega Elementary School

3100 Wheeler
Waco, Texas 76705

La Vega High School

555 N Loop 349
Waco, Texas 76705

La Vega Intermediate School

4201 Williams Road
Waco, Texas 76705

La Vega Junior High School

4401 Orchard Ln
Waco, Texas 76705

La Vega Primary School

4400 Harrison
Waco, Texas 76705

30. General Description of Work:

This work includes but is not limited to the following. All work shall be complete and turn-key.

New rooftop units, split systems, and other HVAC renovations to the Elementary School, High School, Intermediate School, Junior High School, and Primary School.

Demolition work and removal of all non-used materials off-site in a legal manner is included (mechanical and electrical).

31. Drawing List**MECHANICAL, ELECTRICAL AND PLUMBING SHEETS**

MEPD1.1	MECHANICAL, ELECTRICAL & PLUMBING ES DEMOLITION FLOOR PLAN
MEPD1.2	MECHANICAL, ELECTRICAL & PLUMBING HS DEMOLITION ROOF PLAN
MEPD1.3	MECHANICAL, ELECTRICAL & PLUMBING INTERMEDIATE DEMOLITION FLOOR PLAN
MEPD1.4	MECHANICAL, ELECTRICAL & PLUMBING JH DEMOLITION ROOF PLAN
MEPD1.5	MECHANICAL, ELECTRICAL & PLUMBING PRIMARY DEMOLITION ROOF PLAN
MEPD1.6	MECHANICAL, ELECTRICAL & PLUMBING PRIMARY DEMOLITION FLOOR PLAN
MEP1.1	MECHANICAL, ELECTRICAL & PLUMBING ES ROOF PLAN
MEP1.2	MECHANICAL, ELECTRICAL & PLUMBING HS DEMOLITION ROOF PLAN
MEP1.3	MECHANICAL, ELECTRICAL & PLUMBING INTERMEDIATE ROOF PLAN
MEP1.4	MECHANICAL, ELECTRICAL & PLUMBING JH ROOF PLAN
MEP1.5	MECHANICAL, ELECTRICAL & PLUMBING PRIMARY ROOF PLAN
MEP1.6	MECHANICAL, ELECTRICAL & PLUMBING PRIMARY FLOOR PLAN
MEP1.7	MECHANICAL, ELECTRICAL & PLUMBING HS AG BUILDING FLOOR PLAN
MEP7.1	MEP DETAILS
MEP7.2	MEP DETAILS
MEP8.1	MECHANICAL SCHEDULES
MEP8.2	MECHANICAL SCHEDULES

Exhibit "A"
PREVAILING WAGE RATE
LA VEGA ISD

PART 1 - GENERAL

1.1 Requirements

Pay not less than the minimum wage scale and benefits indicated on the "Minimum Wage Schedule" provided herein.

Wages listed are minimum rates only.

No claims for additional compensation will be considered by the Owner because of payments of wage rates in excess of the applicable rate contained in this contract.

1.2 Applicable Statutes

Vernon's Civil Statutes, Section 2 of Article 5159a which states as follows:

"The Contractor shall forfeit as a penalty to the State, County, City and County, City, Town, District or other political subdivision on whose behalf the Contract is made or awarded, ten dollars (\$10.00) for each laborer, workman or mechanic, for each working day, or portion thereof, such laborer, workman or mechanic is paid less than the said stipulated rates for any work done under said Contract, by him, or by any subcontractor under him, and the public body awarding the Contract shall cause to be inserted in the Contract a stipulation to this effect."

1.3 Payroll

In compliance with Article 5159a, Sections 2 and 3, and Article 5159d, Section II of the Revised Civil Statutes referenced above, the Owner reserves the following rights:

1. To receive weekly payroll records.
2. To have the Contractor provide required earning statements to employees.

1.4 Minimum Wage Rates

Pay prevailing basic wage listed, plus any applicable fringe benefits.

PREVAILING WAGE SCALE NOTICE

1. This determination of prevailing wages shall not be construed to prohibit the payment of more than the rates named. Under no condition shall any laborer, workman or mechanic employed on this job be paid less than the minimum wage scale.
2. In execution of this contract, the Contractor must comply with all applicable state and federal laws including, but not limited to, laws concerned with labor, equal employment opportunity, safety and minimum wage.
3. Basic Rates.

Contractor shall contact Department of Labor and obtain current prevailing wage scale.

Apprentice Pay-All Trades and Crafts:

The minimum rate for apprentices shall be in accordance with the scale determined by an approved apprenticeship program or \$1.00 per hour less than journeymen's rates, whichever is lower. An approved apprenticeship program is one approved by the U.S. Department of Labor, Bureau of Apprenticeship Training, and only apprentices enrolled in an approved program may be paid apprenticeship rates.

Base Per Diem Rate:

Hours Worked/Day Times Base Hourly Rate

Multipliers for Overtime Rates:

1. Over 40 hours per week: Base hourly rate times 1.5
2. Holidays: Base hourly rate times 1.5

END OF INSTRUCTIONS TO BIDDERS/PROPOSERS

La Vega Independent School District
Administration Building
400 East Loop 340
Waco, Texas 76705

PROPOSAL FORM/BID FORM
2024 HVAC Renovations
La Vega ISD - Waco, Texas
EMA Project No. 1 001 0710 001

I have received plans and specifications for the project listed above as prepared by EMA Engineering & Consulting, Inc. I have also received Addenda Nos. _____ and have included their provisions in my proposal. I have examined these documents, all of the existing sites, and plans/specifications and submit the following proposal. In submitting the proposal, I agree:

1. To hold my bid open for 60 days after bid receiving date.
2. To accept the provisions of the Instructions to Bidders regarding disposition of bid security.
3. To enter into and execute a contract, if awarded on the basis of this bid.
4. To accomplish the work in accordance with the Contract Documents.
5. Work can begin on **May 31st, 2024**. Coordinate with the on-going school programs. I will substantially complete all HVAC work by the following schedule and complete all work by the following dates.

Substantial Completion
August 2nd, 2024

Final Completion
August 16th, 2024

6. To deliver within five days of receipt of contract all required submittals, list of all suppliers and a schedule of work.
7. I will perform all work as described within these Contract Documents for the prices presented on the following pages, including this page. Bids shall be entered in appropriate spaces of this Proposal Form. I understand that La Vega ISD reserves the right to accept or reject any and all bids and has the right to accept or reject parts of the bid package.
8. **2024 HVAC Renovations at La Vega Independent School District**
 - a) **Base Bid (La Vega ISD 2024 HVAC Renovation):** I will provide complete turn-key work (including all related work) that includes, but is not limited to HVAC renovations for the total lump sum price of _____
_____. (\$_____).

The above lump sum includes an **allowance of \$140,000.00, for construction contingency.**

9. Proposers shall submit a detailed schedule and staffing plan for the scope of work defined in the construction documents so as to be completed on November 10th, 2023.
10. I understand a Performance and Payment Bond is required and a Bid Bond is required.

11. I also certify that I have visited all of the existing buildings where work is to be performed and understand the site conditions and work required. I will provide all work turn-key. Contractor shall provide a person whose primary job is to supervise and coordinate this work.
12. The cost of all bonds, insurance and guarantees are included in my bid prices.
13. I understand liquidated damages apply from date of substantial completion and from date of completion until all work is complete for each scheduled project and acceptable by Engineer and Owner (See General Conditions and Specification Section 00 80 00 - Supplementary Conditions, Article 17 including but not limited to Paragraph 17.9.1).
14. Enclosed with this bid is a complete list of subcontractors that I will use on this project.
15. I am enclosing with the bid, the qualification form as specified in 00 32 00-1.
16. By submitting a bid, each bidder agrees to waive any claim it has or may have against the Owner, the Engineer, and their respective employees arising out of or in connection with the administration, evaluation, or recommendation of any bid; waiver of any requirements under the Bid Documents, or the Contract Documents, acceptance or rejection of any bids; and award of the Contract.
17. Representations: by execution and submission of this Bid, the Bidder hereby represents and warrants to Owner as follows:

The Bidder has read and understands the Bid Documents and the contract documents and this Bid is made in accordance with the Bid Documents.

Date: _____ BIDDER: _____
Company Name

Signature Name Typed

Signature in Ink

TITLE: _____

ADDRESS: _____

PHONE: _____

CERTIFICATION BY CORPORATE BIDDER

2024 HVAC Renovations

La Vega Independent School District

Waco, Texas

IF BIDDER IS A CORPORATION, THE FOLLOWING CERTIFICATE SHOULD BE EXECUTED AND INCLUDED AS PART OF PROPOSAL FORM/BID FORM.

I, _____, certify that I am the _____,
Secretary of the Corporation named as Bidder hereinabove; that _____ who
signed the foregoing proposal on behalf of the bidder was then
_____ of the said corporation; that
said proposal 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

SIGNATURE

DATE

PROPOSER'S QUALIFICATION FORM

2024 HVAC Renovations

La Vega Independent School District
Waco, Texas

American Institute of Architects Document A305 "Contractor's Qualification Statement", current edition, is hereby made a part of the Contract Documents by reference. A complete copy of this document may be examined in the office of the Engineer, EMA Engineering & Consulting 328 South Broadway Ave. Tyler, Texas 75702, or obtained from the American Institute of Architects, 1735 New York Ave., N.W., Washington, D.C. 20006.

Bidders shall submit with the proposal a notarized Contractor's Qualification Statement on AIA Document A305 regarding the qualifications of the Bidder. Provide seven (7) references of specific related school work. For each reference provide project name, Owner's contact (name/phone/address), and Engineer (name/phone/address). Section 16.0 pertaining to the firm's audited financial statement may be withheld until such time it is specifically requested in writing by the Engineer or Owner.

Bidders shall obtain and submit, within 24 hours of the receipt of a written request from the Engineer, notarized Contractor's Qualification Statements on AIA Document A305 regarding the qualifications of the major subcontractors proposed for use in the Work. Section 16.0 pertaining to the firm's audited financial statement may be withheld until such time it is specifically requested in writing by the Engineer or Owner.

LIST OF SUBCONTRACTORS/SUPPLIERS

2024 HVAC Renovations

La Vega Independent School District

Waco, Texas

THIS FORM SHALL BE COMPLETED BY THE GENERAL CONTRACTOR AND SUBMITTED IN SEPARATE ENVELOPE WITH PROPOSAL. A complete list of proposed subcontractors, material suppliers and proprietary items will be required from the successful Bidder, not later than fifteen (15) days from the contract date. The bid submittals required on bid form shall be provided in separate package at time of bid.

TO: La Vega Independent School District
Administration Building
400 East Loop 340
Waco, Texas 76705

The undersigned submits the following names of subcontractors to be used in performing the contract. Where blanks are provided for the listing of Contractor and subcontractors, Bidders are advised that each blank shall be filled in with name of a legitimate Contractor or subcontractor now engaged in an established business in that category. Failure to do so may be cause for rejection of proposal.

Subcontractors

Mechanical: (Bidder) _____

Electrical: _____

HVAC Equipment: _____

Test and Balance: _____

EMCS: _____

Date: _____ BIDDER: _____

(Company Name)

(Signature)

(Address)

By: _____

Title: _____

Mechanical Contractor shall be Bidder.

FELONY CONVICTION NOTIFICATION

2024 HVAC Renovations
La Vega Independent School District
Waco, Texas

FELONY CONVICTION NOTIFICATION

Statutory citation covering notification of criminal history of contractor is found in the Texas Education Code #44.034. Following is an example of a felony conviction notice:

State of Texas Legislative Senate Bill No. 1, Section 44.034, Notification of Criminal History, Subsection (a), states "a person or business entity that enters into a contract with a school district must give advance notice to the district if the person or an owner or operator of the business entity has been convicted of a felony. The notice must include a general description of the conduct resulting in the conviction of a felony."

Subsection (b) states "a school district may terminate a contract with a person or business entity if the district determines that the person or business entity failed to give notice as required by Subsection (a) or misrepresented the conduct resulting in the conviction. The district must compensate the person or business entity for services performed before the termination of the contract."

THIS NOTICE IS NOT REQUIRED OF A PUBLICLY-HELD CORPORATION

I, the undersigned agent for the firm named below, certify that the information concerning notification of felony convictions has been reviewed by me and the following information furnished is true to the best of my knowledge.

COMPANY NAME: _____

AUTHORIZED COMPANY OFFICIAL'S NAME (PRINTED): _____

- A. My firm is a publicly-held corporation, therefore, this reporting requirement is not applicable.

Signature of Company Official: _____

- B. My firm is not owned nor operated by anyone who has been convicted of a felony:

Signature of Company Official: _____

- C. My firm is owned or operated by the following individual(s) who has/have been convicted of a felony:

Name of Felon(s): _____

Details of Conviction(s): _____

Signature of Company Official: _____

FINGER PRINTING PROVISIONS

2024 HVAC Renovations

La Vega Independent School District
Waco, Texas

All Contractors and Sub-Contractors working on building projects for La Vega ISD will be required to submit to the Coordinator of Human Resources proof that their firm has met state fingerprinting requirements for employees hired by their firm after January 1, 2008. This requirement is for employees of contractors and sub-contractors working on any La Vega ISD construction site, whether or not the site is currently being used as a campus since most workers will be working on multiple sites.

Information for establishing a fingerprinting account with the Texas Department of Public Safety (Instructions to School District Contractors Regarding Criminal History Background Searches Under Senate Bill 9) will be available through La Vega ISD Human Resources.

Employee fingerprinting must be completed prior to the employee working on any La Vega ISD construction site. It is the contractor's responsibility to make sure that all employees meet state criminal history guidelines. La Vega ISD reserves the right to prohibit any employee of a contractor or sub-contractor from working on a La Vega ISD site if that employee's criminal history record does not meet school district standards.

No employees are allowed to work onsite until there is confirmation from La Vega ISD that all requirements are met. Any employees without the necessary confirmation will be removed from the site according to policy. La Vega ISD Human Resources will then contact your company to let you know who is and who is not allowed to work onsite.

AGREEMENT FORM

2024 HVAC Renovations

La Vega Independent School District

Waco, Texas

Contract shall be prepared on "Standard Form of Agreement Between Owner and Contractor". On the Basis of A Stipulated Price (refer to owner for sample contract).

PERFORMANCE BOND FORM

2024 HVAC Renovations

La Vega Independent School District
Waco, Texas

Contractor(s) and subcontractors (as specified) shall furnish a Performance Bond for 100% of the work. The Performance Bond(s) shall be prepared on a form acceptable to the Owner and must identify compliance with the provisions of Article 5160 of the Revised Civil Statutes of Texas and state that all liabilities of the bond(s) shall be determined in accordance with the provisions of said Article. The Surety must be authorized to do business under a Certificate of Authority issued by the State of Texas and hold Certificates of Authority as an acceptable Surety on the Current Department of the Treasury listing as found in the Federal Register. The bond shall be a U.S.A. company and located in U.S.A.

A Performance Bond is required from the General Contractor (Mechanical Contractor).

Bonds shall be received and approved by Owner before a Purchase Order will be issued.

LABOR AND MATERIAL PAYMENT BOND

2024 HVAC Renovations

La Vega Independent School District

Waco, Texas

Contractor(s) and subcontractors (as specified) shall furnish a Labor and Material Bond for 100% of the value of the work. The Performance Bond(s) shall be prepared on a form acceptable to the Owner and must identify compliance with the provisions of Article 5160 of the Revised Civil Statutes of Texas and state that all liabilities of the bond(s) shall be determined in accordance with the provisions of said Article. The Surety must be authorized to do business under a Certificate of Authority issued by the State of Texas and hold Certificates of Authority as an acceptable Surety on the Current Department of the Treasury listing as found in the Federal Register. The bond shall be a U.S.A. company and located in the U.S.A.

A Labor and Material Payment Bond is required from General Contractor (Mechanical Contractor).

Bonds shall be received and approved by Owner before a Purchase Order will be issued.

GENERAL CONDITIONS

1. GENERAL:
 - A. National Society of Professional Engineers, Document EDCDC No. 1910-8., "General Conditions of the Construction Contract", 2013 Edition, is hereby made a part of this Contract and shall apply to all Contractors and Subcontractors.
 - B. Copies of the above mentioned document as referred to herein, are on file and may be referred to at the Engineer's office at 328 Broadway Ave, Tyler, Texas, or may be purchased from the National Society of Professional Engineers, 1420 King Street, Alexandria, Virginia 22314, phone 703-684-4811.

SUPPLEMENTARY CONDITIONS

1. SUPPLEMENTS.

These Supplementary Conditions amend or supplement the Standard General Conditions of the Construction Contract (No. 1910-8, 2013 Edition) and other provisions of the Contract Documents as indicated below. All provisions which are not so amended or supplemented remain in full force and effect.

The terms used in these Supplementary Conditions will have the meanings indicated in the General Conditions. Additional terms used in these Supplementary Conditions have the meanings indicated below, which are applicable to both the singular and plural thereof.

2. REFERENCE TO DIVISION 1:

Where provisions of General Conditions related to project administration or work-related requirements of the Contract, those paragraphs are supplemented by Sections in Division 1, "General Requirements" of the Specifications.

ARTICLE 1 – DEFINITIONS AND TERMINOLOGY

1.01.A.28 Notice of Award:

Amend the sentence to read as follows:

The written notice by OWNER or ENGINEER to the apparent successful bidder stating that upon timely compliance by the apparent successful bidder with the condition's precedent listed therein, OWNER will sign and deliver the Agreement.

1.01.A.28 Notice to Proceed:

Amend the sentence to read as follows:

A written notice given by OWNER or ENGINEER to CONTRACTOR fixing the date on which the Contract Times will commence to run and on which CONTRACTOR shall start to perform the Work under the Contract Documents.

ARTICLE 2 - PRELIMINARY MATTERS

2.02. Copies of Documents: N/A

ARTICLE 3 - CONTRACT DOCUMENTS: INTENT, AMENDING, REUSE.

3.01. Add the following language at the end of the first sentence:

No contract is binding upon the OWNER until it has been executed by the OWNER and delivered to the CONTRACTOR.

Add the following new paragraph at the end of Article 3:

3.06. Inter-Relation Of Documents:

A. The inter-relation of the specifications, the drawings and the schedules is as follows: The specifications determine the nature and setting of the several materials, the drawings establish the quantities, dimensions and details, and the schedules give the locations. Anything mentioned in the specifications and not shown on the drawings or schedules, or shown on the drawings or schedules and not mentioned in the specifications, shall be of like effect as if shown or mentioned in both. Should the drawings disagree in themselves or with the specifications, the better quality or greater quantity of work or materials shall be estimated upon, and unless otherwise ordered by the ENGINEER in writing, shall be performed or furnished. In case the specifications should not fully agree with the schedules, the former shall govern. Figures given on drawings govern scale measurements and large scale details govern small scale drawings. In case of discrepancy in the figures, in the drawings, in the schedules or in the specifications, the matter shall be promptly submitted to the ENGINEER who will promptly make a determination, after advice and consent of the OWNER, in writing.

ARTICLE 5 - BONDS AND INSURANCE

SEE ARTICLE 17 THIS SPECIFICATION FOR ADDITIONAL OWNER INSURANCE REQUIREMENTS. FOR ANY DIFFERENCE BETWEEN ARTICLE 5 INSURANCE REQUIREMENTS AND ADDITIONAL OWNER REQUIREMENTS IN ARTICLE 17, PROVIDE THE MOST STRINGENT AND MOST COVERAGE.

THE IMMUNITY OF THE OWNER SHALL NOT BE DEFENSE FROM THE INSURANCE CARRIER.

INSURANCE SPECIFICATIONS

Prior to the execution of the Contract Agreement, Contractor/Construction Manager will submit a Certificate of Insurance showing existing insurance coverage. The Certificate of Insurance shall serve as evidence of insurance that the Construction Manager maintains the Minimum Limits of Liability shown below.

TERMS OF INSURANCE SPECIFICATIONS:

The Contractor / Construction Manager / Subcontractors shall maintain the limits and terms shown below for a period of no less than two (2) years after the final payment to the Contractor / Construction Manager / Subcontractor.

NONCOMPLIANCE WITH INSURANCE SPECIFICATIONS:

This Contract may be terminated by the Owner in the event the Contractor / Construction Manager fails to maintain any insurance coverage specified.

MINIMUM LIMITS OF LIABILITY.

The Contractor / Construction Manager / Subcontractors shall maintain at least the following limits of liability. The coverage should be issued with an insurance company that is rated by A.M. Best. The rating should not be less than A- VII.

The Contractor / Construction Manager shall cause all its' Subcontractors to maintain similar insurance. Subcontractor must maintain limits of insurance for the specified term in Article 11.1.2 of the AIA Document A201 - 2007. Certificates of Insurance should be provided by the Subcontractor to the Contractor / Construction Manager prior to the commencement of work on the project.

All policies for the Contractor / Construction Manager / Subcontractors shall contain a provision that the coverage afforded shall not be canceled or not renewed, nor restrictive modifications or changes added until at least (30) days prior written notice has been given to the Owner.

Commercial General Liability

Liability Limit and Coverage of No Less Than:

General Aggregate	\$ 2,000,000
Products / Completed Operations Aggregate	\$ 2,000,000
Personal & Advertising Injury	\$ 1 000,000
Each Occurrence	\$ 1,000,000
Fire Legal Liability	\$ 100,000
Medical Payments	\$ 5,000

- Occurrence Form
- Contractual Liability covering the above indemnity agreement.
- Products & Completed Operations Liability must extend to work performed under this contract.
- Coverage for explosion, collapse, or underground damage arising out of the work performed under this contract.
- Additional Insured Endorsement for both "on going" and "completed operations" shall apply in favor of Owner, Architect, and Architect's consultants.
- Waiver of Subrogation Endorsement shall apply in favor of Owner, Architect, and Architect's consultants.
- 30-day Notice of Cancellation shall apply in favor of Owner (applicable to Nonpayment of Premium also)
- The insurance shall be Primary and Noncontributory from other such insurance available to the Owner, Architect, and Architect's consultants.
- Limits must apply per project.

Business Automobile Liability

Liability Limit and Coverage of No Less Than:

Combined Single Limit	\$ 1,000,000
Per Occurrence	
Applies to Bodily Injury & Property Damage	

- Coverage extends for use of all owned, non-owned, and hired vehicles.

- Additional Insured Endorsement shall apply in favor of Owner, Engineer, and Engineer's consultants.
- Waiver of Subrogation Endorsement shall apply in favor of Owner, Engineer, and Engineer's consultants.
- 30-day Notice of Cancellation in favor of Owner (applicable to Non-Payment of Premium also)

Workers' Compensation

Workers' Compensation must apply in accordance with the laws of all jurisdictions that may apply to the work being performed and including Employers Liability.

Employers Liability Limit of No Less Than:

Bodily Injury By Accident	\$1,000,000 Each Accident
Bodily Injury By Disease	\$1,000,000 Policy Limit
Bodily Injury By Disease	\$1,000,000 Each Employee

Waiver of Subrogation Endorsement shall apply in favor of Owner, Engineer, and Engineer's consultants.

- 30-day Notice of Cancellation in favor of Owner (applicable to Non-Payment of Premium also)

Excess Umbrella (Applicable to Construction Manager / Contractor)

Liability Limit and Coverage of No Less Than:

Per Occurrence	\$5,000,000
Policy Aggregate	\$5,000,000

Policy must extend over the coverage and terms shown above for the following:

Commercial General Liability
Business Automobile Liability
Employers Liability

Excess Umbrella (Applicable to Subcontractor)

Liability Limit and Coverage of No Less Than:

Per Occurrence	\$1,000,000
Policy Aggregate	\$1,000,000

Policy must extend over the coverage and terms shown above for the following:

Commercial General Liability
Business Automobile Liability
Employers Liability

Contractors Pollution Liability (Applicable to Contractor / Construction Manager)

Liability Limit and Coverage of No Less Than:

Per Occurrence	\$1,000,000
Policy Aggregate	\$1,000,000

This policy may be written on a "Claims-Made or Occurrence" Basis.

ARTICLE 6: CONTRACTORS RESPONSIBILITIES & OTHER PROVISIONS

Labor; Working Hours:

Delete 6.02.B in its entirety.

Insert the following at the end of Article 6.

6.21. Wage Rates and Statutory Penalties:

The OWNER has ascertained the General Prevailing Rate of Per Diem Wages for each credit or type of workman or mechanic and has specified this rate in the call for bids and has also ascertained the prevailing rate for legal holiday and overtime work. These rates set out in Exhibit "A" in the Instruction to Bidders, form part of the Contract Documents, and are incorporated herein by reference in their entirety. The CONTRACTOR and any Subcontractor under him shall pay no less than the aforesaid rates. Nothing herein shall prevent the payment of amounts greater than such rates. The provisions of Article 5159a of the Texas Revised Civil Statutes Annotated, as presently in effect or hereafter amended, are incorporated herein by reference in their entirety. The CONTRACTOR acknowledges the penalty provisions therein, and the CONTRACTOR for himself and each Subcontractor under him shall keep an accurate record showing the name, social security number, occupation by specific trade classification and level as set out in the General Prevailing Rate of Per Diem Wages, hours worked, and actual wages and other benefits paid to each laborer, workman, and mechanic and other person covered by said Article 5159a, and shall provide the OWNER with Certification thereof no less often than monthly during the performance of the Work.

6.22. Equal Opportunity In Employment:

6.22.A. The CONTRACTOR and all Subcontractors under him shall not discriminate against any employee or applicant for employment because of race, religion, color, sex, age or national origin. The CONTRACTOR shall take affirmative action to insure that applicants are employed, and that employees are treated during employment without regard to their race, religion, color, sex, age, or national origin. Such action shall include, but not be limited to the following: employment, upgrading, demotion or transfer; recruitment or recruitment advertising; layoff or termination; rates of pay or other forms of compensation and selection for training, including apprenticeship. The CONTRACTOR agrees to post in conspicuous places, available to employees and applicants for employment, notice setting forth the policies of non-discrimination.

6.22.B. The CONTRACTOR and all Subcontractors shall, in all solicitation or advertisements for employees placed by them or on their behalf, state all qualified applicants will receive consideration for employment without regard to race, religion, color, sex, age, or national origin.

6.22.C. The CONTRACTOR and all Subcontractors agree that the provisions of Paragraph 6.3.2.1. and Paragraph 6.3.2.2. shall be binding on each Subcontractor or vendor; the CONTRACTOR further agrees to permit access to his books, records, and accounts by the OWNER or his agent for the purpose of investigations to ascertain compliance with such agreement.

6.23. Citizenship Or Residency (New):

The CONTRACTOR and all Subcontractors under him who recruit or hire an individual for employment under his contract shall require each individual to attest that he is a citizen or national of the United States or an alien lawfully admitted for permanent residence. Such attestation shall

be on an employment eligibility verification form (Form I-9, provided by the U.S. Department of Justice, Immigration and Naturalization Service, attached herein) to be completed and signed by both the employee and the CONTRACTOR and all Subcontractors and their employees on the form provided.

6.24. Manufacturers and Installing Subcontractors (New):

The ENGINEER will promptly reply in writing to the CONTRACTOR stating whether the OWNER or the ENGINEER, after due investigation, has reasonable objection to any such proposal. If adequate data on any proposed manufacturer or installer is not available, the ENGINEER may state that action will be deferred until the CONTRACTOR provides further data. Failure of the OWNER or ENGINEER to reply promptly shall constitute notice of no reasonable objection. Failure to object to a manufacturer shall not constitute a waiver of any of the requirements of the Contract Documents, and all products furnished by listed manufacturer must conform to such requirements.

Taxes

6.10. This Paragraph is deleted in its entirety. The following is substituted:

6.10. The materials to be incorporated into this project will be exempt from the Limited Sales, Excise and Use Tax imposed by the Act (TEX-TAX GEN. ANN Art. 20.01 et. seq.). An Exemption Certificate will be issued by the OWNER to the successful bidder and the Contract between the OWNER and the CONTRACTOR will contain separate amounts specifically stated for the following:

Labor, overhead and profit Materials to be incorporated into the construction project.

The CONTRACTOR shall ascertain the amounts applicable to the above classifications which will be incorporated into the Contract. Reference is hereby made to the Limited Sales, Excise and Use Texas Ruling No. 9, amended April 3, 1962, in which the Comptroller of Public Accounts of the State of Texas sets forth the rights and obligations of the parties to a contract of this type. (Applicable to repairmen and CONTRACTORS).

6.12 Record Documents:

Add the following sentences to 6.12:

The CONTRACTOR shall keep on the site of the Work a copy of the Contract Documents and shall at all times give the OWNER or his representative and agents access thereto. Further, the CONTRACTOR shall maintain a record set of drawings which reflect the "As-Constructed" conditions and representations of the Work performed, whether it be directed by Addendum, Change Order or otherwise. All records prescribed herein shall be made available for reference and examination by the OWNER and his representatives and agents. The CONTRACTOR shall update the "As-Constructed" drawings a minimum of once monthly prior to submission of periodic partial pay estimates. Failure to maintain such records shall constitute cause for denial of a progress payment otherwise due. Upon completion of all the Work and at the time of final acceptance by the OWNER, the CONTRACTOR shall furnish a complete set of mark-up "As Constructed" drawings to the OWNER.

6.20 Indemnification:

Add the following to Article 6, paragraph 6.20 - Indemnification.

The CONTRACTOR will be required to provide insurance as set forth in the contract between the OWNER and the CONTRACTOR and as further set forth under Supplementary Conditions, Article 5, Insurance. However, the required indemnification as set forth herein will be effective without regard to the availability of insurance to the CONTRACTOR. The CONTRACTOR shall carry Contractual Liability (Blanket Broad Form) with limits equal to general liability limits. The CONTRACTOR shall carry Broad Form Property Damage with limits equal to general liability limits. The liability of the CONTRACTOR is not limited to the availability of insurance nor to limits that are specified therein. This indemnification is in addition to and not in lieu of, the general conditions, the supplementary conditions and amendments as set forth in the general contract. CONTRACTOR shall indemnify and hold harmless OWNER, OWNER'S employees, and consultants to OWNER.

Concerning Subcontractors, Suppliers And Others:

Delete 6.06.A and 6.06.B in their entirety and substitute the following:

6.06.A. Unless otherwise required by the Contract documents, including the Bidding Documents, the Bidder awarded the Contract, as soon as practicable after the receipt of bids, and before the execution of the Contract, shall submit to the OWNER and the ENGINEER in writing the names of all manufacturers, materials or equipment, which are proposed or used in the construction of the Project. No Subcontractor or such person or entity shall be employed by the CONTRACTOR should the ENGINEER or OWNER have reasonable objection. The CONTRACTOR will not be required to employ any Subcontractor, or such person or entity against whom any Subcontractor, or such person or entity against whom he has a reasonable objection. Nothing in these paragraphs circumvents the qualification requirements and the equipment substitution procedures and requirements.

6.06.B. After the execution of the Contract, a change in any approved Subcontractor or such person or entity or the addition of any new Subcontractor or person or entity can only be made with the written consent of the OWNER.

6.06.H. The CONTRACTOR agrees to bind every Subcontractor and such person or entity to the terms of the Contract as far as applicable to his work. The CONTRACTOR shall furthermore fully inform his Subcontractors prior to executing an agreement with them that they and the Subcontractors will be required to perform their work in conformance with the related documents and to submit cost estimates and change order proposals in complete and full analytical detail. The CONTRACTOR shall indemnify the OWNER for any Subcontractor's, Sub-Subcontractor's, or such person's or entity's claim which may result from the failure of the CONTRACTOR to incorporate the provisions in this Contract with any of his Subcontractors.

6.06.I. If, after approving a Subcontractor, or such person or entity, the OWNER or ENGINEER requires a change to another Subcontractor or such person or entity, the CONTRACTOR shall provide the OWNER with an itemized proposal for the cost increase or decrease by reason of such change. An equitable adjustment to the contract will then be determined by agreement between the contracting parties and contract so modified by Change Order. The adjustment shall be made in accordance with the administrative procedures for Change Orders set out in paragraph 11.4 below. If agreement on the adjustment cannot be reached, the matter will be handled as a dispute under the contract. Pending resolution, the Work will proceed using the selected Subcontractor, person or entity who is acceptable to the OWNER and the ENGINEER.

6.06.J. In addition to any bond required in the Bidding Documents of the CONTRACTOR or major Subcontractors, the OWNER may, at his option, require any Subcontractor or such person or entity to provide a satisfactory Performance Bond and Payment Bond of the type furnished by the CONTRACTOR. Bonds required at the option of the OWNER of such Subcontractors, person or entity shall meet the same requirements as specified in the Instructions to Bidders of the Supplementary General Conditions.

6.06.G. This Paragraph remains as written except where it might conflict with Subparagraph 6.06.H above, in which case the language in the latter shall prevail.

Safety And Protection:

Add the following sentences after paragraph 6.13.B.

The CONTRACTOR shall indemnify and hold harmless the OWNER, the Board and all its officers, agents, consultants, and employees, from all suits, action or claims of any character, name and description brought for or on account of any injuries or damages received or sustained by any person or property from said CONTRACTOR, his agents, Subcontractors, his/their employees, or by consequence of any negligence whatsoever. The OWNER by contract number shall be included as an additional insured on Worker's Compensation, General Liability, Automobile Liability and Umbrella policies.

ARTICLE 8: OWNER'S RESPONSIBILITIES & OTHER PROVISIONS

8.02.A. Delete paragraph 8.02.A. in its entirety.

Insert the following paragraphs at the end of Article 8.

8.12. The OWNER'S right to change, amend, delete from, add to, or in any manner modify this Contract or the Contract Documents in accordance with the terms and provisions thereof is hereby declared to be specific and absolute and without any duty or obligations on the part of OWNER to any Subcontractor, material men or other party having any contractual relationship with the CONTRACTOR. This Contract and the Contract Documents described herein shall be made a part of any and all subcontracts, agreements, or contractual arrangements between CONTRACTOR and any Subcontractor, material men, or other party; and, accordingly, the provisions of this Contract and the accompanying Contract Documents shall control and supersede the terms and provisions of any such subcontract or agreement between the CONTRACTOR and any other party.

8.13. Claims For Unpaid Labor And Materials:

8.13.1. The OWNER shall be furnished in accordance with Article 5160 of the Texas Revised Civil Statutes Annotated, a copy of the Payment Bond as required therein and by the Contract Documents. All claimants are cautioned that no lien exists on the funds unpaid to the CONTRACTOR on such Contract, and that reliance on notices sent to the OWNER may result in loss of their rights against the CONTRACTOR and/or his surety. The OWNER is not responsible in any manner to a claimant for collection of unpaid bills, and accepts no such responsibility because of any representation by any agent or employee.

ARTICLE 10: CHANGES IN THE WORK

Add the following sentences to paragraph 10.01.

It is recognized by the parties hereto, and agreed by them, that the specifications and drawings may or may not be complete, or free from error, omissions or imperfections, or otherwise may require changes or additions in order for the Work to be completed to the satisfaction of OWNER, and that, accordingly, it is the express intention of the parties (notwithstanding any other provisions in this Contract) that any errors, omissions or imperfections in such specifications and drawings or any changes in or additions to same, or to the Work, ordered by OWNER, and any resulting delays in the Work or increases in CONTRACTOR'S costs and expenses, shall not constitute or give rise to any claim, demand or cause of action of any nature whatsoever in favor of CONTRACTOR, whether for breach of contract, quantum merit, or otherwise; provided, however that OWNER shall be liable to CONTRACTOR for the sum stated to be due CONTRACTOR in any Change Order approved and signed by both parties, it being agreed hereby that such sum, together with any extension of time contained in said Change Order, shall constitute full compensation to CONTRACTOR for all costs, expenses and damages to CONTRACTOR, whether direct, consequential or otherwise in any wise incident to, arising out of, or resulting directly or indirectly from the Work performed by CONTRACTOR under such Change Order.

Add the following clauses to 10.01.

10.01.A. Such orders, designated or indicated to be Change Orders, include but are not limited to changes:

1. In the Specifications (including drawings and designs);
2. In the methods or manner of performance of the Work;
3. In the OWNER-furnished facilities, equipment, materials, services, or site, or;
4. Directing acceleration in the performance of the Work.

10.01.B. Any other written order or oral order (which terms as used in this clause 10.01.B shall include direction, instruction, interpretation, or determination) from the OWNER shall be treated as a Change Order under this Clause, provided that the CONTRACTOR gives the OWNER written notice stating the date, circumstances, and source of the order and that the CONTRACTOR regards the order as a Change Order.

ARTICLE 11: COST OF THE WORK; CASH ALLOWANCES; UNIT PRICE WORK

Delete paragraph 11.01 and all subparagraphs of 11.01 in its entirety and substitute the following:

11.01. Administrative Procedures for Change Orders: The following administrative procedures shall govern the submission and calculation of all Change Orders.

11.01.A. Contingency Allowance - Reference Division 1.

11.01.B. Lump Sum Proposal

11.01.B.1. In responding to a request for him to propose a price for a change in the Work, or in submitting a claim, the CONTRACTOR shall furnish a lump sum proposal supported by a complete breakdown as described hereafter, indicating the estimated or actual cost to the CONTRACTOR for performance of the changed Work, including the applicable percentage of overhead and profit described hereafter. Any request for an extension must be justified and presented in adequate detail to permit evaluation.

11.01.B.1.A. The proposal for the adjustment of the Subcontractor's Work or CONTRACTOR'S Work which he directly performs shall show cost of any extra Work and shall consist of the following items:

- (1) Estimated cost, using any discounts to the trades, of the materials and supplies used, which shall be itemized completely to include unit cost, quantity and total cost.
- (2) Estimated wages paid for skilled, semi-skilled or unskilled labor performing the additional Work, which shall be itemized completely to include trade(s) hourly rate, hours and total cost including those operating equipment if required. Such labor shall include labor required for performance of the changed Work only. Such labor may include working foremen, all other supervisors shall be excluded and shall be considered as a part of field supervision. Labor for supporting services, including but not limited to safety provisions, layout, and trash removal, shall be excluded and shall be considered as a part of overhead.
- (3) Estimated cost for additional construction equipment solely for the use of the change order Work to include rental rates or owned equipment rates for such items of equipment while in use, which shall be itemized completely to include type(s), number(s) of each, hourly rate, hours and total cost. Equipment which is used regularly at the job shall be employed in change order Work at no extra charge. Rental or owned equipment rates shall be no greater than those established by the AGC for the local areas using current figures; if such current rates are unavailable, the rental or owned equipment rates shall not be greater than the average rate charged for equipment rental in the County of the project. As used herein the terms "construction equipment" and "equipment" shall include wheeled vehicles and small tools.
- (4) Estimated transportation costs for delivery and handling of materials and supplies, bringing to and removing from the site additional construction equipment and/or new items of installed equipment, if applicable, which shall be itemized separately.
- (5) Estimated off-site storage costs in excess of thirty (30) calendar days for new items or installed equipment, if applicable.
- (6) Percentage permitted to be added to the total sum of a, b, c, d and e above to cover all field supervision use of other equipment on the job as necessary for economical performance of the Change Order Work, general office and field services and expenses, interference with other Work, adjustments to progress schedules and all other overhead (including bond and insurance) and profit shall be 10%.

- (7) To the total cost proposed for the Change Order Work which is the sum of a, b, c, d, e, and f above, may be added the net cost of the following, if applicable: Social Security, Old Age Pension and/or other taxes of like nature imposed upon Subcontractor or CONTRACTOR (when he performs the Work) by the State or federal Government, or both, which are incident solely to such Change Order Work and which the CONTRACTOR would be required to pay if or as he performs the Work.
- (8) All pricing shall be per the bid form proposal.

11.01.C. To the amount of the adjustment of the Subcontractor(s) as listed under 11.4.2.1.1 above, the CONTRACTOR will be allowed to add a percentage of 5% to cover all overhead expenses and profit, including supervisors, small tools, insurance and bond. It is to be expressly understood that when the CONTRACTOR performs the Work with his own forces, and where there is no Subcontractor involved, then the CONTRACTOR will be allowed the 10% mark-up described hereinbefore and the 5% mark-up is then not applicable. The term "Subcontractor" as used in 11.4.2.1.1. includes Subcontractors, whereby Subcontractors who perform the Work with their own forces will be entitled to receive the 10% mark-up.

11.01.D. If additional costs are claimed for unchanged Work, as provided in 11.3 above, the CONTRACTOR shall provide sufficient justification and description of such costs to permit evaluation by the OWNER and ENGINEER.

11.01.E. In cases where change in the Work results in credits to the OWNER, the credits shall be limited to direct costs; that is, no overhead or profit shall be charged to such costs. In cases where a change in the Work results in both credits and charges to the OWNER, the CONTRACTOR will be allowed to add the overhead and profit percentages indicated in 11.4.2.1.1 and 11.4.2.1.2 to the net charges, the amount by which the total charges exceeds the total credits; if there is a net credit, no overhead or profit shall be charged.

11.01.F. CONTRACTOR'S proposals for changes in the contract amount of time for Change Order Work shall be submitted within thirty (30) calendar days of the written request for same, unless the OWNER extends such period of time due to the circumstances involved. If such proposals are not timely received, or if such proposals are not acceptable to the ENGINEER and/or the OWNER, or if the changed Work should be started immediately, to avoid damage to the project or to avoid costly delay, the OWNER may, at his discretion and in the interest of prosecuting the Work to timely completion, direct the CONTRACTOR to proceed with the changed Work without waiting for the CONTRACTOR proposals or other cost and/or time estimates to be developed or the formal change to be issued. In the case of an unacceptable CONTRACTOR proposal, the OWNER'S directive to proceed with the changed Work shall be based on "a price not to exceed" the CONTRACTOR'S lump sum proposal. The estimated cost plus the marked-up percentages shall be determined at a later date in accordance with these articles, and said procedure shall be known as "PDL-NTE (Price Determined Later-Not To Exceed)". Such directions as may be given if given orally, shall be confirmed in writing within seven (7) calendar days. The cost or credit and time adjustments will be determined through negotiations as soon as practical thereafter and incorporated in a change order to the Contract. Prior to such negotiations, the CONTRACTOR shall keep separate costs on Change Order Work done up to that point.

11.01.G. Processing:

The OWNER will undertake to formally process and issue OWNER-CONTRACTOR agreed Change Orders within thirty (30) calendar days of such agreement, provided the contingency allowance is not exceeded. In those cases where Change Order Work causes the contingency allowance to be exceeded, approval of high authority will be necessary and, if such approvals are necessary, the OWNER will have ninety (90) additional calendar days to process and issue such agreed Change Orders.

11.01.H. Unilateral Change Order: In the event that the OWNER requires certain Work to be accomplished and the CONTRACTOR fails in the discharge of any or all of his responsibilities described hereinbefore, the OWNER may issue a unilateral Change Order which is a Change Order issued by or at the direction of the OWNER without the full timely agreement of the CONTRACTOR.

11.01.H.A. A unilateral Change Order may be issued before, during or after the changed Work is physically accomplished under the following conditions.

- (1) The CONTRACTOR fails to submit price and/or time extension proposal of the changed Work within thirty (30) days of receipt of the request for proposals or within a reasonable time thereafter as specified by the OWNER; or
- (2) Negotiation fails to achieve an agreed price and/or time extension or there remains a disagreement concerning any part of the changed Work; or
- (3) The CONTRACTOR fails or refuses to execute a Change Order by affixing his signature thereto within thirty (30) days of receipt provided that he has had opportunity to state his objections, and, if stated, they are not mutually resolved.
- (4) The OWNER shall notify the CONTRACTOR in writing that the Change Order is considered to be unilateral and is to be an effective change to the Contract. A notation will be made on the face of the Change Order that it is unilateral and the effective date thereof. Normal distribution of copies will then be made.

11.01.H.B. The terms of a unilateral Change Order including the change in contract price and/or completion date shall be determined by the OWNER assisted by the ENGINEER and shall, in the OWNER'S judgment, be fair and reasonable.

11.01.H.C. When a unilateral Change Order has been issued, it will have the full force and effect of a contract modification. It will be included in schedules, payment estimates, reports and all official records of the Contract. The assurance of a unilateral Change Order will not prejudice any of the CONTRACTOR'S rights to make claims or to appeal disputed matters under other provisions of this Contract.

11.01.H.D. If the CONTRACTOR objects to a unilateral Change Order, he shall state in writing his specific objections to or specific points of disagreements with the Work described in the unilateral Change Order within (30) days of receipt of such Change Order.

11.01.I. Except as provided above, no order, oral statement or directive of the OWNER or his duly appointed representative shall be treated as a change order under this article or entitle the CONTRACTOR to an adjustment thereunder.

Contractor's Fee:

Delete paragraphs 12.01.C and 11.01.D and all subparagraphs of 12.01.C. See Supplementary Conditions Articles 11 and 12.

Unit Price Work:

Delete paragraphs 11.03.A and 11.03.C. See Supplementary Conditions Article 11.

Concealed Conditions (New):

Insert the following at the end of Article 11:

11.04. Should concealed conditions encountered in the performance of the Work below the surface of the ground or should concealed or unknown conditions in an existing structure be at variance with the conditions indicated by the Contract Documents, or should unknown physical conditions below the surface of the ground or should concealed or unknown conditions in an existing structure of an unusual nature, differing materially from those ordinarily encountered and generally recognized as inherent in work of the character provided for in this Contract, be encountered, the Contract Sum shall be equitably adjusted by Change Order upon claim by either party made within twenty days after the first observance of the conditions.

11.04.A. Notwithstanding paragraph 11.10 above, the CONTRACTOR is responsible for having visited the site and having ascertained pertinent local conditions such as location, accessibility, and general character of the site or building, the character and extent of existing Work within the adjacent submission of his proposal. Any failure to do so will not relieve him from responsibility for successfully performing the work without additional expense to the OWNER.

11.04.B. The OWNER makes no representations as to the accuracy or completeness of the site information furnished to the CONTRACTOR by OWNER and does not expressly or impliedly warrant same and is not responsible for any interpretations or conclusions reached by the CONTRACTOR with respect thereto. It is the CONTRACTOR'S sole responsibility to verify to its own satisfaction all site information, including but not restricted to topographical data, borings, subsurface information, utilities, easements, and existing buildings.

Claims For Additional Cost (New):

11.05. Claims for additional costs shall be in accordance with Supplementary Conditions Article 11. If the OWNER and CONTRACTOR cannot agree on the amount of the adjustment in the Contract Sum, it shall be determined by the ENGINEER in accordance with the administrative procedure for Change Orders set out in Supplementary Conditions - Article 11. No claim shall be allowed for an equitable adjustment under this or any other provision of the Contract Documents if asserted after Final Payment.

ARTICLE 12: CHANGE OF CONTRACT PRICE; CHANGE OF CONTRACT TIMES

Delete paragraph 12.01.B and all subparagraphs of 12.01.B in its entirety and substitute the following:

12.01.B If such changes cause an increase or decrease in the CONTRACTOR'S cost of, or time required for performance of the Contract, an equitable adjustment shall be made and confirmed in writing in a Change Order.

12.01.B.1. Except for claims based on defects in specifications furnished by the OWNER, no claim for any change under 10.01.A above shall be allowed for any costs incurred more than twenty (20) days before the CONTRACTOR gave written notice as therein required; provided that, in the case of defects in specifications furnished by the OWNER, the equitable adjustment shall include only those increased direct costs reasonably and necessarily incurred by the CONTRACTOR as a result of such specifications.

12.01.B.2. Procedures for administration of Change Orders are stated in paragraph.

12.01.B.3. If the CONTRACTOR intends to assert a claim for an adjustment of cost or time over and above any adjustment already being granted in a Change Order, he must, within thirty (30) calendar days after receipt of a written Change Order; or oral or written order to proceed with a proposed change under Clause 10.1.1 or the furnishing of a written notice under Clause 10.1.2 submit to the OWNER a written statement setting forth in detail the nature and monetary extent of such claim. The CONTRACTOR shall certify that the claim is made in good faith and that the supporting data is current, accurate and complete to the best of his knowledge and belief, and that the amount requested accurately reflects the contract adjustment for which the CONTRACTOR believes the OWNER is liable. Failure to certify a claim will result in a determination that no claim has been filed. The 30 day period of time for submission of such claim may be extended only by written agreement signed by the OWNER. Except for claims based upon defects in specifications furnished by the OWNER, no claim for any change under Clause 10.1.2 above, shall be allowed for any costs incurred more than twenty (20) days before the CONTRACTOR gave written notice as therein required; provided that in the case of defects in specifications furnished by the OWNER the adjustment in cost shall include only those increased direct costs reasonably and necessarily incurred by the CONTRACTOR as a result of such defective specifications.

12.01.B.4. Except as provided above, no order, oral statement or directive of the OWNER or his duly appointed representative shall be treated as a change under his Article or entitle the CONTRACTOR to an adjustment thereunder.

Delete all of paragraph 12.02 and substitute the following: The Contract Time may only be changed by a Change Order processed in accordance with Supplementary Conditions or Article 11.

ARTICLE 14 - PAYMENTS TO CONTRACTOR AND COMPLETION

Application For Progress Payment:

Add the following clauses 14.02.A.1 and 14.02.A.2 to 14.02.A:

14.02.A.1. Unless otherwise stated in the Agreement, the OWNER will retain 5% of the amount of each estimate except as otherwise provided in Contract Documents. Retained percentage will be held until final completion and acceptance of the work. Progress payments shall be on AIA forms with schedule of values.

14.02.A.2. The itemized Application for Payment shall be notarized.

Review of Applications For Progress Payment:

14.02.B. Modify paragraph 14.02.B to make payment due in accordance with Agreement signed.

Final Inspection, Final Applications For Payment And Final Payment And Acceptance:

Delete paragraphs 14.06, 14.07.A, 14.07.B, and 14.08. in their entirety and substitute the following:

14.06. When the Work is completed, the CONTRACTOR shall notify the ENGINEER in writing that the Work will be ready for final inspection on a definite date. Upon verification by the ENGINEER that the Work is ready for final inspection and acceptance, the OWNER will within ten (10) calendar days make a final inspection and, when the Work is found acceptable under the Contract Documents and the Contract is fully performed, make final payment to the CONTRACTOR.

14.06.A. To avoid delay in final payment, the CONTRACTOR shall have all necessary bonds, guarantees not previously furnished, receipts, releases, affidavits, etc. prepared and signed in advance with a letter of transmittal listing each paper to be furnished to the OWNER at the time of final inspection.

14.07.A. The CONTRACTOR shall be charged with any additional cost of inspection when material and workmanship are not ready at the time specified by the CONTRACTOR for its inspection.

14.07.B. Upon acceptance of the Contract work, the ENGINEER shall execute an acceptance document in accordance with the Contract Agreement and deliver such document to the CONTRACTOR by mail or other means within ten (10) calendar days. The CONTRACTOR'S requirement for insurance coverage of the Work may be terminated on the date of the executed final acceptance document. In the case where heating and ventilating, air conditioning or other systems must be tested seasonally, the OWNER may accept the Work less such testing and final acceptance of such systems will be accomplished after completion of successful tests.

14.07.B.1. Upon execution of the acceptance document by the ENGINEER, the CONTRACTOR shall submit a request for final payment signed by a CONTRACTOR principal. Such request shall be marked "Final Payment" by the CONTRACTOR. This request shall be approved and certified by the ENGINEER and forwarded to the OWNER. If the OWNER determined that all the Work under the Contract has not been satisfactorily completed, he will advise the CONTRACTOR in writing within ten (10) calendar days of receipt of the request for final payment of the reasons that final payment is being retained. The CONTRACTOR shall complete such remaining Work within thirty (30) days. The OWNER will then promptly process final payment.

14.07.B.2. With the application for final payment the CONTRACTOR shall deliver to the ENGINEER (1) an affidavit that all payrolls, bills for materials and equipment, and other indebtedness connected with the Work for which the OWNER or his property might in any way be responsible, have been paid or otherwise satisfied, (2) consent of surety, if any, to final payment, and (3) if required by the OWNER, other data establishing payment or satisfaction of all such obligations, such as receipts, releases and waivers of liens arising out of the Contract, to the extent and in such form as may be designated by the OWNER. If any Subcontractor refuses to furnish a release or waiver required by the OWNER to indemnify him against any such lien, or any such lien remains unsatisfied after all payments are made, the CONTRACTOR shall refund to the OWNER all moneys that the latter may be compelled to pay in discharging such liens, including all costs and reasonable attorneys' fees.

14.07.B.3. Unless otherwise provided in this Contract, acceptance by the ENGINEER shall be made as promptly as practicable after completion and inspection by the OWNER of all the Work required by this Contract. Acceptance shall be final and conclusive except as regards latent defects, fraud or such gross mistakes as may amount to fraud or as regards the OWNER'S rights under any warranty or guarantee.

14.07.B.4. No claim by the CONTRACTOR shall be allowed if asserted after final payment under this contract.

ARTICLE 16 DISPUTE RESOLUTION

Add the following statement at the end of Article 16.

Owner requires Contractor, Subcontractor, Vendors, and Suppliers to waive subrogation against Owner and Engineer.

Mediation shall be the first method of non-binding dispute resolution. Mediation shall occur in Tyler, TX, Smith County.

ARTICLE 17 - MISCELLANEOUS

17.06. Antitrust Claims (New):

17.06.1. The CONTRACTOR hereby assigns to the OWNER any and all claims for overcharges associated with the Contract which arise in any manner under the Antitrust laws of the United States, 15 U.S.C. Section 1 et. seq. (1973), as amended.

17.07. Owner's Occupancy (New):

17.07.1. The CONTRACTOR shall allow the OWNER to place and install OWNER'S equipment, etc., during construction work. The CONTRACTOR will provide a schedule, approved by the ENGINEER, for OWNER'S occupancy relative to the installation of equipment. Such placing and installing of equipment, etc., shall not in any way evidence the completion of the work or any portion of it, or signify the OWNER'S acceptance of the work or any part of it.

17.08. Completion Of Work (New):

17.08.1. The CONTRACTOR will be held to account for the Work being completed in the time that is stated in the Contract.

17.08.2. If, in the judgment of the OWNER, the Work is behind schedule and the rate of placement of work is inadequate to regain scheduled progress so as to insure timely completion of the entire work or a separable portion thereof, the CONTRACTOR, when so informed by the OWNER, shall immediately take action to increase the rate of work placement. This increase shall be accomplished by any one or a combination of the following or other suitable measures: (1) an increase in working forces, (2) an increase in equipment or tools, (3) an increase in hours of work or number of shifts, and/or (4) Expedite delivery of materials.

17.08.3. The CONTRACTOR shall, within ten (10) calendar days after being so informed, notify the OWNER of the specific measures taken and/or planned to increase the rate of progress together with an estimate as to when scheduled progress will be regained. Should the plan of action be deemed inadequate by the OWNER, the CONTRACTOR will take additional steps or make adjustments as necessary to his plan of action until it meets with the OWNER'S approval. The

acceleration of Work will continue until scheduled progress is regained. Scheduled progress will be established from the latest revised approved progress schedule for the job. Timely completion will be understood as the contract completion date is revised by all-time extensions granted at the time acceleration is undertaken. The CONTRACTOR shall not be entitled to additional compensation for the additional effort he applies to the Work under the terms of this sub-paragraph.

17.08.4. Failure of the CONTRACTOR to comply with the requirements of the OWNER under this provision shall be grounds for determination that the CONTRACTOR is guilty of a substantial violation of a provision of the Contract Documents. Upon such determination, the OWNER may terminate the Contract.

17.08.5. Any directive or order to accelerate the Work will be in writing. Any directive or order terminating accelerated Work will be in writing.

17.09. The CONTRACTOR agrees that the Work shall be executed regularly, diligently and without interruption at such rate of progress as will insure completion thereof within the time specified in the contract document. It is expressly understood and agreed by and between the CONTRACTOR and the OWNER, that time is of the essence and that the time of the completion of the work in the contract documents is a reasonable time in which to complete such specified work.

17.10. Contract Warranty And Guarantee After Final Acceptance (New)

17.10.1. One Year Warranty:

17.10.1. Except as otherwise specified, the CONTRACTOR warrants and guarantees all work against defects in materials, equipment or workmanship for one (1) year from the date of Substantial Completion.

17.10.1.2. Upon receipt of written notice from the OWNER of the discovery of any defects, the CONTRACTOR shall remedy the defects and replace any property damaged therefrom occurring within the warranty and guarantee period.

17.10.1.3. In case of Work performed by Subcontractors and where guarantees are required, the CONTRACTOR shall secure warranties from said Subcontractors addressed to and in favor of OWNER, deliver copies of same to ENGINEER upon completion of the Work, guarantee and assume full responsibility for the full period of said warranties. Delivery of said guarantees shall not relieve the CONTRACTOR from any obligations assumed under any other provisions of the Contract.

17.10.1.4. This warranty and guarantee is not the exclusive remedy of the OWNER, but is in addition to the general obligation of the CONTRACTOR to faithfully perform the Contract, and it in no way relieves the CONTRACTOR'S responsibility for faulty materials or workmanship.

17.10.1.5. Neither the final payment nor any provision of the Contract Documents shall relieve the CONTRACTOR of responsibility for faulty materials or workmanship. If the CONTRACTOR, after notice, fails to proceed promptly to comply with the terms of the warranty and guarantee, the OWNER may have the defects corrected and the CONTRACTOR and his surety shall be liable for all expenses incurred.

17.10.1.6. The provisions of these 17.10 paragraphs and sub-paragraphs are in addition to the provisions found in the General Conditions.

17.11. Other Owner Requirements:

17.11.1. CONTRACTOR shall provide all equipment, materials and labor to complete the turnkey work as described in these specifications. All bidders and successful CONTRACTORS shall comply with the special conditions, Division O requirements, Division 1 requirements, Division 15 requirements, Division 16 requirements, and all other Divisions included in this project manual. Bidders submitting proposals which do not comply shall not be considered.

17.11.2. The Bidders shall have been in business for seven continuous years under the company bidding.

17.11.3. OWNER will provide access to the work site. OWNER'S personnel will provide on-site acceptance inspection for compliance with the specifications contained herein and in manufacturer's installation instructions, but exclusive of any inspection required by federal, state or local authority.

17.11.4. Safety Instructions:

No asbestos containing materials will be utilized.

No rigging of equipment over occupied areas.

General safety rules must be followed at all times.

Electrical work must be installed per National Electric Code.

CONTRACTOR is responsible for all damages caused by their employees or representatives in the performance of this contract (i.e. holes in walls, roof leaks, ceiling tiles damaged, equipment and furnishings damage, concrete and grounds damaged from vehicle or heavy equipment, etc.).

CONTRACTOR is solely responsible for means and methods, fire protection, and code/standard compliance.

17.11.5. Smoking and other use of tobacco products on the campus is prohibited.

All work and scheduling shall be coordinated with OWNER'S Representative.

17.11.6. All work shall be scheduled and accomplished without interrupting OWNER'S operations, classes or other school functions.

17.11.7. For pre-bid CONTRACTOR inspection, all CONTRACTORS must identify themselves at the school office PRIOR to touring the site.

17.11.8. All operation and maintenance manuals, bulletins, instruction brochures, guarantees, etc. shall be given to the ENGINEER

17.11.9. Compliance Requirements:

The following contract provisions or conditions shall apply:

CONTRACTORS and/or Subcontractors shall be in compliance with Federal Executive Order 11246, entitled "Equal Employment Opportunity", as amended by Executive Order 11375, and as supplemented in Department of Labor Regulations (41 CFR Part 60).

CONTRACTORS and/or Subcontractors shall be in compliance with the Copeland "Anti-Kickback" Act (18 USC 874) as supplemented in Department of Labor Regulations (29CFR, Part 3). This Act provides that each CONTRACTOR and/or Subcontractor shall be prohibited from inducing, by any means, any person employed in the construction, completion, or repair of public work, to give up any part of the compensation, to which he is otherwise entitled. School districts shall report all suspected or reported violations to the Texas Education Agency.

CONTRACTORS and/or Subcontractors shall be in compliance with Section 103 and 107 of the Contract Work Hours and Safety Standards Act (40 USC 327-330) as supplemented by Department of Labor Regulations (29 CFR, Part 5). Under Section 103 of the Act, each CONTRACTOR and/or Subcontractor shall be required to compute the wages of every mechanic and laborer on the basis of a standard workday of eight hours and a standard workweek of 40 hours. Work in excess of eight hours per day or 40 hours per week shall be compensated at a rate of not less than 1½ times the basic rate of pay. Section 107 of the Act is applicable to construction work and provides that 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.

The Texas Education Agency, the Comptroller General of the United States, or any of their duly authorized representatives, shall have access to any books, documents, papers, and records of the CONTRACTOR and/or Subcontractor which are directly pertinent to the specific contract, for the purpose of making audit, examination, excerpts, and transcriptions. CONTRACTORS and/or Subcontractors shall maintain all required records for five (5) years after final payments and all other pending matters are closed.

CONTRACTORS and/or Subcontractors shall be in compliance with all applicable standards, orders, or requirements issued under Section 306 of the Clean Air Act (42 USC 1857 (a)), Section 508 of the Clean Water Act (33 USC 1368), Executive Order 11378, and Environmental Protection Agency Regulations (40 CFR, Part 15), which prohibits the use under non-exempt federal contracts, grants, or loans of facilities included on the EPA list of violating facilities. The provision shall require reporting of violations to the Texas Education Agency and to the USEPA Assistant Administrator for Enforcement (EN-329).

Contracts shall recognize mandatory standards and policies relating to energy efficiency which are contained in the State energy conservation plan issued in compliance with the Energy Policy and Conservation Act (P.L.94-163).

END OF SUPPLEMENTARY CONDITIONS

SECTION 01 00 00

GENERAL REQUIREMENTS

1. Work Included: Furnishing of all coordination, labor, superintendence, materials, tools, cranes, equipment and sources necessary for the complete installation or modification of the following systems as shown on the plans and as herein specified. It is the intent of these specifications that the Contractor shall furnish and install a system complete in every respect and ready to operate. All miscellaneous items and accessories required for such installation and for the correct and convenient operation of the entire installation whether or not each such item or accessory is shown on the plans or mentioned in these specifications shall be furnished and installed. Drawings and Division 0 apply to this Section.
2. Codes, Standards, and Permits: Comply with all local requirements. All work shall be in strict accordance with all applicable laws and codes, including but not limited to the following:
 - a. National Electrical Code; Latest Edition
 - b. Occupational Safety and Health Administration Standards including (but not limited to) OSHA Standard 2207 - Construction Industry Standards
 - c. Applicable State Codes & Laws
 - d. City Codes and Code Modifications, & Adopted Codes & Ordinances.
 - e. National Fire Protection Association
 - f. Texas Department of Health
 - g. Standard Building Code - 1994 Edition
 - h. Vernon's Law - State of Texas
 - i. Standard Mechanical Code - 1994 Edition
 - j. Standard Plumbing Code - 1994 Edition
 - k. Environmental Protection Agency
 - l. Standard Gas Code - 1994 Edition
 - m. Texas Department of Labor Boiler Rules and Regulations
 - n. NFPA 90A
 - o. American Society of Heating, Refrigerating, and Air Conditioning Engineers.
 - p. Clean Air Act and Amendments.

Nothing in the plans or specifications shall be construed to permit work not conforming to these codes. In all cases of difference between minimum requirements of the various laws, codes and authorities, it is intended that the work shall meet the more stringent requirements.

The Contractor shall procure all necessary permits or licenses to carry out his work and pay the lawful fees therefore; he shall also obtain and pay for all the necessary certificates of approval which must be delivered to the Owner before final acceptance of the work.

The Contractor and Subcontractors shall contact the City and obtain and verify all codes, ordinances, and regulations before beginning work. The Contractor and Subcontractors are responsible for complying with all codes, ordinances, and regulation requirements, and ensuring that current codes are used.

3. Guarantee: The Contractor shall guarantee his work against defective materials and workmanship for a period of one year from date of acceptance of the job. Neither the final payment nor any provisions in Contract documents shall relieve the Contractor of the responsibility for faulty materials and workmanship; he shall remedy any defects due

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thereto, and pay for any damage to other work resulting therefrom, which shall appear within a period of one year from date of substantial completion.

4. Submittals: The Contractor shall submit to the Engineer for review six copies of the material to be used on this job. This submittal shall include all data as well as the manufacturer's name and catalog number.

The review of such plans shall not relieve the Contractor of responsibility for deviation from the Contract plans or specifications.

Shop drawings and samples per General Conditions. Contractor shall submit shop drawings and samples accompanied by transmittal forms.

Construction schedule per General Conditions shall be submitted.

5. Project Closeout:

Cleaning Up: Upon completion of the work, remove surplus materials and rubbish of every kind from the site of the work.

Documents Required Prior to Final Payment: Prior to final payment, and before the issuance of a final certificate for payment in accordance with the provisions of the NSPE General Conditions, file the following notarized papers with the Engineer.

Documents:

Final Certificate for Payment

Contractor's Affidavit of Payment of Debts and Claims (AIA G706)

Contractor's Affidavit of Release of Liens (AIA G706A)

Release of Claims and Waiver of Lien for Subcontractor, Materialmen or Material Fabricators.

Guarantees: The guarantee required by the General Conditions and any other extended guarantee stated in the technical sections of the specifications. Start date of warranty shall be the date of final completion.

Operation and Maintenance Manuals: Furnish as specified under the various sections of the Specifications.

Asbestos certification letter that no asbestos was provided in this project.

Project Record Documents: As the work progresses, keep a complete and accurate record of changes or deviations from the Contract Documents and the shop drawings, indicating the work as actually installed. Changes shall be neatly and correctly shown on the respective portion of the affected document, using blue line prints of the Drawings affected or the Specifications, with appropriate supplementary notes. This record set of Drawings, shop drawings, and Specifications shall be kept at the job site for inspection by the Engineer and Owner.

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The records above shall be arranged in order, in accordance with the various sections of the specifications, and properly indexed. At the completion of the work, certify by endorsement thereon that each of the revised prints of the Drawings and Specifications is complete and accurate. Prior to application for final payment, and as a condition to its approval by the Engineer and Owner, deliver the record set of Drawings and Specifications, arranged in proper order, indexed, and endorsed as hereinbefore specified.

No review or receipt of such records by the Engineer or Owner shall be a waiver of any deviation from the Contract Documents or the shop drawings or in any way relieve the Contractor from his responsibility to perform the work in accordance with the Contract Documents and the shop drawings to the extent that they are in accordance with the Contract Documents.

6. The project site shall be kept free of accumulation of surplus materials and rubbish during construction. Upon the completion of the project all debris shall be removed and the site shall be left clean. During the school term the contractor and subcontractors shall clean-up daily the area where work is performed. If it is necessary for the school to clean up after the contractor or subcontractor, the Owner reserves the right to keep track of costs and bill the Contractor. The Contractor and Subcontractors shall cooperate with the school.

7. Asbestos:
Asbestos work is specifically excluded from this contract. The Contractor and Subcontractors shall communicate directly and separately from the Engineer with Owner in all decisions involving asbestos or whether a material is asbestos.

8. The Division 0, Division 23, Division 26, and General Provisions Division - 1 supplement and modify the Contract Documents and shall form a part of the Contract and all Subcontracts.

9. The project site shall be cleaned-up before final inspection and payment.

10. All trades shall have proper licenses as required by the City where the project is located. It is the responsibility of the General Contractor to verify that all subcontractors have proper required licenses.

11. Special Site Conditions:

- a. All work is to be carried out as quietly and dust free as possible. Noise, vibration, and disturbance shall be kept to a minimum and work shall be accomplished in accordance with local ordinances. Keep the premises free of accumulations of surplus materials and rubbish, and in an orderly condition at all times.
- b. In the event any work is accomplished during the school year when classes are in session, or during office hours, work shall be conducted in a manner that will not interfere with, be disruptive, or distracting to the classes or office. Contractor work schedules during the school term and office hours shall be coordinated with the Owner's representative. Entrance to buildings after school hours or during times when the building is normally closed is the responsibility of the Contractor. The Contractor is responsible for obtaining keys or coordinating with school personnel to obtain access and to secure the building. The Contractor shall become familiar with space limitations and traffic patterns.

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The campus custodians are charged with having their buildings clean and ready for school each day. The Contractor will be cognizant of this important factor and make every effort to complete each area of construction in a timely manner to allow the campus custodians to move in and complete their work. Contractor is responsible for cleaning of their own related work.

- c. Work accomplished during the non-regular school term and hours shall be coordinated with Owner's Representative for building security, and routine school cleaning and maintenance. Contractors shall coordinate and cooperate with Owner to ensure building is ready for the next scheduled use. The Contractor shall be responsible for building security and coordinating security with Owner's Representative. The Contractor shall coordinate and cooperate with any school activities and schedule.
- d. The Owner reserves the right to have their personnel and other Contractors working in the building. The Owner reserves the right to partially occupy the building in completed areas prior to Completion.
- e. Keep public areas such as halls, stairs, etc. free from accumulation of waste and construction debris. Smoking or open fires will not be permitted within the building enclosure or on the premises.
- f. Use of the existing toilets within the building by the Contractor, and his personnel will not be permitted.
- g. Maintain the building in a safe and weather tight condition at all times.

12. Protection of Owner's Operations:

The Contractor is herewith advised that his operations and the operations of any and all subcontractors will be required to be coordinated with the Owner. Other services shall be limited to non-school hours. Temporary outages of electrical power and plumbing shall be limited to non-school hours.

All buildings are equipped with burglar alarm systems. Any work to be done during off hours will require notification of the Owner's representative three (3) days prior in order for the Owner to arrange for disarming and rearming of burglar systems.

Should the Contractor damage Owner's utility lines or apparatus and the Owner be called to make timely repairs, the Contractor will be invoiced based upon current Owner's overtime expenses.

13. Contractor's Affidavit:

After completion of the work contemplated by this Contract, the Contractor shall file with the Owner his affidavit, sworn to before a Notary Public, stating that all workmen and persons employed, all firms supplying the materials and all subcontractors upon the project have been paid in full and that there are no bills outstanding against the project for either labor or materials, except certain items, if any, to be set forth in such affidavit covering disputed claims.

The filing of such affidavit by the Contractor shall be prerequisite to the making by the Owner of the final payment to the Contractor.

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- 1 14. Exposed conduit will not be allowed in occupied areas or spaces. Exposed conduit will not
2 be allowed in the halls below the ceiling. Exposed conduit in normally unoccupied areas will
3 be permitted only after approval of Engineer and Owner. Any exposed conduit permitted
4 shall be wiremold.
5
- 6 15. This project shall be accomplished in a neat and good workmanship manner using accepted
7 methods. Wiring, panels, etc. shall be neat and orderly in appearance. Loose, tangled wires,
8 etc. will not be accepted. The final work shall be complete and finished.
9
- 10 16. Each Contractor and Subcontractor is responsible for cleaning up and removing their own
11 debris, dust, trash, etc. Any damage to the school or school equipment or school supplies
12 requiring repair shall be accomplished by Contractor or Subcontractor doing damage.
13 Spillage, over spray, collections of dust and debris, and damage to Owner occupied spaces
14 shall be cleaned or remedied immediately by the responsible trade. Clean up all surfaces,
15 remove equipment, salvage and debris, and return in condition suitable for use by the Owner
16 as quickly as possible.
17
- 18 17. Asbestos and asbestos containing materials will not be allowed in this project. Upon
19 completion of the project the Contractor and all Subcontractors shall provide Owner with a
20 letter stating that no asbestos and asbestos containing materials were provided at the
21 projects.
22
- 23 18. All wiring shall be in metallic conduit. Conduit on the roof shall be an absolute minimum.
24
- 25 19. CONTINGENCY ALLOWANCE - To be included in Base Bid (See Bid Form). This
26 allowance is for contingencies and shall only be spent on prior written approval of Owner
27 and Engineer. At the end of the contract, unused contingency allowance shall be returned
28 to the Owner. Contingency allowance (dollars) and other allowances (dollars) may be
29 moved from one allowance to another allowance at the sole discretion of the Owner and
30 Engineer, and without any penalty to the Owner.
31
- 32 20. Cutting and Patching.
33
- 34 "Cutting and patching" includes cutting into existing construction to provide for the
35 installation or performance of other work and subsequent fitting and patching required to
36 restore surfaces to their original condition.
37
- 38 "Cutting and patching" is performed for coordination of the work, to uncover work for access
39 or inspection, to obtain samples for testing, to permit alterations to be performed or for other
40 similar purposes.
41
- 42 Do not cut structural members.
43
- 44 21. Schedule, Reports, Meetings, and Payments.
45
- 46 Contractor shall provide and keep current a construction schedule.
47
- 48 Contractor shall prepare a schedule of values on AIA forms. Payment schedule may be
49 submitted no more than one per month.
50

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After completion date, no partial payments will be made until all work is one-hundred percent complete and accepted by Engineer and Owner.

22. Temporary construction and support facilities required for the project include but are not limited to the following:

Sanitary facilities (school facilities shall not be used by contractor personnel)
Drinking water
Temporary enclosures and barricades as required
First aid station
Project identification, bulletin boards and all required local, state and federal signs
Waste disposal services
Rodent and pest control
Construction aids and miscellaneous general services and facilities
All excavation shall be properly filled at the end of each work day.

Security and protection facilities and services for the project include but are not limited to the following:

Temporary fire protection
Barricades, warning signs, lights
Environmental protection
The Contractor shall not use the school telephones.
Any temporary heat required.

Hoists: The Contractor, when required, shall install and operate hoists for proper execution of work. Location of hoists shall be approved by the Owner.

23. Protection of Roof

The Contractor and Subcontractors shall accomplish the work in such a manner so as to protect the roof. The Contractor shall be responsible for any damage to the roof.

24. Protection of Carpet, Other Floor Coverings, Lockers, All Surfaces of School, School Equipment & School Property

25. Protect the building and contents (security, rain, etc.) at all times. Provide all materials and labor.

The Contractor shall protect all school surfaces, school equipment, and school property. Any damage shall be repaired or replaced. Contractor shall also protect from scratches. Contractor shall protect carpet, other floor coverings, lockers, all surfaces, all school equipment and all school property. Contractor shall instruct all employees and subcontractors to protect the school. Any ceilings or ceiling tiles damaged shall be replaced with identical.

26. The Contractor shall be responsible for and insure that the mechanical equipment, controls, and electrical work are fully compatible and coordinated.

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27. Quality Control & Workmanship

Maintain quality control and supervision over subcontractors, suppliers, manufacturers, products, services, site conditions, and workmanship to produce work of specified quality. Perform all work to the level of quality by Standards in individual Specification Section. All work may be inspected by the Engineer and Owner's Representative for compliance with approved submittals and level of quality specified. The Work, or any part of the Work, deemed unsuitable or below the required level quality by the Engineer or Director of Maintenance shall be replaced or repaired by the Contractor at no additional cost to the Owner.

Comply with industry standards required for high quality commercial and institutional buildings, except when more restrictive tolerances or specified requirements indicate more rigid standards or more precise workmanship. Perform work by persons qualified to produce workmanship of specified quality. Secure products in place with positive anchorage devices designed and sized to withstand stresses, vibrations, and racking.

28. Fire Protection

The Contractor and Subcontractors shall be responsible for providing temporary fire protection, and accomplishing work in a fire prevention manner. The Contractor shall be solely responsible for means and methods.

29. Telephone

The Contractor shall not make any long distance phone calls on school phones. Use of Owner's telephone is not allowed.

30. Pre-Construction Site Visit With Owner

Prior to start of the work a pre-construction meeting consisting of the Engineer, Owner, Contractor, Subcontractors, and others determined appropriate shall be held to establish basic project understanding and clarify project questions.

Contractor shall make a pre-construction site visit with Owner and note any existing damage in work areas. Contractor shall be responsible for any damage to school property, building, equipment, furnishings, site or school items.

31. All components, devices, and systems shall be U.L. listed.

32. Parking Lots

Prior to starting work, the Contractor shall coordinate with the Owner any work being accomplished on the parking lots. Coordinate scheduling and access. Contractor shall conduct on-site visit with Owner to inspect parking lots and observe all existing conditions. Contractor and subcontractors shall not damage parking lots. Any damage as a result of Contractor or subcontractors shall be repaired or replaced to the Owner's satisfaction and specifications. Coordinate any trenching across parking lots with Owner/Engineer before starting work. Include all pavement, sidewalk, site, etc. repair/replacement work in base bid.

END OF SECTION

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SECTION 01 02 00

ALLOWANCES

PART 1 - GENERAL

1.1 SUMMARY

A. All work accomplished by allowances shall be complete and turn-key.

1.2 SECTION INCLUDES

A. Include in contractor sum allowances sates in Contract Documents.

B. Designate in construction progress schedule delivery dates for products specified under each allowance.

C. Designate in Schedule of Values quantities of materials required under each allowance.

1.3 ALLOWANCES FOR PRODUCTS

A. Amount of Each Allowance Includes:

1. Cost of Product to Contractor or subcontractor, less any applicable trade discounts.
2. Delivery to site.
3. Labor required under allowance.

B. In addition to amount of each allowance, include in contract sum Contractor's cost for:

1. Handling at site, including unloading, uncrating, and storage.
2. Protection from elements and from damage.
3. Labor for installation and finishing.
4. Other expenses required to complete installation.
5. Contractor's and Subcontractor's overhead and profit.

1.4 SELECTION OF PRODUCTS UNDER ALLOWANCES

A. Engineer's Duties:

1. Consult with Contractor in consideration of Products and suppliers or installers.
2. Make selection in consultation with Owner. Obtain Owner's written decision, designating:
 - a. Product, model and finish.
 - b. Accessories and attachments.
 - c. Supplier and installer as applicable.
 - d. Cost to Contractor, delivered to site or installed, as applicable.
 - e. Manufacturer's Warranties.
3. Transmit Owner's decision to Contractor.
4. Prepare Change Orders.

B. Contractor's Duties:

1. Obtain proposals from suppliers and installers when requested by Engineer.
2. Make appropriate recommendations for consideration of Engineer.
3. Notify Engineer promptly of:
 - a. Any reasonable objections Contractor may have against any supplier, or party under consideration for installation.
 - b. Any effect on Construction Schedule anticipated by selections under consideration.

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1.5 CONTRACTOR RESPONSIBILITY FOR PURCHASE, DELIVERY AND INSTALLATION

- A. On notification of selection, execute purchase agreement with designated supplier.
- B. Arrange for and process Shop Drawings, Product Data and Samples, as required.
- C. Make arrangements for delivery.
- D. Upon delivery, promptly inspect products for damage or defects.
- E. Submit claims for transportation damage.
- F. Install and finish products in compliance with requirements of referenced specification sections.

1.6 ADJUSTMENT OF COSTS

- A. Should net cost be less than specified amount of allowance, contract sum will be adjusted accordingly by Change Order.
 - 1. Amount of Change Order will recognize any changes in handling costs at site, labor, installation costs at site, labor, installation costs, overhead, profit and other expenses caused by selection under allowance.
 - 2. For products specified under unit costs allowance, unit cost shall apply to quantity listed in Schedule of Values.
 - 3. For products specified under unit allowance, unit cost allowance shall apply to quantities actually used with nominal amount for waste, as determined by receipts, invoices or field measurements.
- B. Submit any claims for anticipated additional costs at site, or other expenses caused by selection under allowance, prior to execution of work.
- C. Submit documentation for actual additional costs at site, or other expenses caused by selection under allowance within 60 days after completion of execution or Work.
- D. Failure to submit claims within designated time will constitute waiver of claims for additional costs.
- E. At contractor closeout, reflect approved changes in contract amounts in final statement of accounting.

1.7 CONSTRUCTION CONTINGENCY

- A. Following shall apply to construction contingency allowance:
 - 1. It shall be used only to cover cost of hidden, concealed or otherwise unforeseen conditions that develop during project.
 - 2. Work which is clearly changed in scope shall be authorized and paid for only by means of change order executed in accordance with established procedures.
 - 3. Bidder shall include in his base bid on project his profit and overhead to cover amount of contingency; as each contingency authorization is processed, it will not include any profit or overhead for Contractor.
 - 4. Contractor shall proceed with accomplishing work only after receiving properly executed contingency authorization executed by Engineer.
 - 5. Contractor shall not bill Owner for any work authorized by this procedure until work has been accomplished.
 - 6. Any part of contingency allowance which is not used during construction of project shall be returned to Owner.

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7. At completion of project, Engineer will reconcile all work accomplished through properly executed contingency allowance authorizations, and provide for refund of any unused portion of contingency to Owner through properly executed change order.

PART 2 - PRODUCTS

- A. Not used.

PART 3 - EXECUTION

3.1 SCHEDULE OF ALLOWANCES

- A. Section 01 02 00 - Construction Contingency Allowance: SEE BID FORM

END OF SECTION

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SECTION 02 07 00

SELECTIVE DEMOLITION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of contract, including General and Supplementary Conditions, Division 1, and Division 0 Specification sections, apply to work of this section.

1.2 DESCRIPTION OF WORK

- A. Extent of selective demolition work is indicated on drawings.
- B. Types of Selective Demolition Work. Demolition requires the selective removal and subsequent off-site disposal in a legal manner of the following items but not limited to:
 - 1. Removal of selective piping and items.
 - 2. Removal of Rooftop Units, equipment, ductwork etc. as shown on plans.
 - 3. Other items shown on plans, and required for new installation.
 - 4. Other items required for installation of work. Replace as required and necessary.
 - 5. Other items not needed for new installations.
 - 6. Related Work specified elsewhere:
 - 7. EMCS contractor is to remove all EMC devices.
- C. Remodeling construction work and patching is included within the respective sections of specifications, including removal of materials for re-use and incorporated into remodeling or new construction.
- D. Relocation of pipes, conduits, ducts, other mechanical and electrical work are specified by respective trades.
- E. Should any asbestos-containing material be encountered, Contractor shall stop work immediately and contact Owner and Owner's Representative before proceeding with work. The cost of asbestos abatement and removal is not included as part of this contract. The Owner will provide separate Contractors for this work should it be required. However, should the Contractor fail to comply with above stated requirement he will be charged the costs incurred by the Owner for the asbestos clean-up process as a result of the Contractor's actions which disturb any asbestos containing materials. Contact Owner regarding any asbestos information.

1.3 SUBMITTALS

- A. Schedule:
 - 1. Submit schedule indicating proposed methods and sequence of operations for selective demolition work to Owner's Representative for review prior to commencement of work. Include coordination for shut-off, capping, and continuation of utility services as required, together with details for dust and noise control protection.
- B. Provide detailed sequence of demolition and removal work to ensure uninterrupted progress of Owner's on-site operations.
- C. Coordinate with Owner's occupation of portions of existing building.

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1.4 JOB CONDITIONS

A. Occupancy:

1. Owner may be continuously occupying areas of the building. Conduct selective demolition work in manner that will minimize need for disruption of Owner's normal operations. Provide minimum 72 hours advance notice to Owner of demolition activities which will severely impact Owner's normal operations.

B. Condition of Structures:

1. Owner and Engineer assumes no responsibility for actual condition of times or structures to be demolished.

1.5 Partial Demolition and Removal

- A. Items indicated to be removed but of salvable value to Contractor may be removed from structure as work progresses. Transport salvage items from site as they are removed.

1. Storage and sale of removed items on-site will not be permitted.

1.6 Protections

- A. Provide temporary barricades and other forms of protection as required to protect Owner's personnel and general public from injury due to selective demolition.

- B. Provide protective measures as required to provide free and safe passage of Owner's personnel and general public to and from occupied portions of building.

- C. Erect temporary covered passageways as required by authorize having jurisdiction.

- D. Provide interior and exterior shoring, bracing, or support to prevent movement, settlement, or collapse or structure or element to be demolished, and adjacent facilities or work to remain.

- E. Protection from damage existing finish work that is to remain in place and becomes exposed during demolition operations.

- F. Protect floors with suitable coverings when necessary.

- G. Protect all equipment, furnishings and college property.

- H. Construct temporary insulated solid dustproof partitions where required to separate areas where noisy or extensive dirt or dust operations are performed. Equip partitions with dustproof doors and security locks if required.

- I. Provide temporary weather protection design interval demolition and removal of existing construction on exterior surfaces, and installation of new construction to insure that no water leakage or damage occurs to structure or interior areas of existing buildings.

- J. Remove protections at completion of work.

1.7 Damages

- A. Promptly repair damage caused to adjacent facilities by demolition work at no cost to Owner.

1.8 Traffic

- A. Conduct selective demolition operations and debris removal in a manner to ensure minimum interference with roads, streets, walks, and other adjacent occupied or used facilities.

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1
2 1.9 Explosives

- 3
4 A. Use of explosives will not be permitted.
5

6 1.10 Utility Services

- 7
8 A. Maintain existing utilities keep in service, and protect against damage during demolition
9 operations.
10
11 B. Do not interrupt existing utilities serving occupied or used facilities, except when authorized in
12 writing by authorized having jurisdiction. Provide temporary services during interruptions to
13 existing utilities, as acceptable to governing authorities.
14

15 1.11 Environmental Controls

- 16
17 A. Comply with governing regulations pertaining to environmental protection.
18
19 B. Do not burn on the site.
20

21
22 PART 2 - PRODUCTS - (Not Applicable)
23

24
25 PART 3 - EXECUTION
26

27 3.1 PREPARATION

- 28
29 A. Cease operations and notify the Owner's representative immediately if safety of structure
30 appears to be endangered. Take precautions to support structure until determination is made
31 for continuing operations.
32
33 B. Cover and protect furniture, equipment and fixtures to remain from soiling or damage when
34 demolition work is performed in rooms or areas from which such items have not been
35 removed.
36
37 C. Erect and maintain dust-proof partitions and closures as required to prevent spread of dust or
38 fumes or occupied areas or areas not involved in renovation work.
39
40 D. Provide weatherproof closures for exterior openings from demolition work.
41
42 E. Protection of Roof - The Contractor and Subcontractors shall accomplish work in such a
43 manner to protect roof. Do not roll equipment across roof. Contractor shall be responsible for
44 any damage to roof.
45

46 3.2 Demolition

- 47
48 A. Perform selective demolition work in a systematic manner. Use such methods as required to
49 complete work indicated on Drawings in accordance with demolition schedule and governing
50 regulations.
51
52 B. Demolish concrete and masonry in small sections. Cut concrete and masonry at junctures with
53 construction to remain using power-driven masonry saw or hand tools; do not use power-
54 driven impact tools.
55

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- C. Locate demolition equipment throughout structure and promptly remove debris to avoid imposing excessive loads on supporting walls, floors or framing.
- D. Provide services for effective air and water pollution controls as required by local, state, and federal authorities having jurisdiction.
- E. If unanticipated mechanical, electrical or structural elements which conflict with intended function or design are encountered, investigate and measure both nature and extent of the conflict. Submit report to Owner's Representative in written accurate detail. Pending receipt of directive from Owner's Representative rearrange selective demolition schedule as necessary to continue overall job progress without delay.

3.3 Disposal of Demolition Materials

- A. Remove debris, rubbish and other materials resulting from demolition operations from building site. Transport and legally dispose of materials off site.
- B. If hazardous materials are encountered during demolition operations, comply with applicable regulations, laws and ordinances concerning removal, handling and protection against exposure or environmental pollution. If asbestos is encountered, do not disturb. Contact Engineer and Owner.
- C. Burning of removed materials is not permitted on project site.
- D. Refrigerants shall not be released to the environment.

3.4 Clean-Up and Repair

- A. Upon completion of demolition work, remove tools, equipment and demolished materials from site. Remove protections and leave interior areas broom clean.
- B. Repair demolition performed in excess of that required. Return structures and surfaces to remain to condition existing prior to commencement of selective demolition work. Repair adjacent construction or surfaces soiled or damaged by selective demolition work.

END OF SECTION

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SECTION 09 50 00

ACOUSTICAL CEILING SYSTEMS

PART 1 - GENERAL

1.1 SECTION INCLUDES:

A. Contractor to reuse existing ceiling tile. In the event that the existing ceiling tile is broken, misplaced or soiled use the following specifications. Match existing ceiling tile.

B. Acoustical ceiling systems.

1.2 RELATED SECTION:

A. Selective Demolition - Section 02 07 00.

1.3 REFERENCES:

A. ASTM C367 - Strength Properties of Prefabricated Architectural Acoustical Materials.

B. ASTM C423 - Sound Absorption of Acoustical Materials.

C. ASTM C523 - Light Reflectance of Acoustical Materials by the Integrating Sphere Reflectometer.

D. ASTM C635 - Metal Suspension System for Acoustical Tile and Lay-In Panel Ceilings.

E. ASTM C636 - Recommended Practice of Installation of Metal Ceiling Suspension Systems for Acoustical Tile and Lay-In Panels.

F. ASTM E84 - Surface Burning Characteristics of Building Materials.

G. FS SS-S-118B - Sound Controlling Blocks and Boards (Acoustical Tile and Panels, Prefabricated).

1.4 SUBMITTALS:

A. Product Data: Submit manufacturer's product data sheets for each product.

B. Certificates: Submit certification attesting compliance with fire endurance rating and flame spread index of fire rating organization.

1.5 QUALITY ASSURANCE:

A. Applicator: Minimum of 3 previous project installations of comparable size.

1.6 DELIVERY, STORAGE AND HANDLING:

A. Deliver materials in factory packages with factory labels attached indicating brand, pattern, size and fire rating as applicable.

B. Store acoustical materials at normal room temperature in a protected enclosure having a stabilized moisture content.

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1.7 PROJECT CONDITIONS:

- A. Environmental Requirements: In areas to receive acoustical materials, maintain humidity of 65-75% and temperature of 55°F-75°F, 24 hours before, during, and after installation.
- B. Coordination: Coordinate installation with other work including installation of drywall systems, diffusers and grilles and light fixtures.

PART 2 - PRODUCTS

2.1 CEILING BOARD - TYPE AC-1:

- A. Qualities: Mineral acoustical board, Class 25:
 - 1. Pattern: Non-directional fissured.
 - 2. Noise Reduction Coefficient (NRC): .50-.60, ASTM C423.
 - 3. Light Reflectance: LR-1, over 75%, ASTM C523.
 - 4. Size: 5/8 in. x 24 in. x 24 in. or 24 in. x 48 in.
 - 5. Finish: Factory painted white vinyl latex finish to match existing.
 - 6. Edge: Square.
- B. Standard: FS SS-S-118B, Type III.
- C. Source: Armstrong World Industries, Inc., USG Acoustical Products Co., or Celotex Corp.

2.2 EXPOSED LAY-IN SUSPENSION SYSTEM:

- A. Qualities: Exposed tee grid system, intermediate-duty classification:
 - 1. Main and cross tees fabricated of cold-rolled steel, electro-galvanized and factory painted low sheen satin white finish. 15/16 in. exposed flange.
 - 2. Edge molding, 0.020 in. steel, channel or angle shaped, 15/16 in. exposed flange, paint finish to match grid.
 - 3. Provide 0.020 in. steel special closures.
 - 4. Hold down clips by suspension system manufacturer.
 - 5. Maximum deflection: 1/360 span.
- B. Standard: ASTM C635.
- C. Source: Chicago Metallic Corp., National Rolling Mills, Armstrong World Industries, Inc. or USG Interiors, Inc.

2.3 RELATED MATERIALS:

- A. Hanger Wire: Minimum 12 ga., galvanized, soft-annealed, mild steel wire.

PART 3 – EXECUTION

3.1 EXAMINATION:

- A. Examine areas with school personnel for conditions that would affect quality and execution of work. Do not proceed until defects are corrected.
- B. Ceiling height to be determined by Engineer.

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3.2 INSTALLATION - GENERAL:

- A. Install suspension systems in accordance with ASTM C636.
- B. Minimum width of border tile or board allowed: one-half unit width.
- C. Install ceiling true to line and level with maximum variation of 1/8 in. in 12 ft. in any direction.

3.3 INSTALLATION - EXPOSED GRID SYSTEM:

- A. Space main tees at 48 in. o.c., suspend from structure with hanger wire spaced at 48 in. o.c. Install additional hanger wires at ends of each suspension member and at each corner of light fixtures.
- B. Space cross tees at 24 in. o.c., connect to main tees. Rest main and cross tees on wall moldings.
- C. Rigidly brace entire system in both directions. Leave bottom surface of members flush and level.
- D. Install ceiling board in level plane bearing on suspension members. Neatly cut out board around other work installed in ceiling.

3.4 ADJUSTING AND CLEANING:

- A. Replace damaged members of exposed suspension system.
- B. Replace ceiling material that is damaged, installed improperly, or shows visible signs of sagging.
- C. Clean soiled areas of ceiling material with mild soap and water. Replace material damaged by improper cleaning.

END OF SECTION

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DIVISION 23 - HEATING, VENTILATING, AND AIR-CONDITIONING (HVAC)

23 00 00	Basic Mechanical Requirements
23 00 90	HVAC Submittal Procedures
23 05 29	Hangers and Supports for HVAC Piping and Equipment
23 05 33	Roof Curb Adapters
23 05 53	Identification for HVAC Piping and Equipment
23 05 93	Testing, Adjusting, and Balancing for HVAC
23 07 13	Duct and Grille Insulation
23 07 21	Refrigerant Piping Insulation
23 09 23	Energy Management Control System (BACnet)
23 09 23G	Sequence of Operations Rooftop Unit Sequences
23 09 23H	Sequence of Operations Split System Sequences
23 23 00	Refrigerant Piping
23 31 13	Metal Ductwork
23 33 33	Access Doors
23 43 23	Bipolar Ionization Air Purification System
23 81 19	Packaged HVAC Units
23 81 26	Split System HVAC Units
23 82 27	Small Capacity Split System Units

SECTION 23 00 00

BASIC MECHANICAL REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions, and Division 01 Specifications apply to this Section.

1.2 SECTION INCLUDES

- A. Basic mechanical requirements necessary to provide complete installation of all Division 23 work.

1.3 WORK INCLUDED

- A. This section of work comprises furnishing of all materials, equipment, tools, scaffolding, rigging, hoisting, labor, and transportation necessary for the complete installation of the mechanical systems as shown on the plans and as specified herein.
- B. Bidders shall determine the contents of a complete set of drawings and specifications and be aware that they may be bidding from a partial set of drawings, applicable only to the various separate contracts, subcontracts, or trades as may be issued for bidding purposes only. The contract documents and the complete scope of work for the project are illustrated on the combined Architectural, Structural, Plumbing, Heating, Ventilating, Air Conditioning, and Electrical, and each Bidder shall thoroughly acquaint himself with all the details of the complete set of drawings and specifications before submitting his bid. All drawings and specifications form a part of the contract documents for each separate contract and shall be considered as bound therewith in the event partial sets of plans and specifications are issued for bidding only. The submission of bids shall be deemed evidence of the review and examination of all drawings, specifications, and addenda issued for this project as no allowances will be made because of unfamiliarity with any portion of the complete set of documents.

1.4 CODES AND REFERENCE STANDARDS

- A. General:
 - 1. Perform all Division 23 work in strict accordance with the requirements and recommendations stated in all the latest editions of the applicable state codes, national building codes and local ordinances.
 - 2. Nothing in the Contract Documents shall be construed to permit work not conforming to these codes.
 - 3. When two or more codes or standards are applicable to the same work, then the stricter code or standard shall govern.
 - 4. The date of the code or standard that is in effect on the date of issue of the contract documents except when a particular publication date is specified.
 - 5. The Contractor shall be held responsible for verifying all local codes and ordinances that may alter any part of the plans or specifications. The Contractor shall bear all costs for correcting the deficiencies.
 - 6. Where local codes and ordinances are not in writing or on record, but a local precedence has been set, the Owner shall pay for any additional cost incurred.
- B. Applicable Codes and Standards for All Division 23 Work:

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1. International Building Code
2. International Gas Code
3. International Plumbing Code
4. International Mechanical Code
5. International Energy Conservation Code
6. National Electrical Code
7. American Society of Heating, Refrigerating and Air Conditioning Engineers Standards.
8. Occupational Safety and Health Administration Standards:
 - a. OSHA Standard 2207 - Construction Industry Standards
 - b. OSHA 29 CFR 1926 - Regulation of Excavation
 - c. All other applicable standards
9. National Fire Protection Association:
 - a. NFPA 90A - Installation of Air Conditioning and Ventilating Systems
10. Clean Air Act and Clean Air Act Amendments
11. State Codes:
 - a. All other applicable codes
12. Local Municipal Codes and Ordinances

1.5 SCHEDULE OF ABBREVIATIONS

- A. Reference Standards are listed in Section 23 using abbreviations listed below:
1. AABC (NSTSB) - Associated Air Balance Council
 2. AASHTO - American Association of State Highway and Transportation Officials
 3. ADA - Americans with Disabilities Act
 4. ADC - Air Diffusion Council
 5. A/E - Architect/ Engineer
 6. AGA - American Gas Association
 7. AMCA (DIR) - Air Moving and Conditioning Association
 8. ANSI - American National Standards Institute
 9. AHRI - Air-Conditioning and Refrigeration Institute
 10. ASHRAE - American Society of Heating, Refrigerating and Air-Conditioning Engineers
 11. ASME - American Society of Mechanical Engineers
 12. ASPE - American Society of Plumbing Engineers
 13. ASTM- American Society for Testing and Materials
 14. AWE - American Welding Society
 15. AWWA - American Water Works Association
 16. CGA - Compressed Gas Association
 17. CISPI - Cast Iron Soil Pipe Institute
 18. CS - Commercial Standard
 19. CSA - Canadian Standards Association
 20. DIPRA - Ductile Iron Pipe Research Association
 21. DOT - Department of Transportation
 22. DOC - Department of Commerce
 23. FCC - Federal Communications Commission
 24. FM - Factory Mutual
 25. FS - Federal Specification
 26. GSHPA - Ground Source Heat Pump Association
 27. IBC - International Building Code
 28. ITL - Independent Testing Laboratories
 29. NEC - National Electric Code
 30. NFPA - National Fire Protection Association
 31. NSF - National Sanitation Foundation
 32. OSHA - Occupational Safety and Health Administration
 33. PDI - Plumbing and Drainage Institute
 34. SMACNA - Sheet Metal and Air Conditioning National Association
 35. UBC - Uniform Building Code

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36. UL - Underwriters Laboratories

1.6 QUALITY ASSURANCE

- A. Provide complete installations of all systems.
- B. Furnish all items of equipment, material, and labor to complete the Contract even though each and every item necessary is not specifically mentioned or shown.
- C. In case of any conflict between the specifications, plans, and ordinances, the ordinances shall govern.
- D. All materials furnished under this Contract shall be new, free from defects of any kind, of the quality and design hereinafter specified, and shall conform to the standards of Underwriter's Laboratories Inc., except for equipment which U.L. does not list or provide label service.
- E. All mechanical equipment and fixtures shall be the same brand unless scheduled differently on plans.
- F. Contractor's Responsibility:
 - 1. Contractor assumes all responsibility regarding the safety of his personnel on the project during construction.
 - 2. Erect barricades, protective fencing, and signs to prevent injury to personnel on site.
 - 3. Make permanent connection to utilities or existing lines. Determine depth and location, and bid accordingly.
 - 4. Relocate and repair any existing lines cut by general construction work.
 - 5. Pay all costs in connection with metering devices.
 - 6. Plans do not show exact location and elevations of lines, nor do they show all offsets required.
 - 7. Deviate from plans as required to conform to the general construction and provide proper grading.
 - 8. Maintain all utility services during construction to existing portions of job that remain.
 - 9. Procure and pay for all necessary permits or licenses to carry out the work.
 - 10. Obtain and pay for all the necessary certificates of approval which must be delivered to the Architect/Engineer before final acceptance of the work.
 - 11. Periodically remove rubbish, clean or repair all surfaces marred by the work required under this contract.
 - 12. Protect work from damage by other trades.
 - 13. Make all tests required by law; pay all costs in connection with the testing.
 - 14. Where job conditions require changes in indicated locations and arrangement, make such changes without extra cost to Owner.
 - 15. Provide motor starters, controls, relays, all low-voltage wiring, conduit and wiring related to HVAC and other equipment and devices to form a complete working system.

1.7 DEFINITIONS

- A. Approval:
 - 1. It is understood that approval must be obtained from the Architect/Engineer in writing before proceeding with the proposed work.
 - 2. Approval by the Architect/Engineer of any changes, submitted by the Contractor will be considered as general only to aid the Contractor in expediting his work.
- B. Contractor:
 - 1. The Contractor engaged to execute the work included in a particular section only, even though he may be technically described as a Subcontractor to the General Contractor.
 - 2. If the Contractor engaged to execute said work employs Sub-Contractors to perform various portions of the work included under this Section, he shall be held responsible for the execution of same, in full conformity with Contract Document requirements.

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3. The Contractor shall cooperate at all times and shall be responsible for the satisfactory cooperation of his Subcontractors with the other Contractors on the job so that all of the various phases of the work may be properly coordinated without unnecessary delays or damage to any parts of the work of any Contractor.
- C. Provide:
 1. Defined as requiring the furnishing and installing of the item or facility indicated, complete in all respects, and ready for operation unless otherwise specifically noted.
- D. As Required:
 1. Indicates that the Contractor shall perform the work or provide the material as indicated in accordance with manufacturer's installation instructions; and in accordance with applicable codes or regulations; and in a workmanlike manner as defined by good local practice.
- E. Or Equal:
 1. Indicates that the Contractor may substitute equipment by another manufacturer if the salient features of the equipment indicated by manufacturer's name and/or described are, in the judgment of the Architect/Engineer, adequate. Submittals for approval are required where indicated.
- F. Intent of Contract Documents:
 1. The specific intent of these documents is to provide to the Owner, in a thoroughly functional condition, all the various systems, equipment, etc., indicated herein. Final authority over interpretation of the "intent" shall rest with the Architect/Engineer.

1.8 WARRANTY

- A. The Contractor shall warranty his work against defective materials and workmanship for a period of one year from the date of acceptance of the job.
- B. Neither the final payment nor any provisions in Contract Documents shall relieve the Contractor of the responsibility for faulty materials or workmanship.
- C. He shall remedy any defects due thereto, and pay for any damage to other work resulting therefrom, which shall appear within a period of one year from date of substantial completion.
- D. The Owner shall give notice of observed defects with reasonable promptness.
- E. This Guarantee shall not be construed to include the normal maintenance of the various components of the system covered by these specifications.

1.9 SITE VISIT

- A. Before submitting his proposal, each bidder shall examine all plans and specifications relating to the work, shall visit the site of the project and become fully informed of the extent and character of the work required.
- B. No consideration will be granted for any alleged misunderstanding of the materials to be furnished or the amount of work to be done, it being fully understood that the tender of a proposal carries with it the agreement to all items and conditions referred to herein, or indicated on the accompanying plans or required by nature of the site of which may be fairly implied as essential to the execution and completion of any and all parts of the work.

1.10 PROJECT RECORD DOCUMENTS

- A. The Contractor shall keep a set of plans on the job, noting daily all changes made in connection with the final installation including exact dimensioned locations of all new and uncovered existing utility piping outside the building.

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- B. Upon submitting his request for final payment, he shall turn over to the Architect/Engi, for subsequent transmittal to the Owner, a clean, neatly marked set of reproducible plans showing "as installed" work and an electronic file with changes of materials.
- C. In addition to the above, the Contractor shall accumulate during the job's progress the following data, in duplication (2 each), prepared in 3 ring binders of sufficient size, black in color, neat in appearance, and turned over to the Architect/Engineer for checking and subsequent delivery to the Owner. Electronic copies of the following are also acceptable, but they must be saved to a single flash drive or external hard drive:
 - 1. All warranties, guarantees, and manufacturer's directions on equipment and material covered by the Contract.
 - 2. Approved fixture brochures.
 - 3. Copies of approved shop drawings.
 - 4. Set of operating instructions. Operating instructions shall also include recommended maintenance and seasonal changeover procedures.
 - 5. Any and all other data and/or plans required during construction.
 - 6. Repair parts lists of all major items and equipment including name, address, and telephone number of local supplier or agent.
- D. The first page, or pages, shall have the names, addresses, and telephone numbers of the following:
 - 1. General Contractor and all sub-contractors.
 - 2. Major Equipment Suppliers.

1.11 TRAINING

- A. Upon completion of the work and at a time designated by the Owner's representative, provide a formal training session for the Owner's operating personnel to include location, operation, and maintenance of all mechanical equipment and systems, some sections have further instructions.
- B. Before proceeding with instruction, prepare a typed outline in triplicate listing the subjects that will be covered. Submit the outline for review by the Owner's representative.
- C. At the conclusion of the instruction, obtain the signatures of the attendees on each copy of the outline to signify that they have a proper understanding of the operation and maintenance of the system. Submit the signed outlines to the Owner's representative and Engineer as a condition of final acceptance.

1.12 PLANS AND SPECIFICATIONS

- A. The plans show diagrammatically the locations of the various lines, ducts, conduits, fixtures, and equipment and the method of connecting and controlling them.
- B. It is not intended to show every connection in detail and all fittings required for a complete system.
- C. The systems shall include but are not limited to the items shown on the plans.
- D. Exact locations of these items shall be determined by reference to the general plans and measurements of the building and in cooperation with other contractors, and in all cases, shall be subject to the approval of the Architect/Engineer.
- E. The Architect/Engineer reserves the right to make any reasonable change in the location of any part of this work without additional cost to the Owner.
- F. Contractor, subcontractor, vendors, and suppliers are required to waive subrogation against Owner and Engineer.

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1.13 UTILITIES, LOCATIONS, AND ELEVATIONS

- A. Locations and elevations of the various utilities within the scope of this work have been obtained from the City and/or other substantially reliable sources and are offered separately from the Contract documents, as a general guide only, without guarantees as to accuracy.
- B. The Contractor shall examine the site, shall verify to his own satisfaction the locations, elevations and availability of all utilities and services required, and shall adequately inform himself as to their relation to the work; the submission of bids shall be deemed evidence thereof.
- C. The Contractor shall coordinate all services with the Utility Companies during construction, coordinate changes made by Utility Companies to the design of project, and coordinate with the Owner, Architect/E, and Utility the scheduling of any shutdowns or delays that may occur in providing service.
- D. The Contractor shall verify location, conduct all necessary tests, inspections, coordinate with Owner's representatives and utilities, and check for existing underground utilities and lines before ditching.
- E. The Contractor shall be responsible for repair of any cut or damaged lines or utilities he uncovers. There are lines and utilities not shown on any plans.

1.14 SUBSTITUTION OF PRODUCTS

- A. Substitution of products specified herein will be considered only when a complete list of proposed alternative equipment is submitted to the Engineer in writing, supported by adequate technical and cost data. This includes a complete description of the proposed substitution, drawings, catalog cuts, performance data, test data, or any other data or information necessary for evaluation.
- B. All proposed substitutions and data must be received by the Engineer no less than seven working days prior to the scheduled date for opening of bids.
- C. The Engineer will consider all such submittals and the Architect/Engineer will issue an addendum listing items which the Engineer considers acceptable. Only such items as specified or approved as acceptable will be installed on this project.
- D. Manufacturers' names are listed herein and on the plans to establish a standard of quality and design. Where a manufacturer's name is mentioned, products of other manufacturers will be acceptable, if, in the opinion of the Engineer, the substitute material is of equivalent quality or better than that of the material specified.
- E. The Contractor's Bid represents that the bid price is based solely upon the materials and equipment described in the Bid Documents (including addenda, if any) and that he contemplates no substitutions or extras.
- F. Requests for substitution are understood to mean that the Contractor:
 - 1. Has personally investigated the proposed substitution and determined that it is equal or superior in all respects to that specified.
 - 2. Will provide the same guarantee for the substitution that he would for that specified.
 - 3. Will, at no cost to the Owner, replace the substitute item with the specified product if the substitute item fails to perform satisfactorily.
 - 4. After Award of the Contract, substitutions will be considered only under one or more of the following circumstances:
 - a. The substitution is required for compliance with subsequent interpretations of code or insurance requirements.

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- b. The specified product is unavailable through no fault of the Contractor.
 - c. The manufacturer refuses to warranty the specified products as required.
 - d. Subsequent information that the specified product is unable to perform properly or to fit in the designated space.
 - e. In the Engineer's sole judgment, the substitution would be in the Owner's best interest.
5. Revisions to the mechanical system shall be under the supervision of the Engineer at a standard hourly rate charged by the Engineer and shall be paid by the Contractor originating the changes.

1.15 PROTECTION OF EQUIPMENT AND MATERIALS

- A. Contractor shall continuously maintain adequate protection of both stored and installed materials and equipment. Fixtures and equipment, whether located inside or outside, shall be tightly covered with sheet polyethylene or waterproof tarpaulin as protection against dirt, rust, moisture and abuse from other trades. Adequate air circulation shall be provided under any protective sheet to prevent condensate build up. Materials and equipment shall not be stored directly on the ground, floor or roof deck. Ductwork, piping and equipment shall not be used by other trades as supports for scaffolds or personnel. At the completion of the work, equipment, fixtures, exposed supports and piping shall be cleaned of dirt, construction debris, overspray, etc., to the satisfaction of the Architect/Engineer. Repairs made necessary by damage shall be paid for by the Contractor.
- B. Contractor in performing his work shall take particular care not to damage the structure. All finished floors and step treads shall be covered to prevent any damage by workmen or their tools and equipment during the construction of the building. In addition, each Contractor shall protect any materials on the job site whether a part of this contract or the property of another Contractor.
- C. Contractor shall be responsible for damage to project caused by this Contractor's failure to recognize hazards associated with items such as leaks, scheduling of work, inexperienced workmen, excessive cutting, etc.
- D. Contractor shall familiarize himself with working conditions to the extent that he shall be responsible for damage to concealed piping, wiring and other equipment to remain and shall repair any damage caused by his negligence at no cost to the Owner.
- E. The Contractor shall take such precautions as may be necessary to properly protect his apparatus from damage.
- F. This shall include the creation of all required temporary shelters to adequately protect any apparatus above the floor of the construction and the covering of apparatus in the completed building with tarpaulins or other protective covering.
- G. Failure to comply with the above to the satisfaction of the Owner's inspector will be sufficient cause for the rejection of the equipment in question and its complete replacement by this Contractor.
- H. All apparatus shall be cribbed up from the floor or ground by the Contractor and covered with tarpaulins or other protective covering where necessary or directed.
- I. Each contractor shall provide space for storage of materials, equipment or tools at ground level. Any storage contemplated within the building will be allowed only upon specific approval of the Architect/Engineer.

1.16 FINAL INSPECTION

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- A. It shall be the duty of this Contractor to make a careful inspection trip of the entire project, assuring himself that the work on the project is ready for final acceptance before calling upon the Architect/Engineer to make a final inspection.
- B. To avoid delay of final acceptance of the work, the Contractor shall have all necessary bonds, warranties, receipts, affidavits, etc., called for in the various articles of these specifications, prepared and signed in advance, together with a letter of transmittal, listing each paper included, and shall deliver the same to the Architect/Engineer at or before the time of said final inspection. The Contractor is cautioned to check over each bond, receipt, etc., before preparing for submission to verify that the terms check with the requirements of the specifications.

1.17 ASBESTOS

- A. No asbestos or asbestos containing materials shall be permitted in this project.

1.18 CUTTING AND PATCHING

- A. All Subcontractors shall notify the General Contractor sufficiently ahead of construction of any floors, walls, ceiling, roof, etc., of any openings that will be required for his work.
- B. He shall see that all sleeves required for his work are set at proper times so as to avoid delay of the job.
- C. All necessary cutting of walls, floors, partitions, ceilings, etc., as required for the proper installation of the work under this Contract shall be done at the Subcontractor's expense in a neat and workmanlike manner, and as approved by the Architect/Engineer.
- D. No joists, beams, girders, or columns shall be cut by any Contractor without first obtaining written permission of the Architect/Engineer.
- E. Patching of openings and/or alterations shall be provided by the General Contractor.
- F. All openings in firewalls and floors shall be completely sealed after installation for a completely airtight installation. Sealing material shall be non-combustible and UL approved. The installed sealing assembly shall not cause the fire rating of the penetrated structure to be decreased.
- G. All openings in exterior walls shall be sealed watertight.

1.19 MANUFACTURER'S INSTRUCTIONS

- A. All equipment and devices shall be stored, protected and installed in accordance with these plans and specifications, manufacturer's instructions, and applicable codes.
- B. Where specifications call for installation of a product to be in accordance with manufacturer's instructions and/or where manufacturer's instructions are required for installation of a product, it shall be the contractor's responsibility to obtain the necessary applicable manufacturer's instructions and install the product in accordance with the manufacturer's instructions.
- C. It shall be the Contractor's responsibility to install all equipment, materials, and devices shown on the plans and as called out in these specifications even if manufacturer's instructions are absolutely unattainable.
- D. Any such work performed that does not comply with the manufacturers' directions shall have deficiencies corrected at no cost to the Owner.

1.20 RELATED WORK

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- A. Whether specifically identified or not, it is the responsibility of the Mechanical Contractor to coordinate all mechanical work with all related trades.

1.21 ELECTRICAL WIRING AND EQUIPMENT FOR MECHANICAL SYSTEMS

- A. All wiring, conduit, boxes, equipment (controls, thermostats, relays, contactors, motor starters, heaters, switches), and any other control devices or equipment required to form a complete and properly operating system, shall be the responsibility of the Mechanical Contractor.
- B. The Electrical Contractor shall only provide line voltage (including hook-up) to all mechanical equipment.
- C. All mechanical controls and devices shall be low voltage unless otherwise noted or shown on the plans. Where line voltage controls or devices are noted, the Contractor shall provide complete wiring diagrams (approved by the Engineer) to the Electrical Contractor prior to final hook-up.
- D. All electrical resistance heating elements which are scheduled to be served by three-phase electrical power shall impose an equal electrical load on all phases. Electrical resistance elements which are not balanced over all three phases are not acceptable.
- E. The Mechanical and Electrical plans are based on the equipment and devices scheduled as shown on the plans or as called for in the specifications. Should any mechanical equipment or device be changed or approved from those which are shown or noted, all electrical and/or mechanical changes shall be made at the expense of the trade or contractor initiating the change with no expense to the Owner, Architect, Engineer or their representatives.
- F. All wiring provided by this Contractor shall be installed in a workmanlike manner using tie wraps, labels, anchors and etc. Loose wiring is not acceptable.
- G. All conduit and boxes required in all walls for control purposes (thermostats, etc.) shall be provided by electrical contractor. All conduit required in attic, clear spaces, or on roof shall be by mechanical contractor.

1.22 DEMOLITION AND REMODEL

- A. It shall be the responsibility of this Contractor to see that all demolition and remodeling work involving his trade (including but not limited to chilled and hot water piping used for space cooling and heating, condensate lines, air handlers, mechanical equipment, etc.) is accomplished in a manner and completeness to provide the appearance of new construction work.
- B. Abandoned air conditioning units shall be removed and disposed of off-site in a legal manner.
- C. Any usable equipment and/or structure damaged during demolition and remodel work shall be replaced.
- D. All abandoned and/or otherwise unused piping shall be securely capped using materials of the same composition as the original piping.
- E. No exposed piping and/or other materials will be permitted in the finished job.
- F. Any abandoned piping which penetrates the slab in an exposed area shall be securely capped below the slab.

1.23 OPERATION PRIOR TO COMPLETION

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- A. When any piece of mechanical or electrical equipment is operable and the Contractor needs to operate the equipment, he may do so providing that he properly supervises the operation.
- B. The warranty period shall, however, not commence until such time as the equipment is operated for the beneficial use of the Owner.
- C. Regardless of whether or not the equipment has or has not been operated, the Contractor shall properly clean the equipment, install clean filter media, properly adjust and complete all punch list items before final acceptance by the Owner.
- D. The date of acceptance and the start of the warranty may not be the same date.

1.24 SAFETY GUARDS

- A. Contractor shall furnish and install all safety guards required. All belt driven equipment, projecting shafts, and other rotating parts shall be enclosed or adequately guarded.

1.25 FLAME SPREAD PROPERTIES OF MATERIALS

- A. All materials and adhesives used for air conditioning filters, acoustical lining, and insulation shall conform to NFPA and UL life and flame spread properties of materials.
- B. The composite classifications shall not exceed the flame spread rating and the smoke development rating as outlined by NFPA 255/ ASTM E-84 for the basic material, the finishes, adhesives, etc., specified for each system, and shall be such when completely assembled.

1.26 FILTER ASSEMBLIES

- A. All filter housings and assemblies shall be factory built and supplied with the unit. A separate filter rack may be required and is the responsibility of the mechanical contractor to provide.
- B. Access doors (panels) must be opened to change the air filters shall be labeled "Filter Access" and the number and size of required filters shall be identified.
- C. No piping conduit etc. shall be installed in front of this access door.
- D. Install clean filters prior to substantial completion.
- E. All air handlers shall have filters installed upstream of all coils.

1.27 LEAD MATERIALS

- A. No lead or lead containing materials shall be allowed in any domestic or potable water supply piping, valves, fixtures, components, equipment, or any other item.

1.28 REFRIGERANTS

- A. Chlorofluorocarbons (CFCs) and Hydrochlorofluorocarbons (HCFCs) shall not be allowed in any equipment on this project.
- B. Comply with ASHRAE Standards 15 and 34.

1.29 REFRIGERANT RECOVERY AND RECYCLE

- A. Refrigerants shall not be released to the environment.
- B. Contractor shall provide recovery and recycle equipment that has been certified by the Electrical Testing Laboratories or Underwriters Laboratories.

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- C. Contractor shall also provide properly trained and certified (in accordance with EPA) personnel for refrigerant work during installation, demolition, start-up, servicing, etc.

1.30 ACCESS CLEARANCE

- A. Proper access to all installed equipment shall be provided. The Mechanical Contractor shall label all points of access immediately upon installation with a marker pen.
- B. A minimum of 3 feet shall be maintained in front of all access points.
- C. If another trade violates this space, the Mechanical Contractor shall immediately notify the General Contractor to correct this condition.
- D. When equipment is installed above lay-in ceiling the Mechanical Contractor shall coordinate with the Ceiling Contractor to provide access without removing part of T-bar ceiling.
- E. No speakers, lights, fire alarm equipment, etc. shall be installed in lay-in ceiling tiles where access is to be gained.

PART 2 PRODUCTS

2.1 MATERIALS

- A. All materials shall be new and free from defects at the time of installation. Materials or equipment damaged in shipment or otherwise damaged prior to installation shall not be repaired at the job site, but shall be replaced with new.

2.2 MANUFACTURERS REQUIREMENTS

- A. When a manufacturer's name appears in these specifications, it is not to be construed that the manufacturer does not have to meet the full requirements of the specifications or that his standard cataloged item will be acceptable.

PART 3 - EXECUTION

3.1 CONFLICTS, INTERFERENCES AND COORDINATION BETWEEN TRADES

- A. Drawings are not to be construed as shop drawings, but indicate the extent, general location, arrangement, etc., of piping systems and equipment. This Contractor shall refer to other sections of the specifications and other drawings such as electrical, structural, architectural, etc., in order to eliminate conflicts and undue delays in the progress of the work. Where other Contractors furnish items requiring piping connections by this Contractor, they will be held responsible for providing roughing-in drawings and assistance upon request.
- B. Each trade shall so harmonize its work with that of the other trades so that the work may be done in the most direct and workmanlike manner without hindering the other trades. Piping interference shall be handled by giving precedence to pipelines which require a stated grade for proper operation.

3.2 TESTING

- A. After all mechanical systems have been completed and put into operation, subject each system to an operating test under design conditions to ensure proper sequence and operation throughout the range of operation regardless of the season the contractor shall test all HVAC equipment in both heating and cooling modes.

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- B. Each and every phase of the new air conditioning, heating, and ventilating systems shall be operated separately, or in conjunction with the other, for a period of time, to demonstrate to the satisfaction of the Architect/Engineer the ability of the equipment to meet the capacity and performance requirements while maintaining design conditions in accordance with the true intent and purpose of these specifications.
- C. Previous to such performance tests, the Contractor shall have set all valves, dampers, motors, controllers, thermostats, etc., and shall have the system operating and maintaining design temperatures, humidity, and air circulation throughout all areas of the building.
- D. Make adjustments as required to ensure proper functioning of all systems.
- E. Special tests on individual systems are specified under individual sections.
- F. See Section 23 05 93 for Testing, Adjusting, and Balancing for HVAC.

END OF SECTION

SECTION 23 00 90

HVAC SUBMITTAL PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

- A. This section supplements Division 01 Submittal Procedures and contains additional requirements applicable to Division 23 submittals.

1.2 SECTION INCLUDES

- A. This section includes, but is not limited to:
 - 1. HVAC submittal procedures
 - 2. This section applies only to the Division 23 specifications. Submittals required by other specification divisions are not included here, even though the same subcontractor may be providing work under other divisions.

1.3 RELATED SECTION

- A. Division 01 - Submittal Procedures

1.4 DEFINITIONS

- A. Product Data: Illustrations, standard schedules, performance charts, instructions, and brochures furnished by the contractor, subcontractor, manufacturer, or supplier to illustrate materials or equipment or to illustrate some portion of the work. Provide a summary of scheduled items with all data in schedules.
- B. Shop Drawings: Drawings, diagrams, schedules, and other data specifically prepared for the work by the contractor, subcontractor, manufacturer, or supplier to illustrate some portion of the work.
- C. Equipment/Material Submittal Package: A compilation of the product data, shop drawings, and other items as required by the specifications, submitted near the start of the work. Typically, the specifications require the initial submittal package to be submitted within a certain number of days after the work starts.
- D. Quality Assurance Submittal: Items submitted before and during the execution of a particular portion of the work for the purpose of guarding against defects and deficiencies.
- E. Quality Control Submittal: Items submitted at the completion of a particular portion of the work for the purpose of evaluating completed activities and elements of the work for conformance with contract requirements (e.g. start-up reports).
- F. Closeout Submittals: Items submitted at or near the completion of the contract.

1.5 SUBMITTALS

- A. The materials, workmanship, design, and arrangement of all work installed under this contract shall be subject to the review of the architect, engineer, and owner. Review of shop drawings and/or submittal data shall not relieve the Contractor of responsibility for deviations from the contract drawings or specifications.
- B. Manufacturers: Manufacturers submitted shall be as per the acceptable manufacturers listed in each specification section or referenced schedule.

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- C. Required Submittals: All material, components and equipment that fall under Division 23 shall be submitted.
- D. Contractor's Coordination Submittals: The contractor may require his subcontractors to provide drawings, setting diagrams, and similar information to help coordinate the project, but such data shall remain between the contractor and his subcontractors and will not be reviewed by the engineer.
- E. Electronic Submittals: E-mail or other electronic forms of submittals from the contractor are required. The procedures described in this section shall be as follows:
 - 1. The contractor shall supply one electronic copy of the submittal.
 - 2. The electronic files will either be e-mailed to the architect or posted to a project management and information exchange website, depending on the architect's requirements. The architect and contractor can distribute copies of the files as desired.
 - 3. The engineer will retain an electronic copy of the submittal and all responses.
- F. Coordination Correspondence: The contractor may desire to verify the acceptability of a particular item prior to assembling the initial submittal package. The contractor may send material directly to the engineer for comments and feedback. This communication will be treated as normal coordination correspondence and will not be tracked or documented as a formal submittal. The engineer may or may not respond to such correspondence. If the engineer agrees, in writing, to the use of a particular item, then that same material shall be included in the initial submittal package along with a copy of the correspondence.
- G. Unapproved Products: If materials or equipment are installed before being reviewed by the engineer, the contractor shall be liable for the removal and replacement of such unapproved materials and equipment, at no additional expense to the owner. Additionally, if the removal and replacement of rejected materials or equipment necessitates the removal and replacement of other related materials or equipment, then the contractor shall be liable for the removal and replacement of the related materials and equipment at no additional expense to the owner.
- H. Product Data: Where the content of manufacturer submittal literature includes data not pertinent to the submittal, clearly indicate which portions of the contents are being submitted for review. Catalogs, pamphlets, or other documents submitted to describe items on which review is being requested shall be specific and identifications in catalogs, pamphlets, etc., of items submitted shall be clearly made in a contrasting ink or highlighting. Data of a general nature shall not be acceptable.
- I. Shop Drawings:
 - 1. Contractor shall submit shop drawings showing all piping, ductwork and equipment shown by drawings and specification. Submit drawings on all mechanical rooms and congested areas. The drawings shall be coordinated with structural, electrical and fire sprinkler drawings. Submit prior to construction of work.
 - 2. Scale and measurements: Make shop drawings accurately to a scale sufficiently large to show all pertinent aspects of the item.
 - 3. Electronic shop drawing submittals are required.

PART 2 - PRODUCTS

2.1 NOT USED

PART 3 - EXECUTION

3.1 SUBMITTALS

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- A. Make submittals of product data, shop drawings, samples, quality assurance submittals, quality control submittals, and other items in accordance with the requirements of this section, applicable sections in Division 23, and additional requirements of each individual Division 23 specification section.
- B. Grouping of Submittals:
 - 1. The submittal package shall be coordinated and included in a single submission. Multiple submissions are not acceptable except where prior written approval has been obtained from the engineer. Partial submittals may be rejected, without being reviewed, as not complying with the provisions of the contract.
 - 2. In the case that multiple submissions are approved, it is the responsibility of the contractor to maintain and update a submittal checklist. The contractor shall ensure that all applicable submittal sections are submitted to the Engineer. If a submittal section is not submitted, it will be considered rejected until reviewed by the Engineer.
 - 3. If submittal sections are submitted as individual submittal files, the submittal sections will be grouped and returned as one file with one set of submittal responses.
- C. Electronic Submittal Organization:
 - 1. Electronic submittals are to be submitted as a single PDF file. Within the PDF file, each section shall be bookmarked.
 - 2. Provide an electronic submittal cover sheet that lists at least the following:
 - a. Project name
 - b. Date
 - c. Name and address of architect
 - d. Name and address of engineer
 - e. Name, address, and telephone number of prime contractor
 - f. Name, address, and telephone number of HVAC contractor
 - g. Name, address, and telephone number of HVAC supplier
 - 3. Provide an electronic index sheet listing all items submitted.
 - 4. The contractor shall call to the attention of the engineer, clouded in the submittal and noted after the index sheet, any instance in which the submittals are known to differ from the requirements of the contract documents.
 - 5. Organize all required items by specification section. The material for each specification section shall be organized as follows:
 - a. Provide an electronic section cover sheet that lists the same information as the submittal cover sheet, plus the specification number and title and the name, address, and telephone number of the vendor or vendor's representative, if applicable.
 - b. Refer to the individual Division 23 specification sections for any required organization of the submittal material within each submittal section.
 - c. Bookmarked sections shall be arranged by specification section number in numerical order.
 - d. Submit in accordance with these procedures and procedures described in Division 01 Submittal Procedures.
 - e. Submittals not organized as described here may be rejected, without being reviewed, as not complying with the provisions of the contract.
- D. Response to engineer's review:
 - 1. Review comments: Review comments of the engineer will either be shown on the returned sets to the contractor or shown on a document attached to the sets. If the comments are on an attached document, then the engineer will place a note on the submittal referring to the attached comments. In such cases, the engineer's signature will appear only on the attached document. If the attached, signed document becomes physically separated from the submittal, then the submittal will no longer be considered as being a reviewed submittal.

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2. Complete rejection: If the submittal is not complete or does not meet the requirements of this specification section, then the engineer may reject the entire submittal and return the submittal without further review or comment. In such cases, the entire submittal shall be completely revised and resubmitted. The resubmittal shall be given a new submittal number and shall be documented and processed as a separate submittal from the original.
 3. Held for completion: If the submittal is not complete, but is only missing some minor item, the engineer may, at the engineer's sole discretion, hold the submittal rather than rejecting and returning the submittal. In such cases, the engineer will notify the architect and contractor that the submittal is being held for completion. The contractor will be given a predetermined amount of time to provide the missing item. Upon receipt of the missing item, the engineer will insert the missing item into the submittal package and proceed with the review process.
 4. Partial rejection: The engineer may reject only certain portions of the submittal. In such cases, only those rejected portions or items need to be revised and resubmitted.
 5. Provide as noted and corrected: The engineer may note a required change to a submitted item, but may not consider the change serious enough to require a resubmittal. In such cases, the engineer will note that the item is to be provided as noted or corrected. In such cases, the contractor may proceed to provide the item. However, if subsequent observations reveal that the noted change was not made, then the contractor shall be liable for removal and replacement of the item at no additional cost to the owner.
 6. Reviewed without comment: The contractor may proceed to provide all materials and equipment as submitted.
- E. Close-out Submittals:
1. Provide close-out submittals and O&M's at or near completion of the contract.

END OF SECTION

SECTION 23 05 29

HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions, Division 1 Specifications, and Section 23 00 00, apply to this Section.

1.2 SECTION INCLUDES

- A. Isolation pads
- B. Concrete bases
- C. Expansion joints
- D. Other supports

1.3 RELATED SECTIONS

- A. Section 23 00 00 - Basic Mechanical Requirements
- B. Section 23 09 23 - Energy Management Control System
- C. Section 23 31 13 - Metal Ductwork
- D. Section 23 81 26 - Split System HVAC Units

1.4 SUBMITTALS

- A. Product Data:
 - 1. Provide submittal data on all items specified in this section in accordance with Section 23 00 90, General Conditions, and Division 1.
 - 2. Submit shop drawings and catalog data with locations of use.

1.5 REFERENCES

- A. Refer to Section 23 00 00 for complete names of references identified in this section.
- B. SMACNA Standards
- C. ASHRAE - American Society of Heating, Refrigeration and Air Conditioning Engineers

1.6 QUALITY ASSURANCE

- A. Isolation devices must be provided by a company whose sole business is to provide isolation equipment.
- B. All equipment and materials to be installed in workmanlike manner by experienced mechanics and as recommended by the manufacturers.
- C. Design Data: Complete design of isolation equipment including confirmation that no noise will be transmitted to structure of building.

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PART 2 - PRODUCTS

2.1 GENERAL

- A. Provide isolation and support devices as required for all mechanical equipment.

2.2 MANUFACTURERS

- A. Amber/Booth
- B. Anvil
- C. Kenetics
- D. Korfund Vibration Mountings
- E. Mason
- F. Peabody
- G. Vibro Acoustics

2.3 CONDENSING UNIT ISOLATION

- A. Provide isolation pad between unit and structure

2.4 FLEXIBLE DUCT CONNECTIONS

- A. Use "Ventglas" fabric, fireproof, waterproof, and mildew resistant, approximately 30 ounces per square yard.
- B. Comply with SMACNA standards.

2.5 HVAC PIPE SUPPORTS

- A. Hangers:
 - 1. All Copper Piping
 - a. Copper plated ferrous hangers.
 - 2. 2" and smaller piping in walls:
 - a. May be split cast ring type with fastening device in walls and chases.
 - 3. Trapeze Hangers for Multiple Pipes
 - a. Steel channels with welded spacers and hanging rods
 - 4. All Other Above Ceiling Locations:
 - a. Adjustable clevis type. Hangers to accommodate circumference of pipe and saddles.
- B. Vertical Supports:
 - 1. Wall support for 3" or smaller diameter pipe:
 - a. Cast iron hooks
 - 2. Wall support for 4" or larger diameter pipe:
 - a. Welded steel bracket and wrought steel clamp
- C. Floor Supports:
 - 1. Cast iron adjustable pipe saddle, lock, nut, nipple, floor flange, concrete pier or steel support
- D. Hanger Rods:
 - 1. Type:

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- a. Minimum 3/8 inch diameter with machine threads.
- E. Minimum Steel Hanger Rod Diameter for Individually Suspended Horizontal Pipes:
 - 1. 2" and smaller diameter pipe:
 - a. 3/8"
 - 2. 2-1/2" to 3-1/2" diameter pipe:
 - a. 1/2"
 - 3. 4" diameter pipe:
 - a. 5/8"
 - 4. 5" to 6" diameter pipe
 - a. 3/4"
 - 5. 8" to 12" diameter pipe or larger:
 - a. 7/8"

2.6 SLEEVES

- A. Application:
 - 1. Provide sleeves for all pipes and conduits which pass through a concrete slab, masonry wall/concrete wall, roof, or other portion of the building structure. Each pipe and duct, regardless of material, which passes through a concrete slab, masonry wall, roof or other portion of the building structure shall be free from the structure and shall pass through a sleeve.
 - 2. After installation of pipe and duct through sleeves, all sleeves shall be sealed with materials suitable for maintaining thermal resistance, acoustic properties, and weatherproofing of walls, roofs, etc.
- B. Above Grade and/or dry locations:
 - 1. Material:
 - a. 18 gauge galvanized steel.
 - 2. Size:
 - a. As necessary to allow free passage of the insulated pipe.
- C. Passing through fire-rated enclosures:
 - 1. Material:
 - a. Fire stopped using approved materials to maintain the fire rating of the structure
 - b. Galvanized or black steel pipe.
 - c. Non-combustible.
 - d. PVC will not be allowed.

PART 3 - EXECUTION

3.1 ISOLATION DEVICES AND PAD INSTALLATION

- A. Install isolation pads between floor and equipment pads according to manufacturer's recommendations and approved shop drawings.
- B. Install flexible duct connections where ducts connect to fans or air handling units.
- C. All joints to be airtight.
- D. Provide a minimum of 1/2" slack in connections, and a minimum of 2 1/2" distance between the edges of ducts.
- E. Comply with recommendations of ASHRAE for the selection and application of vibration materials and units.

3.2 SECURING AND SUPPORTING OF HVAC PIPING

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- A. Support all pipe from the building structure by means of approved hangers and supports while maintaining required grade and pitch, preventing vibration and providing for expansion and contraction.
- B. Secure all hangers to approved inserts wherever possible.
- C. Set hanger inserts in place when the concrete is poured.
- D. If Joists Are Used for Attachment:
 - 1. 2" diameter or smaller:
 - a. May be attached to the bottom of joists.
 - 2. Greater than 2" diameter:
 - a. Must be attached to the top cord of the joists.
 - 3. Do not support any piping and trapeze hangers from joist bridging on roof and floor deck.
- E. If Structural Steel Framing Is Used for Attachment:
 - 1. Use approved beam clamps.
 - 2. Where required, install channels to span between framing members.
 - 3. Do not attach hangers to the roof deck or cross bracing.
- F. Change of Direction:
 - 1. Install supports within two feet of change of direction.
 - 2. Brackets of approved type may be used along the walls.
 - 3. Install hangers within 2 feet of each change in vertical or horizontal direction, pipe tees and on each side of valves, strainers, etc.
 - 4. Multiple horizontal pipes, smaller than 12" diameter pipe, may be supported on trapeze hangers. Space trapeze hangers in accordance with the schedule for pipe spacing based upon the smallest size pipe.
 - 5. Properly size the trapeze members for the piping load they are to support. The number of pipes on the trapeze must be approved by the Engineer to prevent overloading of the building structure.
 - 6. Where pipes are insulated, oversize the hanger accordingly to accommodate the outside diameter of the insulation. Provide half-round 16 gauge galvanized steel shields, not less than 12" long and rolled to fit the insulation diameter, between the insulation and the hanger.
 - 7. When pipe is guided at top and bottom, cover the entire pipe circumference with metal shields.
 - 8. Adhere metal shield to the insulation so that the metal will not slide with respect to the insulation.
 - 9. Wood struts shall not be used to support piping in walls.

3.3 SLEEVES

- A. Above Grade and/or Dry Locations:
 - 1. Walls:
 - a. Mount flush on both sides.
 - 2. Floors:
 - a. Mount 2 inches above finished floor in pipe chases.
- B. Passing Through Fire-Rated Enclosure:
 - 1. Fill the void space around the pipe in accordance with NFPA requirements.
 - 2. Do not allow the sleeve installation to lower the fire rating of the assembly.

END OF SECTION

SECTION 23 05 33

ROOF CURB ADAPTERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions, Division 1 Specifications, and Section 23 00 00, apply to this Section.

1.2 SECTION INCLUDES

- A. Roof curb adapters for packaged rooftop HVAC units and roof mounted fans.

1.3 RELATED SECTIONS

- A. Section 23 00 00 - Basic Mechanical Requirements
- B. Section 23 81 19 - Packaged HVAC Units

1.4 REFERENCES

- A. ASTM A-446, 525, and 527

1.5 SUBMITTALS

- A. Product Data: Submit manufacturer's product data sheets, including installation instructions, in accordance with Section 23 00 90, General Conditions, and Division 1.
- B. Shop Drawings: Submit for prefabricated equipment supports in accordance with Section 23 00 90.

PART 2 - PRODUCTS

2.1 ROOF CURB ADAPTERS FOR PACKAGED ROOFTOP HVAC UNITS AND ROOF MOUNTED FANS

- A. Type: Prefabricated insulated, self-contained curb adapters.
- B. Material: Minimum 18 gauge prime galvanized steel.
- C. Construction:
 - 1. Designed to support weight of the equipment.
 - 2. Welded corners.
 - 3. Seams joined by continuous water and airtight welds.
 - 4. Include necessary block-offs to allow use of existing ductwork.
 - 5. Insulated and internally reinforced with T-bars 36" on center.
- D. Manufacturer/Model:
 - 1. HVAC Manufacturer
 - 2. ThyCurb
 - 3. TECO Metal Products
 - 4. Rooftop Systems

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- E. Contractor and manufacturer to verify all existing rooftop units and roof mounted fans. Contractor and manufacturer shall ensure proper fit between existing rooftop equipment base and new rooftop unit and fabricate curb adapter so that any slope in the existing roof curb is accounted for, and all equipment is installed level.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that substrates are smooth and clean to extent needed for work.

3.2 INSTALLATION

- A. General:
 - 1. Install prefabricated roof curb adapters securely between new equipment and old roof curbs.
 - 2. Install work watertight, without waves, warps, buckles, fastening stresses or distortion.
 - 3. Allow for expansion and contraction.
 - 4. Coat contact surfaces of dissimilar metals with zinc chromate paint.

END OF SECTION

SECTION 23 05 53

IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions, Division 01 Specifications, and Section 23 00 00, apply to this Section.

1.2 SECTION INCLUDES

- A. Identification required for mechanical systems.
- B. Code required identification not shown on plans nor specified herein shall be provided.

1.3 RELATED SECTION

- A. Section 23 00 00 - Basic Mechanical Requirements

1.4 SUBMITTALS

- A. Provide submittal data on all items specified in this section in accordance with Specification Section 23 00 90, General Conditions, and Division 01.
- B. Submit wording of nameplates with submittals.
- C. Submit a list of all products incorporated in this section.

1.5 REFERENCES

- A. Comply with ANSI A13.1
- B. USAS Code B31.8
- C. NTSB-PSS-73-1
- D. AGA

1.6 DESCRIPTION OF WORK

- A. Nameplates and tags are to be provided for all mechanical equipment and piping in the project. Identification is also required for the following, but is not limited to:
 - 1. Air Handlers
 - 2. Boilers/Water Heaters
 - 3. Condensing Units
 - 4. Duct Dampers
 - 5. Filter Sizes for Air Handlers
 - 6. Fire Dampers
 - 7. Heat Exchangers
 - 8. Outside Air Units
 - 9. Piping
 - 10. Pumps
 - 11. Starters
 - 12. Supply/Exhaust Fans
 - 13. Valves

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PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Seton
- B. Brady
- C. MSI

2.2 EQUIPMENT LABELS

- A. Type: Engraving-Stock, melamine plastic laminate, 3 layer.
 - 1. Thickness:
 - a. Less than 25 square inches: 1/16 inch
 - b. 25 square inches or more: 1/8 inch
- B. Color:
 - 1. Black
- C. Conform to FS L-P-387A

2.3 LETTERING

- A. Style:
 - 1. Engraved standard print.
- B. Size:
 - 1. 3/16 inch to 1/4 inch
- C. Color:
 - 1. White letters, black background

2.4 NAMEPLATE/TAG INFORMATION

- A. HVAC Equipment:
 - 1. Unit mark from Drawings/Owner
 - 2. Voltage - Phase
 - 3. Manufacturer and Model Number
 - 4. Filter size

2.5 NAMEPLATE FASTENERS

- A. Securely attach nameplates to equipment with non-corroding stainless steel screws.
- B. In addition to name plate tags on HVAC equipment, provide and install 1/2" diameter nameplate marker (color to be approved by A/E), and apply to T-bar ceiling below any mechanical equipment and fire dampers above lay-in ceiling.
- C. Non-corroding pop rivets are acceptable.
- D. Stick-ons or adhesives will not be allowed.

2.6 IDENTIFICATION OF PRODUCTS

- A. Provide pipe markers with the following features.
 - 1. Letters from 1/2" to 3-1/2"; size letters to afford readability from the appropriate viewing position.

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2. Repeated and reversed words for viewing from 360o around pipe.
 3. Self-clinging, coiled markers that snap into place around pipe and do not require any other securement.
 4. Integral directional arrows.
- B. Letters on Field:
1. Identify the specific material conveyed. (i.e. "Domestic Cold Water", "Sprinkler", etc.)
- C. Model:
1. Less than 3/4":
 - a. Tags: Piping System Devices, color codes for hazard.
 2. 3/4" up to 6"; snap-on.
 3. Over 6"; strap-on, with stainless steel spring straps.
 4. Use tags and/or nameplates that are scratch resistant and UV resistant for outdoor equipment and piping.
- D. Piping System Devices (Valves, Thermometers, Pressure Gages, etc., and Pipe Less Than 3/4"):
1. Identify with the following:
 - a. Tags:
 - 1) Not less than 1-1/2 inch brass or aluminum tags, round, square, or octagonal.
 - b. Stamp tags with minimum 1/2" high descriptive characters, 1/2" high numbers with black enamel-filled indentations.
- E. Attachment:
1. Stainless steel or solid brass jack chain, or stainless steel or brass "S" hooks
- F. Ductwork:
1. Stenciled letters or self-adhesive labels, minimum 1" high characters.
 2. Red ribbon at each balancing damper.
- G. Underground Gas Piping:
1. Attach No. 18 gauge copper tracer wire to the piping and terminate above grade at each end.
- H. Pipeline Markers for Pipe Beneath Pavement and Slabs:
1. Minimum 2" round, square, or octagonal, same as specified in Subparagraph: Piping System Devices.
- I. Attachment:
1. 1-1/2" screw, bolted to tag as anchor.
 2. Anchor Setting Compound:
 - a. Epoxy or epoxy grout, compatible with the pavement.

PART 3 - EXECUTION

3.1 GENERAL

- A. Contractor shall verify room numbers with Owner/Engineer before nameplates are fabricated.
- B. The following shall be permanently and clearly identified:
1. Each air handler, condensing unit, compressor, exhaust fan, and pump.
 2. Each zone duct, outside air duct, and return air duct whose duty is not immediately apparent.
 3. Each valve whose service and/or duty is not immediately apparent.
 4. Every piping system

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3.2 INSTALLATION

- A. Install signs on non-removable panels. Attach to equipment with pop rivets or stainless steel screws.
- B. Mount in an easily visible location.
- C. All labeling identification shall conform to final room numbers. Coordinate with General Contractor, A/E, and Owner to secure construction room numbers.
- D. In addition to name plate tags on HVAC equipment, provide and install 1/2" diameter nameplate marker (color to be approved by A/E), and apply to T-bar ceiling below any mechanical equipment and fire dampers above lay-in ceiling.
- E. Provide all additional signage required by local authority at no cost to the Owner.
- F. Provide filter sizes and quantity on all air handlers.
- G. Complete installation in accordance with ANSI A13.1 and manufacturer's installation instructions and with the Drawings. Fasten each unit securely in place with stainless steel screws.
- H. Equipment Labeling:
 - 1. Install on scheduled items of equipment, including the following:
 - a. Air conditioning equipment
 - b. Pumps
 - c. Control panels and major control components
 - d. Include Mark Number and descriptive name from Drawing and Specification schedules
 - e. Attach with corrosion resistant, stainless steel screws or pop rivets
- I. Piping System Color Coding:
 - 1. Designate for painter the following:
 - a. Types of piping services
 - b. Direction of flow
 - c. Other information required for proper identification.
- J. Surfaces to be Painted:
 - 1. Bare piping
 - 2. Insulation covering of insulated piping
- K. Piping System Devices (Valves, Thermometers, Pressure Gages, etc.):
 - 1. Identify with the following information:
 - a. System
 - b. Device number
 - c. Device Function
- L. Device Chart:
 - 1. Key devices to device chart
 - 2. Give complete description of device function and system.
- M. Key devices to drawings as follows:
 - 1. Floor plans
 - 2. Schematic drawings of piping systems

END OF SECTION

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SECTION 23 05 93

TESTING, ADJUSTING, AND BALANCING FOR HVAC

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions, Division 1 Specifications, and Section 23 00 00, apply to this Section.

1.2 SECTION INCLUDES

- A. Testing and balancing services for the heating, ventilating, and air conditioning (HVAC) systems of this project.
- B. The testing and balancing agency will be responsible for the satisfactory execution of testing and balancing of the HVAC systems.
- C. The following are acceptable agencies:
 - 1. Complete System Balance
 - 2. Delta-T, Inc.
 - 3. Engineered Air Balance
 - 4. PHI Service Agency, Inc.
 - 5. Air Balancing Company, Inc.
 - 6. Elite Test and Balance, LLC
 - 7. ATCO EnviroAir Testing Engineers

1.3 RELATED SECTIONS

- A. Section 23 00 00 - Basic Mechanical Requirements
- B. Section 23 07 13 - Duct and Grille Insulation
- C. Section 23 09 23 - Energy Management Control System
- D. Section 23 31 13 - Metal Ductwork
- E. Section 23 34 16 - HVAC Fans
- F. Section 23 81 19 - Packaged HVAC Units
- G. Section 23 81 26 - Split System HVAC Units

1.4 STANDARDS

- A. The balancing agency shall perform the services specified herein in accordance with the Associated Air Balance Council's National Standards, including revisions, to the date of the contract.
- B. All terms in this specification shall have their meaning defined as stated in the National Standards.
- C. If these specifications set forth more stringent requirements than the AABC National Standards, these specifications shall prevail.

1.5 QUALIFICATIONS OF THE BALANCING AGENCY

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- A. The balancing agency shall be a member of the Associated Air Balance Council (AABC) and/or certified by the National Environmental Balancing Bureau (NEBB).
- B. To perform required professional services, the balancing agency shall have a minimum of one "Test and Balance Engineer" certified by the Associated Air Balance Council and/or the National Environmental Balancing Bureau (NEBB).
- C. This certified "Test and Balance Engineer" shall be responsible for supervision and certification for the total work herein specified.
- D. The balancing agency shall submit records of experience in the field of air and hydronic system balancing or any other data as requested by the Owner/Engineer. The supervisory personnel for the firm shall have at least five (5) years' experience, and be a full-time employee for a minimum of six (6) months prior to the project. All employees used in this project shall be qualified technicians in this specific field.
- E. The balancing agency shall furnish all necessary calibrated instrumentation to adequately perform the specified services. An inventory of all instruments and devices in possession of the balancing agency may be required by the Owner to determine the balancing agency's performance capability.
- F. The balancing agency shall have operated for a minimum of five (5) years under its current name.

1.6 DOCUMENTS

- A. The General Contractor will provide the balancing agency one copy of the following documents:
 - 1. Project drawings (mechanical sepia's if requested) and specifications.
 - 2. Reviewed construction revisions pertaining to the HVAC systems.
 - 3. Reviewed submittal data on HVAC equipment and systems to be installed by the Mechanical Subcontractor.
 - 4. Reviewed HVAC shop drawings.
 - 5. Reviewed HVAC wiring diagrams, control diagrams, and equipment brochures, as appropriate.

1.7 COORDINATION

- A. It will be necessary for the balancing agency to perform its services in close coordination with the Mechanical Subcontractor.
- B. The plans and specifications indicate meters, valves, dampers, and other devices for the purpose of adjusting the system to obtain optimum operating conditions. It will be the responsibility of the Mechanical Subcontractor to install these devices in a manner that will leave them accessible, readily adjustable, and complete. The balancing agency shall provide guidance if there is a questionable arrangement of a control or balancing device.
- C. The General Contractor, Mechanical Contractor, Temperature Controls Subcontractor, and the suppliers of the HVAC equipment shall all cooperate with the balancing agency to provide all necessary data on the design and proper application of the system components. In addition, they shall furnish all labor and materials required to eliminate any system deficiencies.

1.8 RESPONSIBILITIES OF THE MECHANICAL CONTRACTOR

- A. The Mechanical Contractor shall complete the installation and start all HVAC systems to ensure they are working properly and shall perform all other items as described hereinafter to assist the balancing agency in performing the testing and balancing of the HVAC systems.

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- B. Air Distribution Systems:
 - 1. Verify installation for conformity to design.
 - 2. Terminate all supply, return, and exhaust ducts, and pressure test them, for leakage, as required by specification.
 - 3. Ensure that all splitters, extractors, and volume and fire dampers are properly located and functional. Dampers serving requirements of minimum and maximum outside, return, relief, and exhaust air shall provide tight closure and full opening, with a smooth and free operation.
 - 4. Verify that all supply, return, exhaust, and transfer grilles; registers; diffusers; and high-pressure terminal units are installed and operational.
 - 5. Ensure that air-handling systems, units, and associated apparatus, such as heating and cooling coils, filter sections, access doors, etc., are blanked and/or sealed to eliminate excessive bypass or leakage of air.
 - 6. Ensure that all fans (supply, return, relief, and exhaust) are operating and free of vibration. All fans and drives shall be checked for proper fan rotation and belt tension. Overload protection shall be of proper size and rating. A record of motor current and voltage shall be made to verify that the motors do not exceed nameplate rating.
 - 7. Make any necessary changes to the sheaves, belts, and dampers, as required by the balancing agency, at no additional cost to the Owner.
 - 8. Install clean filters.
- C. Water Circulating Systems:
 - 1. Verify installation for conformity to design.
 - 2. Check all pumps to verify pump alignment and rotation.
 - 3. Ensure that systems are clean, with the proper strainer screens installed for normal operation.
 - 4. Check all pump motors for current and voltage, to ensure that motors do not exceed nameplate rating.
 - 5. Verify electrical overload protection of proper size and rating.
 - 6. Ensure that all water circulating systems shall be full and free of air; that expansion tanks are set for proper water level; and that all air vents were installed at high points of systems and are operating.
 - 7. Check and set operating temperatures of heat exchangers to design requirements.

1.9 RESPONSIBILITIES OF THE TEMPERATURE CONTROLS CONTRACTOR

- A. The Temperature-Controls Contractor shall allow sufficient time in the project to provide assistance and instruction to the balancing agency in the proper use and setting of control components such as, but not limited to, computers, static pressure controllers, or any other device that may need set points changed so that the testing and balancing work can be performed.
- B. Furnish to the balancing agency any software and cables required to make adjustments to controls. Any unique micro-processor required to set controls shall be furnished by Temperature Controls Contractor.
- C. The Temperature Controls Contractor shall complete the installation of the temperature control system, and operate and test all control systems to ensure they are functioning properly as designed. The Temperature Controls Contractor shall assist the balancing agency in testing and balancing the HVAC systems, as described hereinafter.
 - 1. Verify that all control components are installed in accordance with project requirements and are functional, including all electrical interlocks, damper sequences, air, and water reset, and fire and freeze stats.
 - 2. Verify that all controlling instruments are calibrated and set for design operating conditions.

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3. Calibrate room thermostats/sensors after installation, and before the thermostat control verification tests are performed. The balancing agency shall prove the accuracy of final settings by taking temperature readings. The readings shall be in a typical conditioned space for each separately controlled zone.

1.10 PRE-BALANCING CONFERENCE

- A. Prior to beginning of the testing, adjusting, and balancing procedures, schedule and conduct a conference with the Architect/Engineer, General Contractor, Mechanical Contractor, Electrical Contractor, and Temperature Controls Contractor. The objective of the conference is final coordination and verification of system operation and readiness for testing, adjusting, and balancing.

1.11 NOTIFICATION FOR TESTING AND BALANCING WORK TO BEGIN

- A. The general contractor shall notify the balancing agency in writing when all heating, ventilating, and air conditioning systems are complete and ready for testing and balancing. The Mechanical Contractor shall attest that he has completed all items as described in "RESPONSIBILITIES OF THE MECHANICAL CONTRACTOR" Section of these specifications.
- B. If upon commencing the work, the balancing agency finds that the systems are not ready, or if a dispute occurs as to the readiness of the systems, the balancing agency shall request an inspection to be made by the Mechanical Engineer. This inspection shall establish to the satisfaction of the represented parties whether or not the systems meet the basic requirements for testing and balancing. Should the inspection reveal the notification to have been premature, the balancing agency shall be reimbursed for all costs for the inspection and work previously accomplished. Furthermore, such items that are not ready for testing and balancing shall be completed and placed in operational readiness before testing and balancing services shall again be requested.

PART 2 - PRODUCTS

2.1 NOT USED

PART 3 - EXECUTION

3.1 SCOPE

- A. In accordance with Project Drawings and Specifications and as specified herein, the balancing agency shall provide all supervision, personnel, instruments, calibration equipment, and all other materials and services necessary to perform all testing and balancing of the heating, ventilating, and air conditioning systems. All test data including all pertinent calculations shall be reported on appropriate forms.

3.2 GENERAL

- A. The testing and balancing of the heating, ventilating, and air conditioning systems shall be performed by an independent balancing agency approved by the Engineer. The balancing agency shall have a minimum of five years specialized experience in air and hydronic system balancing, possess calibrated instruments, certified "Test and Balance Engineers", and skilled technicians to perform all required tests. The balancing agency shall be a certified member of the Associated Air Balance Council and/or the National Environmental Balancing Bureau (NEBB).
- B. The tests shall demonstrate the specified capacities and operation of all equipment and materials comprising the systems. The balancing agency shall then make available to the

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Owner's representative such instruments and technicians as are required for spot checks of the system.

- C. The balancing agency shall not instruct or direct the Mechanical Contractor in any of the work. Any proposed changes or revisions in the work shall be submitted to the Architect and General Contractor in writing.
- D. Document Review:
 - 1. The Test and Balance Firm shall be responsible for reviewing the HVAC plans and specifications relating to the test and balance services for proper arrangement and adequate provisions of devices for testing, adjusting, and balancing.
 - 2. Test and Balance Firm shall review HVAC manufacturers' submittals data relative to balanceability.
 - 3. Test and Balance Firm shall review submitted HVAC automatic temperature control sequences for conformity to the specifications.

3.3 SERVICES

- A. During construction, the balancing agency shall inspect the installation of pipe systems, sheet metal work, temperature controls, and other component parts of the heating, ventilating, and air conditioning systems.
- B. The inspections shall be performed periodically as the work progresses. A minimum of two inspections are required as follows: (1) when 60 percent of the ductwork is installed; (2) when 90 percent of the equipment is installed. The balancing agency shall submit a brief written report of each inspection to the General Contractor and Engineer.
- C. Upon completion of the installation and start-up of the mechanical equipment by the Mechanical Contractor, the balancing agency shall test and balance the system components to obtain optimum conditions in each conditioned space in the building.

3.4 DEFICIENCIES

- A. If in the process of performing the TAB work, any deficiencies encountered shall be brought to the attention of the contractor responsible through defined procedures and entered in the punch list of deficiencies on the next daily Status Report. If correction of the deficiency is urgent, the matter shall be brought to the attention of all involved parties for quick resolution. The General Contractor shall provide and coordinate services of qualified responsible subcontractors, suppliers, and personnel as required to correct, repair, or replace any and all deficient items or conditions during the testing, adjusting, and balancing period.
- B. The notification may be for single or multiple deficiencies. The work necessary to correct items on the listing shall be performed and verified in writing by the affected trade.
- C. All deficiencies that prevent proper TAB work from being completed shall be corrected prior to submittal of the Final TAB Report, unless the correction of such deficiencies cannot be accomplished in a reasonable period of time, in which case the Mechanical Engineer may grant permission to submit the Final TAB Report with the deficiencies detailed in the report.

3.5 AIR SYSTEM PROCEDURES

- A. The balancing agency shall perform the following testing and balancing functions in accordance with the Associated Air Balance Council's National Standards:
 - 1. Fan Speeds:
 - a. For all two stage units, low and high fan speeds must be individually set. For all multistage units, every fan speed step must be individually set. When controls contractor are directly controlling fan speed, the balancing agency shall provide the fan speeds needed to control units at every stage.

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- b. Test and adjust fan RPM to achieve design CFM requirements.
2. Current and Voltage:
 - a. Measure and record motor current and voltage.
3. Pitot-tube Traverse:
 - a. Perform a Pitot-tube traverse of main supply and return ducts to obtain total CFM. If a Pitot-tube traverse is not practical, the summation of the outlets or inlets may be used. An explanation of why a traverse was not made must appear on the appropriate datasheet.
4. Outside Air:
 - a. Test and adjust system minimum outside air by Pitot-tube traverse. If a Pitot-tube traverse is not practical, the percentage of outside air may be determined by calculations from the return air, outside air, and mixed air temperatures. Make allowances for heat of compression and motor heat where applicable.
5. Static Pressure:
 - a. Test and record system static pressures, including suction and discharge static pressure of each fan.
6. Air Temperature:
 - a. Take wet-bulb and dry-bulb air temperatures on the entering and leaving side of each cooling coil. Dry-bulb temperature shall be taken on the entering and leaving side of each heating coil.
7. Zone Ducts:
 - a. Adjust zone ducts to within design CFM requirements. At least one zone balancing damper shall be completely open.
8. Main Ducts:
 - a. Adjust main ducts to within design CFM requirements and traverse for total CFM quantities.
9. Branch Ducts:
 - a. Adjust branch ducts to within design CFM requirements. Multi-diffuser branch ducts shall have at least one outlet or inlet volume damper completely open.
10. Tolerances:
 - a. Test and balance each diffuser, grille, and register to within 10 percent of design requirements.
11. Identification:
 - a. Identify the location and area of each grille, diffuser, register, and terminal box. This information shall be recorded on air outlet data sheets.
12. Description:
 - a. Record the size, type, and manufacturer of each diffuser, grille, and register on air outlet data sheets.
13. Terminal Boxes:
 - a. Set volume regulators on all terminal boxes to meet design maximum and minimum CFM requirements. All associated temperature controls shall be checked for proper operation and calibration. If the terminal boxes have separate settings for heating and cooling CFM, the CFM quantities for each shall be recorded on air outlet data sheets. All diffusers connected to the terminal box shall be read in the heating and cooling modes and their readings recorded on air outlet data sheets.
14. Minimizing Drafts:
 - a. Adjust all diffusers, grilles, and registers to minimize drafts in all areas.

3.6 VERIFICATION OF TEMPERATURE CONTROL

- A. The balancing agency shall be assisted by the Temperature Controls Contractor in verifying the operation and calibration of all temperature control systems. The following tests shall be conducted:
 1. Verify that all control components are installed in accordance with project requirements and are functional, including all electrical interlocks, damper sequences, air and water

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- reset, and fire and freeze stats.
 2. Verify that all controlling instruments are calibrated and set for design operating conditions.
 3. Verify the accuracy of the final settings by taking temperature readings. The readings shall be in a typical conditioned space for each separately controlled zone.
- B. In the process of performing the TAB work, the balancing agency firm shall:
1. Verify that all dampers, valves, and other controlled devices are operated by the intended controller.
 2. Verify that all dampers and valves are in the position indicated by the controller (open, closed, or modulating).
 3. Verify the integrity of valves and dampers in terms of tightness of close-off and of full-open position. This includes dampers in VAV terminals.
 4. Check that all valves are properly installed in the piping system in relation to direction of flow and location.
 5. Verify the proper application of all normally open and normally closed valves.
 6. Check the locations of all thermostats and humidistats for potential erratic operation from outside influences such as sunlight, drafts, or cold/hot walls.
 7. Check the locations of all sensors to determine whether their position will allow them to sense only the intended temperatures or pressures of the media.
 8. Check the sequence of operation for any control mode to ensure that it is in accordance with the Contract Documents.
- C. Verify that all controller set points meet the design intent. Record observations of systems under DDC control. Record all default set points if different from operating set points.
- D. Check all dampers for free and full operation, and record any obstructions.
- E. Verify the operation of all interlock systems.
- F. Perform all system verifications to assure the safety of the system and its components.
- G. Verify that the changeover from heating to cooling mode occurs as specified.
- 3.7 TEST AND BALANCE REPORT**
- A. The test and balance report shall be complete with logs, data, and records as required herein. All logs, data, and records shall be typed on white bond paper and bound and submitted in a single PDF file. The report shall be certified, accurate and complete by the balancing agency's certified Test and Balance Engineer.
- B. The report shall contain the following general data in a format selected by the balancing agency:
1. Project number
 2. Contract number
 3. Project title
 4. Project location
 5. Project Architect
 6. Project Mechanical Engineer
 7. Test & Balance agency
 8. Test & Balance Engineer
 9. General Contractor
 10. Mechanical Subcontractor
 11. Dates tests were performed
 12. Certification
- C. The test and balance report shall be recorded on report forms conforming to the recommended forms in the AABC National Standards. At a minimum, the report shall include:

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1. Preface:
 - a. A general discussion of the system, any abnormalities, and problems encountered.
 - b. A deficiency log detailing system abnormalities that do not meet these specifications.
 - c. The list of instruments including type, model, manufacturer, serial number, and calibration dates.
2. Air System Data:
 - a. All test and balance data indicating design conditions, and actual conditions of operation for each device and/or piece of HVAC equipment.
 - b. Outside Air Temperatures, dry bulb, and wet bulb.
 - c. Entering Air Temperatures, dry bulb, and wet bulb.
 - d. Discharge Air Temperatures, dry bulb, and wet bulb.
 - e. Suction and discharge static pressures across each fan.
3. System Identification:
 - a. In each report, the zones, supply, return, exhaust openings, and traverse points shall be numbered and/or lettered on mechanical drawings corresponding to the numbers and letters used on the report data sheets.
4. Controls:
 - a. Document verification of controls.
5. Occupancy Inspection:
 - a. Make a total of three (3) inspections within ninety (90) days after occupancy of the building, and make adjustments if required, to ensure that satisfactory conditions are being maintained throughout. Inspections to be coordinated with Architect/Engineer and Owner and shall be documented with a supplemental report containing data and information as required.
6. Instructions to Operating Personnel:
 - a. Test and Balance Firm shall instruct the operating personnel regarding the following:
 - 1) Systems Operation
 - 2) Unusual Operating Conditions.
 - 3) System Troubleshooting Procedures.

3.8 REPORT SUBMITTAL

- A. The test and balance report are required and shall be submitted to the General Contractor for distribution to the Owner, Architect, and Mechanical Engineer. The test and balance report shall be submitted in a single, fully bound PDF file.

3.9 FINAL ACCEPTANCE

- A. At the time of final inspection, the balancing agency shall recheck, in the presence of the Owner's representative, specific and random selections of data recorded in the certified test and balance report.
- B. Points and areas for recheck shall be selected by the Owner's representative.
- C. Measurements and test procedures shall be the same as the original test and balance.
- D. Selections for recheck, specific plus random, shall not normally exceed 15 percent of the total number tabulated in the report, except where special air systems require a complete recheck for safety reasons.
- E. If random tests demonstrate a measured flow deviation of 10 percent or more from that recorded in the certified test and balance report, the report shall automatically be rejected. In the event the report is rejected, all systems shall be readjusted and tested, new data recorded, a new certified test and balance report submitted, and a new inspection test made, all at no additional cost to the Owner.

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3.10 OPPOSITE SEASON TEST

- A. Opposite season test and balance work shall be required for systems that cannot be tested and balanced due to climate or seasonal conditions. An example would be Chiller operation in the winter season, or Boiler operation in the summer season. In such case, the balancing agency shall perform an inspection of the buildings HVAC system during the opposite season from that in which the initial adjustments were made. The balancing agency shall make any necessary modifications to the initial adjustments to produce optimum system operation in compliance with the contract documents. The TAB agency shall contact the Owner's Commissioning Agent, to coordinate such work, no less than 14 calendar days prior to any Opposite Season Testing.
- B. Opposite Season Testing is not required if the Owner's Commissioning Agent can simulate off season conditions via the building automated controls system.

END OF SECTION

SECTION 23 07 13

DUCT AND GRILLE INSULATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions, Division 01 Specifications, and Section 23 00 00, apply to this Section.

1.2 SECTION INCLUDES

- A. External duct insulation
- B. Internal duct liner

1.3 RELATED SECTIONS

- A. Section 23 00 00 - Basic Mechanical Requirements
- B. Section 23 31 13 - Metal Ductwork
- C. Section 23 37 13 - Diffusers, Registers, and Grilles

1.4 SUBMITTALS

- A. Product Data:
 - 1. Provide submittal data on all equipment specified in this section in accordance with Section 23 00 90, General Conditions, and Division 01.
 - 2. Submit product data indicating typical catalog of information.
 - 3. Submit product data sheets indicating dimensions, general assembly, and ratings.
 - 4. Submit manufacturer's installation instructions.
 - 5. Submit kitchen exhaust duct wrap to City for approval prior to submitting to Engineer.

1.5 REFERENCES

- A. Refer to Section 23 00 00 for complete names of references identified in this section.
 - 1. ASTM E84 - Standard test for surface burning characteristics of building materials.
 - 2. NFPA 221 - Fire walls and fire barrier walls.
 - 3. NFPA 255 - Surface burning characteristics of building materials.
 - 4. NFPA 96 - Ventilation control and fire protection of commercial cooking operations.
 - 5. UL 723 - Test for surface burning characteristics of building materials.
 - 6. UL 1978 - First Edition Standard for Grease Ducts
 - 7. ASTM C553 - Standard specification for mineral fiber blanket thermal insulation for commercial and industrial applications.
 - 8. ASTM C1071 - Fibrous glass duct lining insulation (thermal and sound).
 - 9. IECC - International Energy Conservation Code
 - 10. ASTM E96 - Standard Test Methods for Water Vapor Transmission of Materials
 - 11. ASTM C916-85(2001)e1 - Standard Specification for Adhesives for Duct Thermal Insulation
 - 12. ASTM C1136-02 - Standard Specification for Flexible, Low Permeance Vapor Retarders for Thermal Insulation
 - 13. ASTM A635/A635M-02 - Standard Specification for Steel, Sheet and Strip, Heavy-Thickness Coils, Carbon, Commercial Steel, Drawing Steel, Structural, High-Strength Low-Alloy, and High-Strength Low-Alloy with Improved Formability, Hot-Rolled, General

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Requirements

14. ASTM A924 - Hot Dip Galvanized Coils & Sheets - Tolerances

1.6 QUALITY ASSURANCE

- A. Fire Hazard Rating:
1. All insulation used on the project must have a flame spread rating not exceeding 25 and a smoke developed rating not exceeding 50 as determined by test procedures ASTM E84, NFPA 255 and UL 723. Bear UL label.
 2. These ratings must be as tested on the composite of insulation, jacket or facing, and adhesive.
 3. Components such as adhesives, mastics and cements must meet the same individual ratings as minimum requirements.
 4. Install in accordance with SMACNA standards.
- B. Insulations shall not contain formaldehyde, asbestos, lead, mercury, mercury compounds, or poly-brominated diphenyl ether fire retardants.
- C. Fiberglass insulations shall have a minimum of 50 percent recycled glass content; certified and UL Validated.
- D. Fiberglass insulations shall have a bio-based, formaldehyde-free binder and be UL GREENGUARD Gold certified.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials in original sealed containers or unopened packages, and clearly labeled with manufacturer's name, product identification, and lot numbers.
- B. Store materials out of weather and in an enclosed shelter.

PART 2 - PRODUCTS

2.1 APPLICATIONS

- A. Supply ducts
- B. Return ducts
- C. Outside air ducts
- D. Supply and return diffusers
- E. Grilles
- F. Registers with exposed surfaces in unconditioned areas

2.2 MANUFACTURERS

- A. Owens Corning
- B. Knauf Insulation
- C. Manson Insulation
- D. Johns Manville

2.3 EXTERNAL DUCT WRAP AND GRILLE INSULATION

- A. Minimum Thickness and Density:

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1. Minimum 2" thick at 1 pound per cubic foot, Minimum Value of R-6.0
- B. Material:
 1. Fiberglass insulation with factory-applied FSK vapor retarding facing complying with ASTM C 1136. Fiberglass bonded with a bio-based thermosetting binder.
 2. Flexible Blanket Duct Wrap insulation, complying with ASTM C 553, Type I, II, and III; ASTM C 1136 Type II; and ASTM C 1290, Type III. UL/ULC Classified per UL 723 for FSK; NFPA 90A and 90B.
 3. Thermal conductivity (k-value) at 75 degrees F mean temperature is 0.27 Btu x in. /h x sq. ft. x degrees F, or less. Maximum service temperature of 250 degrees F with FSK facing, 350 degrees F for un-faced material.
 4. Flame spread/Smoke-developed rating (ASTM E84) of 25/50.
 5. Must be UL Environment GREENGUARD Gold certified and UL Validated Formaldehyde-free.

2.4 INTERNAL DUCT LINER

- A. Use only where specifically noted, or with written approval of Engineer.
- B. Install internal duct liner that extends no more than 2'-0" below roof deck at each rooftop unit.
- C. Thickness:
 1. Minimum 1½ inch thick, Minimum Value R-6.0
- D. Material:
 1. Rigid Plenum and Duct Liner
 - a. Fiberglass complying with ASTM C 1071 Type II, ASTM 1338, ASTM G21/G22, NFPA 90A and 90B, ASTM C 1104, and NAIMA AH124, "Fibrous Glass Duct Liner Standard". Fiberglass bonded with a bio-based thermosetting binder, having a bonded, black mat-faced airstream surface and factory-applied edge coating.
 - b. Thermal conductivity (k-value) at 75 degrees F mean temperature is 0.23 Btu x in. /h x sq. ft. x deg. F., or less. Maximum service temperature of 250 degrees F. UL/ULC Classified per UL 723.
 - c. Flame spread/Smoke-developed rating (ASTM E84) of 25/50.
 - d. Must be UL Environment GREENGUARD Gold certified and UL Validated Formaldehyde-free.
 2. Flexible Duct Liner
 - a. Fiberglass complying with ASTM C1071 Type I, ASTM C 1338, NFPA 90A and 90B, and NAIMA AH124, "Fibrous Glass Duct Liner Standard". Rotary glass fibers bonded with bio-based thermosetting binder, having a bonded, black mat-faced airstream surface and factory-applied edge coating.
 - b. Must be UL Environment certified GREENGUARD Gold and UL Validated Formaldehyde-free.
 - c. Surface Burning Characteristics: ASTM E84, UL 723 – Flame spread less than 25 and Smoke developed less than 50.
 - d. Maximum Rated Air Velocity: ASTM C 1071 – 6,000 ft. /min. (30.5 m/sec.).
 - e. Maximum Thermal Conductivity: ASTM C 177, C518, C1114 - 0.24 Btu / (ft² x hr. x °F) @ 75°F mean temperature.
 - f. Water Vapor Sorption: ASTM C 1104 – Not exceeding 3 percent by weight.
 - g. Antimicrobial Agent: Compound shall be tested for efficacy by an NRTL, and registered by the EPA for use in HVAC systems. Mold & Mildew Growth/Fungi Resistance: ASTM C 1338, ASTM G21/G22 – Pass.
 - h. Corrosiveness/Corrosion: ASTM C 665 / C 1617 - Does Not Accelerate / Pass.
 - i. Required Markings: EI rating, UL label, duct liner thickness, and other markings required by UL 181 on each full roll of duct liner.

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- j. Duct liner adhesive shall be applied to the sheet metal with a minimum coverage of 90%. Adhesive shall meet the requirements of ASTM C916.
- k. Noise Reduction Coefficient (NRC): ASTM C 423, Type "A" Mounting
 - 1) 1.5 PCF Density: 1"=.70, 1-1/2"=.80, 2"=.95
 - 2) 2.0 PCF Density: 1/2"=.50, 1"=.70, 1-1/2"=.85

PART 3 - EXECUTION

3.1 DUCT WRAP INSTALLATION

- A. To ensure that it will achieve its highest possible performance and serve its intended purpose, install all insulation materials and accessories in accordance with manufacturer's published instructions (latest edition) and industry practices detailed by the North American Commercial and Industrial Insulation Standards (latest edition).
- B. Wrap insulation on the ductwork with all circumferential joints butted and longitudinal joints overlapped a minimum of 3 inches. Do not over stretch, or compress more than 25%, during installation process.
- C. On circumferential joints, secure the 2-inch flange of the facing and tape with a minimum of 3 inch wide foil-scrim-Kraft tape (FSK).
- D. On longitudinal joints, secure the overlap using 1/2 inch outward clinch staples applied 6 inches on centers and taped with minimum 3 inch wide foil-scrim-Kraft tape (FSK).
- E. Tape all pin penetrations or punctures in facing.
- F. The duct wrap insulation on all rectangular/square ducts 24-inch or wider shall be additionally secured to the bottom of the duct with mechanical fasteners such as pins and speed clip washers. Spacing at 18-inch on center each direction to prevent sagging.
- G. Duct wrap should be attached and sealed to grilles, registers and diffusers in the same manner as used for duct.
- H. Extend insulation 1 inch beyond each outer surface of diffuser, grille, and register.

3.2 INTERNAL DUCT LINER

- A. Provide internal duct liner as indicated on the plans.
- B. Install internal duct liner on rooftop unit supply and return ducts no more than 2'-0" below roof deck.
- C. To ensure that it will achieve its highest possible performance and serve its intended purpose, install Duct Liner insulation and all accessories in accordance with manufacturer's published instructions (latest edition) and industry practices detailed by the NAIMA FGDLS (North American Insulation Manufacturers Association, Publication AH-124 Fibrous Glass Duct Liner Standard) or SMACNA HVAC DCS (Sheet Metal and Air Conditioning Contractors' National Association, Publication HVAC Duct Construction Standards – Metal & Flexible).
- D. Apply the liner to the inside of the duct with heavy density side to the air stream and secure to the duct with adhesive Insul-Coustic No. 225 or equal meeting ASTM C916, providing a minimum of 90% coverage of clean sheet metal.
- E. Do not use duct liner in kitchen or other areas that may have excess moisture present.
- F. Mechanical fasteners shall be used to secure the duct liner to the sheet metal, spaced in accordance with NAIMA FGDLS or SMACNA HVAC DCS. Fasteners may be either impact-

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driven, weld-secured, or adhesively secured.

- G. Accurately cut the liner and thoroughly coat the ends with adhesive to make a firmly butted and tightly sealed joint.
- H. Where ducts are lined, exterior insulation will not be needed except as otherwise specified.

END OF SECTION

SECTION 23 07 21

REFRIGERANT PIPING INSULATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions, Division 1 Specifications, and Section 23 00 00, apply to this Section.

1.2 SECTION INCLUDES

- A. Elastomeric closed-cell structure insulation
- B. Applications - All refrigerant line sets serving units

1.3 RELATED SECTIONS

- A. Section 23 00 00 - Basic Mechanical Requirements
- B. Section 23 23 00 - Refrigerant Piping

1.4 SUBMITTALS

- A. Product Data:
 - 1. Provide submittal data on all equipment specified in this section in accordance with Section 23 00 90, General Conditions, and Division 1.
 - 2. Submit product data indicating typical catalog of information.
 - 3. Submit product data sheets indicating dimensions, general assembly, and ratings.
 - 4. Submit manufacturer's installation instructions.

1.5 SHOP DRAWINGS

- A. Submit 1/4" per foot shop drawing(s) showing all piping and equipment shown by plans and specifications. The drawings shall be coordinated with structural, electrical, and fire sprinkler drawings.

1.6 REFERENCES

- A. Refer to Section 23 00 00 for complete names of references identified in this section.
- B. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials
- C. ASTM E96/E96M - Standard Test Methods for Water Vapor Transmission of Materials

1.7 QUALITY ASSURANCE

- A. Fire Endurance Rating: The composite classifications shall be listed and labeled to not exceed 25 flame spread rating and 50 smoke development rating as outlined by NFPA 255/ ASTM E84/ UL 723 for the basic material, the finishes, adhesives, etc., specified for each system, and shall be such when completely assembled.
- B. Components such as adhesives, mastics, and cement must meet the same requirement.

PART 2 - PRODUCTS

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2.1 PIPE INSULATION

- A. Type: Closed-Cell Flexible Elastomeric Foam Pipe Insulation w/dual-tape overlap self seal lip closure.
- B. Performance Criteria: Resistant to ultra-violet and biological degradation.
- C. Temperature Range: -297°F to 220°F
- D. Water Vapor Permeability (Dry Cup): Less than 0.03 per inch when measured by ASTM E96.
- E. Thermal Conductivity: 0.24 - 0.27 BTU-IN/HR-FT²-°F.
- F. All Refrigerant Line Set Insulation thickness - 1" on Interior Pipe, 1½" on Exterior Pipe
- G. Manufacturer/Model:
 - 1. Armacell
 - 2. Aeroflex

2.2 SEALANT & ADHESIVE

- A. Manufacturer/Model:
 - 1. Therma-Cel
 - 2. Armacell
 - 3. Aeroflex

2.3 ALUMINUM METAL JACKETING/CLADDING

- A. All exterior refrigerant line sets
 - 1. Manufacturers:
 - a. Polyguard
 - b. Johns Manville
 - c. VentureClad
 - d. RPR Products

PART 3 - EXECUTION

3.1 PIPE

- A. To ensure that it will achieve its highest possible performance and serve its intended purpose, install all insulation materials and accessories in accordance with manufacturer's published instructions (latest edition) and industry practices detailed by the North American Commercial and Industrial Insulation Standards Manual (latest edition).
- B. Where straps or hangers are used, provide insulating pipe support insert and insulation shield.
- C. Apply insulation to clean, dry pipes.
- D. Butt insulation joints firmly together.
- E. Seal butt seams with sealant. Duct tape or electrical tape will not be permitted.
- F. Insulation without proper sealing of butt ends and longitudinal seams and/or not neat in appearance will be rejected by the Engineer.
- G. Do not stretch insulation around elbows. All fittings must be factory-fabricated or site-fabricated from same materials as straight pipe insulation.

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- H. When possible, install insulation on piping prior to final connection.
- I. Longitudinal joints installed after pipe is assembled are not acceptable.
- J. Do not allow liquid lines to come in contact with any structural members or steel stubs. Use plastic ties to secure liquid lines to insulation on vapor line. Do not crush insulation.

3.2 FINISH

- A. All exterior insulation to be protected with aluminum metal jacketing/cladding. Apply as recommended by the manufacturer, to protect the insulation on exterior of building.

3.3 VALVES, FLANGES & FITTINGS

- A. Insulate all valves, flanges, and fittings in a neat manner.

3.4 REPAIRS AND REPLACEMENT

- A. Replace any insulation that has ever been wet.
- B. Repair any damage caused by condensation due to improper insulating.
- C. Replace any insulation which is cut or torn during construction.

END OF SECTION

SECTION 23 09 23

ENERGY MANAGEMENT CONTROL SYSTEM (BACNET)

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions, Division 1 Specifications, and Section 23 00 00, apply to this Section.

1.2 SUMMARY

- A. It is the intent of this specification to describe the basic architecture and performance requirements of the Energy Management Control System (EMCS). The turn-key EMCS shall include Control Units, Distributed Controllers, Unitary Controllers, Local Area Networks (LANs), sensors, modems, wiring, connectors, control devices, actuators, installation and calibration, supervision, adjustments, and fine tuning necessary for a complete and fully operational system.
- B. A distributed logic control system complete with all software and hardware functions shall be provided and installed. System shall be completely based on ANSI/ASHRAE Standard 135-2001, BACnet. This system is to control all mechanical equipment, including all unitary equipment such as VAV boxes, heat pumps, fan-coils, AC units, etc. and all air handlers, boilers, chillers, and any other listed equipment using Native BACnet-compliant components.
- C. All systems shall be complete true stand-alone systems.
- D. **All communication wiring shall communicate using BACnet. LonWorks or Proprietary communication networks are not allowed. This includes ARCNET network cabling.**
- E. Everything shall be reprogrammed through software without change of any hardware. The owner shall have all the tools necessary to reprogram without any additional costs.
- F. EMCS shall have backward and forward compatibility.
- G. Systems shall be furnished and installed complete in all respects, including any and all equipment, controls, wiring, instrumentation, enclosures, labor, engineering, training, commissioning, programming, supervision, calibration, coordination with other trades, etc. No information given in (or omitted from) these specifications shall relieve the contractor of this absolute requirement. Include all associated electrical work except as noted. Work includes furnishing of all labor, superintendence, materials, tools, equipment and sources necessary for the complete installation or modification of the following systems as herein specified. It is the intent of these specifications that the Contractor shall furnish and install the systems complete in every respect and ready to operate. All equipment, miscellaneous items and accessories required for such installation and for the correct and convenient operation of the entire installation whether or not each such item or accessory is shown on the plans or mentioned in these specifications shall be furnished and installed.
- H. Bidders shall take into account that projects require verification of existing conditions that are not described in these specifications. Bids shall include, at Bidder's discretion, costs related to site verifications for renovation projects. No additional costs shall be allowed for such items.
- I. Should discrepancies or ambiguities arise within these specifications, the most stringent condition with regard to cost shall govern the bid. Obtain clarification from the Engineer prior to purchasing equipment and proceeding with the work.

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- J. Where drawings are provided as part of or supplement to these specifications, such drawings are inherently schematic only and not intended to convey all controls, wiring, installation, details, etc. It shall be the responsibility of the EMCS contractor to verify that control approaches presented are appropriate for the HVAC systems involved, and that bids include all work described, specified, or otherwise necessary for a complete and functioning system.
- K. Schedule: Contractor acknowledges that submission of bid constitutes agreement with and conformance to the completion dates.
- L. Codes, Permits, and Fees: This contractor shall comply with all local, state and national codes, and shall secure and pay all applicable costs, fees, permits, and licenses. No additional costs shall be allowed for these items.
- M. Other Conditions:
 - 1. Safety: Execute all work with the highest regard to safety. Comply with all laws governing safety, including the "Occupational Safety and Health Standards" and the "Safety and Health Regulations for Construction", State and federal. All applicable power tools used during construction shall have current approval under an approved Equipment Grounding Program, and shall bear the tag relating such. Contractor is solely responsible for all means and methods.
 - 2. Coordination and Supervision: Each bid shall include the necessary detail and interconnection work to coordinate his work with the work of other trades. Contractor shall keep competent supervisory personnel on the job whenever work is being performed which affects his trade.
 - 3. Storage of Materials: Each Contractor shall provide temporary storage facilities suitable for equipment stored at the job site. Storage facilities shall be weatherproof and lockable as required.
 - 4. Protection of Building and Materials: Each Contractor shall take necessary precautions to prevent damage to existing buildings and to work of other trades.
 - 5. Observations: Site observation by Owner or Engineer is for express purpose of verifying compliance by Contractor with Contract Documents, and shall not be construed as construction supervision nor indication of approval of manner or location in which work is being performed as being safe practice or place.
 - 6. Contractor is reminded that he shall also comply with all respects to the Invitation to Bid, General Conditions, Supplementary Conditions, Notice of Bidders, Instructions to Bidders, and all other governing parts of these specifications and the contract documents. These sections are included as part of the contract.
 - 7. Where the term "Contractor" is used within these specifications, it shall be understood to mean an approved controls manufacturer/contractor, and facility management systems contractor.
- N. The entire system shall be approved and listed by Underwriters Laboratories, Inc., under UL 916 for energy management systems and FCC-Part 15 Subparagraph J Class A Emissions Requirements.
- O. Equipment and Software Updates/Upgrades:
 - 1. Equipment: All equipment, components, parts, materials, etc. provided throughout the period of Work (as governed in the Agreement) shall be fully compatible with all other equipment, etc. provided at any other time throughout the period of Work. Should updated versions of equipment be provided which are not fully compatible with earlier equipment provided, Contractor shall replace earlier equipment with the later version at no cost to Owner.
 - 2. Software: All software upgrades applicable to system and offered by the manufacturer/contractor for this system shall be provided at no cost to the Owner throughout the period of work. This no cost upgrade shall include installation, programming, modifications to field equipment, data base revisions, training, etc. as

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appropriate.

- P. The Engineer shall reserve all authority regarding approval, conditional approval, or rejection of systems not fully complying with these specifications.

1.3 WORK INCLUDED

- A. Existing control system is (CONTROLS BRAND) controls by (CONTROLS COMPANY). All new equipment to be connected to the existing EMCS. All programming, software upgrades, controllers, etc. necessary to connect new equipment to existing control system shall be verified and provided by (CONTROLS COMPANY).
- B. The EMCS shall be a totally Native BACnet-based system based on a distributed control system in accordance with this specification. The workstation, all building controllers, application controllers, and all input/output devices shall communicate using the protocols and network standards as defined by ANSI/ASHRAE Standard 135-2001, BACnet. In other words, all workstations and controllers, including unitary controllers, shall be Native BACnet devices. No gateways shall be used for communication to controllers installed under this section. Gateways may be used for communication to existing systems or to systems installed under other sections.
- C. The installing contractor shall provide the new web-based software and software updates required for this project. Additionally, the installing contractor shall provide all computer related components (BAS Web server) for the new software platform to function in a peer-to-peer environment.
- D. The owner will provide reserved DHCP addresses and any other network configuration information necessary to each control contractor for the purpose of configuring each building controller and/or server on the owner's network. The controls contractor shall coordinate the IP address for each building controller and/or server. It shall be the responsibility of each control contractor to coordinate with the owner for network connectivity.
- E. The Energy Management and Control System (EMCS) application program shall be written to communicate specifically utilizing BACnet protocols. Software shall include password protection, alarming, logging of historical data, full graphics including animation, full suite of field engineering tools including graphical programming and applications. Systems using operating systems other than that described above are strictly prohibited.
- F. Building controllers shall include complete energy management software, including scheduling building control strategies and logging routines. All energy management software and firmware shall be resident in field hardware and shall not be dependent on the operator's terminal. Operator's terminal software is to be used for access to field-based energy management functions only. Provide zone-by-zone direct digital logic control of space temperature, scheduling, runtime accumulation, equipment alarm reporting, and override timers for after-hours usage.
- G. All application controllers for every terminal unit (VAV, HP, UV, etc.) air handler, all central plant equipment, and any other piece of controlled equipment shall be fully programmable. Application controllers shall be mounted next to controlled equipment and communicate with building controller via BACnet LAN.
- H. Provide all necessary BACnet-compliant hardware and software to meet the system's functional specifications. Provide Protocol Implementation Conformance Statement (PICS) for Windows-based control software and every controller in system, including unitary controllers.
- I. Prepare individual hardware layouts, interconnection drawings, and software configuration from project design data.

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- J. Implement the detailed design for all analog and binary objects, system databases, graphic displays, logs, and management reports based on control descriptions, logic drawings, configuration data, and bid documents.
- K. Design, provide, and install all equipment cabinets, panels, data communication network cables needed, and all associated hardware.
- L. Provide and install all interconnecting cables between supplied cabinets, application controllers, and input/output devices.
- M. Provide and install all interconnecting cables between all operator's terminals and peripheral devices (such as printers, etc.) supplied under this section.
- N. Provide complete manufacturer's specifications for all items that are supplied. Include vendor name of every item supplied.
- O. Provide supervisory specialists and technicians at the job site to assist in all phases of system installation, startup, and commissioning.
- P. Provide a comprehensive operator and technician training program as described herein.
- Q. Provide as-built documentation, operator's terminal software, diagrams, and all other associated project operational documentation (such as technical manuals) on approved media, the sum total of which accurately represents the final system.
- R. Provide new sensors, dampers, valves, and install only new electronic actuators. No used components shall be used as any part or piece of installed system.
- S. Unless otherwise specified, all products shall be of single manufacturer where possible with substitutions approved by Engineer/Owner.
- T. Provide all indicating devices, interface equipment, and other apparatus required to operate mechanical system and to perform functions specified and to operate other items specified.
- U. Provide protective devices to prevent damage to the EMCS as a result of lightning.
- V. The Energy Management Control system shall allow full user operation with minimum of training. It shall have an English language display, with both user prompts and a "help" user tutorial. It shall contain management reports for the monitoring of both current and historical energy usage, heating and cooling degree day, building status and after hours occupancy information.
- W. All applications programs shall be pre-engineered and pretested. Program entries shall utilize graphical templates.
- X. Workmanship:
 - 1. Contractor shall use only thoroughly trained and experienced workmen completely familiar with the items required and with the manufacturers recommended methods of installation. In all respects, the workmanship shall be of the highest grade, and all construction shall be done according to the best practice of the trade. Unless otherwise noted, conduit shall be concealed and installed square to the building lines. Any work not meeting these requirements shall be replaced or rebuilt without extra expense to the Owner

1.4 RELATED SECTIONS

- A. Section 23 00 00 - Basic Mechanical Requirements

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- B. Section 23 05 93 - Testing, Adjusting, and Balancing for HVAC
- C. Section 23 81 19 - Packaged HVAC Units
- D. Section 23 81 26 - Split System HVAC Units
- E. Section 26 00 00 - Basic Electrical Requirements

1.5 DEFINITIONS

- A. Energy Management Control System, Facility Management System, and Control System are to be considered the same.

1.6 REFERENCES

- A. The latest edition of the following standards and codes in effect and amended as of supplier's proposal date, and any applicable subsections thereof, shall govern design and selection of equipment and material supplied:
 - 1. American Society of Heating, Refrigerating and Air Conditioning Engineers (ASHRAE).
 - 2. ANSI/ASHRAE - Standard 135-2001, BACnet.
 - 3. Uniform Building Code (UBC), including local amendments.
 - 4. UL 916 - Underwriters Laboratories Standard for Energy Management Equipment. Canada and the US.
 - 5. National Electrical Code (NEC).
 - 6. FCC Part 15, Subpart J, Class A.
 - 7. EMC Directive 89/336/EEC (European CE Mark).
 - 8. City, county, state, and federal regulations and codes in effect as of contract date.
 - 9. Except as otherwise indicated the system supplier shall secure and pay for all permits, inspections, and certifications required for his work and arrange for necessary approvals by the governing authorities.

1.7 SPECIFICATION NOMENCLATURE

EMCS	Energy Management and Control System
WAN	Wide Area Network
RWS	Remote Work Station
HHI	Hand Held Interface
LAN	Local Area Network

1.8 QUALITY ASSURANCE

- A. Responsibility:
 - 1. The supplier of the EMCS shall be responsible for inspection and Quality Assurance (QA) for all materials and workmanship furnished.
- B. Component Testing:
 - 1. Maximum reliability shall be achieved through extensive use of high-quality, pre-tested components. Each and every controller, sensor, and all other DDC components shall be individually tested by the manufacturer prior to shipment.
- C. Tools, Testing and Calibration Equipment:
 - 1. The EMCS supplier shall provide all tools, testing, and calibration equipment necessary to ensure reliability and accuracy of the system.

1.9 SUBMITTALS

- A. Drawings

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1. The system supplier shall submit detailed complete, engineered drawings, control sequence, and bill of materials for approval.
 2. The contractor shall supply one electronic copy of the submittal.
 3. The electronic files will either be e-mailed to the architect or posted to a project management and information exchange website, depending on the architect's requirements. The architect and contractor can distribute copies of the files as desired.
 4. The engineer will retain an electronic copy of the submittal and all responses.
- B. System Documentation
1. Include the following in submittal package:
 - a. Data sheets for all pieces of equipment.
 - b. System configuration diagrams in simplified block format.
 - c. All input/output object listings and an alarm point summary listing.
 - d. Electrical drawings that show all system internal and external connection points, terminal block layouts, and terminal identification.
 - e. Complete bill of materials, valve schedule, and damper schedule.
 - f. Manufacturer's instructions and drawings for installation, maintenance, and operation of all purchased items.
 - g. Overall system operation and maintenance instructions including preventive maintenance and troubleshooting instructions.
- C. For all system elements - operator's workstation(s), building controller(s), application controllers, routers, and repeaters, provide BACnet Protocol Implementation Conformance Statements (PICS) as per ANSI/ASHRAE Standard 135-2001.
- D. Provide complete description and documentation of any proprietary (non-BACnet) services and/or objects used in the system.
- E. A list of all functions available and a sample of function block programming that shall be part of delivered system.
1. Scheduling
 - a. The vendor shall provide a detailed project design and installation schedule with time markings and details for hardware items and software development phases. Schedule shall show all the target dates for transmission of project information and documents and shall indicate timing and dates for system installation, debugging, and commissioning.
 2. Drawings and Manuals:
 - a. Upon completion of the work, the Contractor shall provide the Owner with "record" layouts for the system. Layouts shall indicate all equipment and the function of each item shall be indicated.
 3. Operating instructions and as-built system flow diagrams and drawings shall be prepared, bound, and delivered to the Owner. Each sensor, relay, switch, motor, controller, indicator (when inside panel), and item of equipment, etc., shall be identified with a number or mark identical to one which shall be tagged on each item. Large items of equipment may be identified by a suitable symbol listed in a legend on the control diagram.

1.10 EMCS CONTRACTOR QUALIFICATION REQUIREMENTS

- A. The Energy Management Control System Manufacturer/Contractor, to be acceptable to this project, must have had an established engineering and service office serving the Owner's area for a minimum of five years prior to bid date of this project and be the authorized installing contractor for the manufacturer of the BACnet components. This office shall have a staff of factory trained technicians fully capable of rendering training, instruction, calibration procedures, and routine and emergency maintenance service on all system components furnished.

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- B. Installers shall have not less than five years' experience with electronic and pneumatic controls.
- C. The entire system shall be provided by a qualified and approved Controls Manufacturer/Contractor. It shall be designed by engineers and installed by competent technicians, all of which are regularly employed by the manufacturer of the control equipment. The Manufacturer/Contractor shall maintain permanent local facilities for engineering, installation, and 24-hour maintenance and service. Submit required Qualifications Form as specified. The manufacturer shall provide evidence of the ability to support and service the work in the Owner's facilities.
- D. The Bidder/Contractor shall be certified by the manufacturer of the equipment and have factory trained installers
- E. Equipment and performance are intended as a standard of quality, but not as a means of excluding other approved Manufacturers/Control Contractors.

1.11 WARRANTY

- A. The temperature control contractor shall guarantee all workmanship and material in the installed temperature regulation system for a period of one (1) year, such guarantee dating from the date of final acceptance of the entire air conditioning system by the Architect/Engineer.
- B. This warranty shall cover the repair or replacement without additional costs to the Owner of any defective materials, parts, etc. of facility workmanship.
- C. During the warranty period, the temperature controls contractor shall respond to calls for warranty service within eight (8) working hours. Emergency service shall be obtainable within four (4) hours of notification by the Owner. Emergency service shall be obtainable on a 24-hour basis, seven (7) days per week.
- D. The temperature control contractor's office shall be within a 150-mile radius of the job site.
- E. Warranty Access:
 - 1. The Owner shall grant to the Contractor, reasonable access to the EMCS system during the warranty period. The owner shall provide, at no cost to the contractor, remote software access to an on-site computer or VPN access for the following functions:
 - a. Access to the entire facility control system by the contractor to provide service and diagnostic support.
- F. Service:
 - 1. All service of the system shall be furnished by the Contractor, at no cost to the Owner, for a period of one (1) year, concurrent with the warranty period specified above.

PART 2 - PRODUCTS

2.1 ACCEPTABLE EMCS VENDORS

- A. Alerton/Distech - Climatec
- B. Automated Logic
- C. Delta - TEAM Solution
- D. Distech - JMS
- E. Reliable Controls - Enviromatic Systems

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- F. Distech - Storer
- G. KMC - Mechanical Concepts
- H. Reliable Controls - Unify
- I. The Engineer and Owner shall reserve all authority regarding approval, conditional approval, or rejection of systems not fully complying with these specifications

2.2 MATERIALS

- A. General: All materials and equipment used shall be standard components, of regular manufacture for this application. All systems and components shall have been thoroughly tested and proven in actual use.
- B. Exceptions to the specification will qualify bid as unacceptable.

2.3 OPERATOR'S WORKSTATION

- A. This system is an addition to the existing control system and shall be connected to the existing local area network (LAN) and computer. No additional workstation is required.
- B. The new graphics software shall be fully integrated to the owners existing front end software and existing workstation. Floor plan and interactive color graphics shall be provided for the school with each zone providing color indication of the zone comfort level. In addition to the floor plan graphic, each piece of controlled equipment shall be represented by a graphic that is accessible by clicking on the zone or indicated piece of equipment. All points shall be available on the graphic.
- C. Software:
 - 1. EMS software shall be provided as an all-inclusive package. Software package shall allow the owner to have all the software modules/software tools that the controls contractor has for installation. The district shall have the software tools to be 100% self-sufficient when it comes to programming the systems, modifying DDC and graphics, creating reports and trends, etc. Provisions to provide software at each school campus at no additional charge in the future must be included as a part of this bid.

2.4 BUILDING CONTROLLER

- A. This system is an addition to the existing control system and shall be connected to the existing building controller if feasible. Field verify if existing building controller can be expanded or if additional building controller(s) is necessary.
- B. General:
 - 1. All communication with operator workstation and all application controllers shall be via BACnet. Building controller shall incorporate as a minimum, the functions of a 3-way BACnet router. Controller shall route BACnet messages between the high-speed LAN (Ethernet 10/100MHz), at least 4 master slave token passing (MS/TP) LANs, a point-to-point (PTP - RS-232) connection and an on-board modem.
 - a. Each MS/TP LAN must be software configurable from 9.6 to 76.8Kbps.
 - b. The RJ-45 Ethernet connection must accept either 10Base-T or 100Base-TX BACnet over twisted pair cable (UTP).
 - c. The direct access port must be a female DB-9 connector supporting BACnet temporary PTP connection of a portable BACnet operator terminal at 9.6 to 115.2 Kbps over RS-232 null modem cable.
 - 2. Building controller shall be capable of providing global control strategies for the system based on information from any objects in the system regardless if the object is directly

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monitored by the controller or by another controller. The program that implements these strategies shall be completely flexible and user definable. Any systems utilizing factory pre-programmed global strategies that cannot be modified by field personnel on-site or downloaded via remote communications are not acceptable. Changing global strategies via firmware changes is also unacceptable.

3. Programming shall be object-oriented using control function blocks, supporting DDC functions, 1000 Analog Values and 1000 Binary Values. All flowcharts shall be generated and automatically downloaded to controller. Programming tool shall be resident on workstation and the same tool used for all controllers.
 4. Provide means to graphically view inputs and outputs to each program block in real-time as program is executing. This function may be performed via the operator's workstation or field computer.
 5. Building controller shall provide battery-backed real-time (hardware) clock functions.
 6. Controller shall have a memory needed to ensure high performance and data reliability. Battery shall retain static RAM memory and real-time clock functions for a minimum of 1.5 years (cumulative).
 7. Global control algorithms and automated control functions should execute via 32-bit processor.
 8. Controller installation shall include memory-free gel-cell battery providing ongoing power conditioning and noise filtering for operation data integrity. It shall provide up to 5 minutes of powerless operation for orderly shutdown and data backup.
 9. BACnet Conformance:
 - a. Building Controller shall as a minimum support Point-to-Point (PTP), MS/TP and Ethernet BACnet LAN types. It shall communicate directly via these BACnet LANs as a Native BACnet device and shall support simultaneous routing functions between all supported LAN types. Global controller shall be a BACnet conformance class 3 device and support all BACnet services necessary to provide the following BACnet functional groups:
 - b. Clock Functional Group
 - 1) Files Functional Group
 - 2) Reinitialize Functional Group
 - 3) Device Communications Functional Group
 - 4) Event Initiation Functional Group
 10. Refer to section 22.2, BACnet Functional Groups, in the BACnet standard for a complete list of the services that must be directly supported to provide each of the functional groups listed above. All proprietary services, if used in the system, shall be thoroughly documented and provided as part of the submittal data. All necessary tools shall be supplied for working with proprietary information.
 11. Standard BACnet object types supported shall include as a minimum: Analog Value, Binary Value, Calendar, Device, File, Group, Notification Class, Program and Schedule object types. All proprietary object types, if used in the system, shall be thoroughly documented and provided as part of the submittal data. All necessary tools shall be supplied for working with proprietary information.
 12. The Building Controller shall comply with Annex J of the BACnet specification for IP connections. This device shall use Ethernet to connect to the IP internetwork, while using the same Ethernet LAN for non-IP communications to other BACnet devices on the LAN. Must support interoperability on wide area networks (WANs) and campus area networks (CANs) and function as a BACnet Broadcast Management Device (BBMD).
- C. Schedules:
1. Each building controller shall support a minimum of 250 BACnet Schedule Objects and 250 BACnet Calendar Objects.
- D. Logging Capabilities:
1. Each building controller shall log as minimum 1000 trendlogs. Any object in the system (real or calculated) may be logged. Sample time interval shall be adjustable at the

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- operator's workstation.
- 2. Logs may be viewed both on-site or off-site via remote communication.
- 3. Building controller shall periodically upload trended data to networked operator's workstation for long term archiving if desired.
- 4. Archived data stored in database format shall be available for use in third-party spreadsheet or database programs.
- 5. Alarm Generation:
 - a. Alarms may be generated within the system for any object change of value or state either real or calculated. This includes things such as analog object value changes, binary object state changes, and various controller communication failures.
 - b. Each alarm may be dialed out as noted in paragraph 2 above.
 - c. Alarm log shall be provided for alarm viewing. Log may be viewed on-site at the operator's terminal or off-site via remote communications.
 - d. Controller must be able to handle up to 1500 alarm setups stored as BACnet event enrollment objects - system destination and actions individually configurable.

2.5 WEB BROWSER CLIENTS

- A. The system shall be capable of supporting an unlimited number of clients using a standard Web browser such as Internet Explorer™ or Mozilla Firefox™. Systems requiring additional software (to enable a standard Web browser) to be resident on the client machine, or manufacture-specific browsers shall not be acceptable.
- B. The Web browser software shall run on any operating system and system configuration that is supported by the Web browser. Systems that require specific machine requirements in terms of processor speed, memory, etc., to allow the Web browser to function with the EMCS shall not be acceptable.
- C. The Web browser shall provide the same view of the system, in terms of graphics, schedules, calendars, logs, etc., and provide the same interface methodology as is provided by the Graphical User Interface. Systems that require different views or that require different means of interacting with objects such as schedules, or logs, shall not be permitted.
- D. The Web browser client shall support at a minimum, the following functions:
 - 1. User log-on identification and password shall be required. If an unauthorized user attempts access, a blank web page shall be displayed. Security authentication and encryption techniques to prevent unauthorized access shall be implemented.
 - 2. Graphical screens developed for the GUI shall be the same screens used for the Web browser client. Any animated graphical objects supported by the GUI shall be supported by the Web browser interface.
 - 3. HTML programming shall not be required to display system graphics or data on a Web page. HTML editing of the Web page shall be allowed if the user desires a specific look or format.
 - 4. Storage of the graphical screens shall be in the Network Area Controller (NAC), without requiring any graphics to be stored on the client machine. Systems that require graphics storage on each client are not acceptable.
 - 5. Real-time values displayed on a Web page shall update automatically without requiring a manual "refresh" of the Web page.
 - 6. Users shall have administrator-defined access privileges. Depending on the access privileges assigned, the user shall be able to perform the following:
 - a. Modify common application objects, such as schedules, calendars, and set points in a graphical manner.
 - 1) Schedule times will be adjusted using a graphical slider, without requiring any keyboard entry from the operator.
 - 2) Holidays shall be set by using a graphical calendar, without requiring any keyboard entry from the operator.

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- b. Commands to start and stop binary objects shall be done by right-clicking the selected object and selecting the appropriate command from the pop-up menu. No entry of text shall be required.
- c. View logs and charts
- d. View and acknowledge alarms
- 7. The system shall provide the capability to specify a user's (as determined by the log-on user identification) home page. Provide the ability to limit a specific user to just their defined home page. From the home page, links to other views, or pages in the system shall be possible, if allowed by the system administrator.
- 8. Graphic screens on the Web Browser client shall support hypertext links to other locations on the Internet or on Intranet sites, by specifying the Uniform Resource Locator (URL) for the desired link.

2.6 TERMINAL UNIT APPLICATION CONTROLLERS (ROOFTOPS, HEAT PUMPS, AC UNITS, FAN COILS)

A. General:

- 1. Provide one Native BACnet application controller for each piece of unitary mechanical equipment that adequately covers all objects listed in object list for unit. All controllers shall interface to building controller via MS/TP LAN using BACnet protocol. No gateways shall be used. Controllers shall include input, output, and self-contained logic program as needed for complete control of unit.

B. BACnet Conformance:

- 1. Application controllers shall as a minimum support MS/TP BACnet LAN types. They shall communicate directly via this BACnet LAN at 9.6, 19.2, 38.4, and 76.8 Kbps, as a Native BACnet device. Application controllers shall be of BACnet conformance class 3 and support all BACnet services necessary to provide the following BACnet functional groups:
 - a. Files Functional Group
 - b. Reinitialize Functional Group
 - c. Device Communications Functional Group
- 2. Refer to section 22.2, BACnet Functional Groups in the BACnet standard for a complete list of the services that must be directly supported to provide each of the functional groups listed above. All proprietary services, if used in the system, shall be thoroughly documented and provided as part of the submittal data. All necessary tools shall be supplied for working with proprietary information.
- 3. Standard BACnet object types supported shall include as a minimum-Analog Input, Analog Output, Analog Value, Binary Input, Binary Output, Binary Value, Device, File and Program Object Types. All proprietary object types, if used in the system, shall be thoroughly documented and provided as part of the submittal data. All necessary tools shall be supplied for working with proprietary information.
- 4. Application controllers shall include universal inputs with 10-bit resolution that can accept 3K and 10K thermistors, 0-5 VDC, 4-20 mA, dry contact signals and a minimum of 3 pulse inputs. Any input on controller may be either analog or digital. Controller shall also include support and modifiable programming for interface to intelligent room sensor. Controller shall include binary outputs on board with analog outputs as needed.
- 5. All program sequences shall be stored on board controller in EEPROM. No batteries shall be needed to retain logic program. All program sequences shall be executed by controller 10 times per second and shall be capable of multiple PID loops for control of multiple devices. Programming of application controller shall be completely modifiable in the field over installed BACnet LANs or remotely via modem interface. Operator shall program logic sequences by graphically moving function blocks on screen and tying blocks together on screen. Application controller shall be programmed using same programming tools as building controller and as described in operator workstation section. All programming tools shall be provided and installed as part of system.

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6. Application controller shall include support for intelligent room sensor (see Section 2.9.B.). Display on room sensor shall be programmable at controller and include an operating mode and a field service mode. All button functions and display data shall be programmable to show specific controller data in each mode based on which button is pressed on the sensor. See sequence of operation for specific display requirements at intelligent room sensor.
- C. Smoke Detectors:
1. Smoke detectors (duct and area type) shall be provided, installed, and wired into the Fire Alarm System by the Electrical Contractor. The Controls Contractor shall be responsible for interlock wiring between duct smoke detectors and control relays, and starter safety circuits.

2.7 VAV BOX CONTROLLERS-SINGLE DUCT

- A. General:
1. Provide one Native BACnet application controller for each VAV box that adequately covers all objects listed in object list for unit. All controllers shall interface to building controller via MS/TP LAN using BACnet protocol. No gateways shall be used. Controllers shall include on board CFM flow sensor, inputs, outputs and programmable, self-contained logic program as needed for control of units.
- B. BACnet Conformance:
1. Application controllers shall as a minimum support MS/TP BACnet LAN types. They shall communicate directly via this BACnet LAN at 9.6, 19.2, 38.4, and 76.8 Kbps, as a Native BACnet device. Application controllers shall be of BACnet conformance class 3 and support all BACnet services necessary to provide the following BACnet functional groups:
 - a. Files Functional Group
 - b. Reinitialize Functional Group
 - c. Device Communications Functional Group
 2. Refer to section 22.2, BACnet Functional Groups, in the BACnet standard, for a complete list of the services that must be directly supported to provide each of the functional groups listed above. All proprietary services, if used in the system, shall be thoroughly documented and provided as part of the submittal data. All necessary tools shall be supplied for working with proprietary information.
 3. Standard BACnet object types supported shall include as a minimum - Analog Input, Analog Output, Analog Value, Binary Input, Binary Output, Binary Value, Device, File and Program Object Types. All proprietary object types, if used in the system, shall be thoroughly documented and provided as part of the submittal data. All necessary tools shall be supplied for working with proprietary information.
 4. Application controllers shall include universal inputs with 10-bit resolution that can accept 3K and 10K thermistors, 0-5 VDC, and dry contact signals. Inputs on controller may be either analog or digital. Controller shall also include support and modifiable programming for interface to intelligent room sensor with digital display. Controller shall also include binary outputs on board. For applications using variable speed parallel fans, provide a single analog output selectable for 0-10 V or 0-20 mA control signals. Application controller shall include microprocessor driven flow sensor for use in pressure independent control logic. All boxes shall be controlled using pressure independent control algorithms and all flow readings shall be in CFM (LPS if metric).
 5. All program sequences shall be stored on board application controller in EEPROM. No batteries shall be needed to retain logic program. All program sequences shall be executed by controller 10 times per second and shall be capable of multiple PID loops for control of multiple devices. Programming of application controller shall be completely modifiable in the field over installed BACnet LANs or remotely via modem interface. Operator shall program logic sequences by graphically moving function blocks on screen

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and tying blocks together on screen. Application controller shall be programmed using the same programming tool as Building Controller and as described in operator workstation section. All programming tools shall be provided as part of system.

6. Application controller shall include support for intelligent room sensor (see Section 2.9.B.). Display on room sensor shall be programmable at application controller and include an operating mode and a field service mode. All button functions and display data shall be programmable to show specific controller data in each mode based on which button is pressed on the sensor. See sequence for specific display requirements for intelligent room sensor.
7. On board flow sensor shall be microprocessor driven and precalibrated at the factory. Precalibration shall be at 16 flow points as a minimum. All factory calibration data shall be stored in EEPROM. Calibration data shall be field adjustable to compensate for variations in VAV box type and installation. All calibration parameters shall be adjustable through intelligent room sensor. Operator workstation, portable computers and special hand-held field tools shall not be needed for field calibration.
8. Provide duct temperature sensor at discharge of each VAV box that is connected to controller for reporting back to operator workstation.

2.8 VAV BOX CONTROLLERS-DUAL DUCT

A. General:

1. Provide one and only one Native BACnet application controller for each dual-duct VAV box that adequately covers all objects listed in object list for unit. Systems that use two or more controllers for control of a single dual duct box shall be rejected. All controllers shall interface to building controller via MS/TP LAN using BACnet protocol. No gateways shall be used. Controllers shall include two (2) on board flow sensors, inputs, outputs and self-contained logic program as needed for control of units.

B. BACnet Conformance

1. Application controllers shall as a minimum support MS/TP BACnet LAN types. They shall communicate directly via this BACnet LAN at 9.6, 19.2, 38.4 and 76.8 Kbps, as a Native BACnet device. Application controllers shall be of BACnet conformance class 3 and support all BACnet services necessary to provide the following BACnet functional groups:
 - a. Files Functional Group
 - b. Reinitialize Functional Group
 - c. Device Communications Functional Group
2. Refer to section 22.2, BACnet Functional Groups, in the BACnet standard, for a complete list of the services that must be directly supported to provide each of the functional groups listed above. All proprietary services, if used in the system, shall be thoroughly documented and provided as part of the submittal data. All necessary tools shall be supplied for working with proprietary information.
3. Standard BACnet object types supported shall include as a minimum - Analog Input, Analog Output, Analog Value, Binary Input, Binary Output, Binary Value, Device, File, Program and Schedule object types. All proprietary object types, if used in the system, shall be thoroughly documented and provided as part of the submittal data. All necessary tools shall be supplied for working with proprietary information.
4. Application controllers shall include universal inputs with 10-bit resolution that can accept 3K and 10K thermistors, 0-5 VDC and dry contact signals. Inputs on controller may be either analog or digital. Controller shall also include support and modifiable programming for interface to intelligent room sensor with digital display. Controller shall include binary outputs on board. Application controller shall include two (2) microprocessor driven flow sensors, one for hot deck and one for cold deck, for use in pressure-independent control logic. All boxes shall be controlled using pressure independent control algorithms and all flow readings shall be in CFM (LPS if metric).

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5. All program sequences shall be stored on board application controller in EEPROM. No batteries shall be needed to retain logic program. All program sequences shall be executed by controller 10 times per second and capable of multiple PID loops for control of multiple devices. All calculations shall be completed using floating-point math and system shall support display of all information in floating-point nomenclature at operator's terminal. Programming of application controller shall be completely modifiable in the field over installed BACnet LANs or remotely via modem interface. Operator shall program logic sequences by graphically moving function blocks on screen and tying blocks together on screen. Application controller shall be programmed using the same programming tool as Building Controller as described in operator workstation section. All programming tools shall be provided as part of system.
6. Application controller shall include support for intelligent room sensor (see Section 2.9.B.). Display on field sensor shall be programmable at application controller and include an operating mode and a field service mode. All button functions and display data shall be programmable to show specific controller data in each mode based on which button is pressed on the sensor.
7. On-board flow sensor shall be microprocessor driven and precalibrated at the factory. Precalibration shall be at 16 flow points as a minimum. All factory calibration data shall be stored in EEPROM. Calibration data shall be field adjustable to compensate for variations in VAV box type and installation. All calibration parameters shall be adjustable through intelligent room sensor. Operator workstation, portable computers and special hand held field tools shall not be needed for field calibration.
8. Provide duct temperature sensors at discharge of cold duct and hot duct for report of data at operator workstation.

2.9 ELECTRONIC ACTUATORS

A. General:

1. Shall be Electric unless otherwise specified.
2. Shall be manufactured by Belimo. **Equal substitutions allowed with written approval by owner prior to bid.**
3. Five-year manufacturer's warranty. Two-year unconditional and three-year product defect from date of installation.
4. Furnish a Freeze-stat and install "Hard Wire" interlock to disconnect the mechanical spring return actuator power circuit for fail-safe operation. Use of the control signal to drive the actuators closed is not acceptable.
5. VAV box damper actuation shall be Floating type or Analog (2-10vdc, 4-20ma) and provide to VAV box manufactured for factory installation.
6. Booster-heat valve actuation shall be Floating type or Analog (2-10vdc, 4-20ma).
7. Primary valve control shall be Analog (2-10vdc, 4-20ma).
8. UL Listed Standard 873 and Canadian Standards Association Class 481302 shall certify Actuators.
9. Mechanical spring shall be provided when specified. Capacitors or other non-mechanical forms of fail-safe are not acceptable.
10. Position indicator device shall be installed and made visible to the exposed side of the Actuator. For damper short shaft mounting, a separate indicator shall be provided to the exposed side of the Actuator.
11. Overload Protection: Actuators shall provide protection against actuator burnout by using an internal current limiting circuit or digital motor rotation sensing circuit. Circuit shall insure that actuators cannot burn out due to stalled damper or mechanical and electrical paralleling. End switches to deactivate the actuator at the end of rotation are acceptable only for Butterfly Valve actuators.
12. A push button gearbox release shall be provided for all non-spring actuators.
13. Modulating actuators shall be 24VAC and consume 10VA power or less.
14. Conduit connectors are required when specified and when code requires it.

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B. Damper Actuators:

1. **All damper actuators shall be provided and installed by EMCS contractor.**
2. Electronic damper actuators shall be direct-coupled rotary type, suitable for mounting directly on the damper end shaft. Electronic damper actuators shall be properly sized to provide sufficient torque to position the damper throughout its operating range. Damper actuators used on economizer and/or outside air dampers shall be spring return.
3. Terminal unit damper actuators shall be electric, low voltage, utilizing floating control.
4. Outside Air and Exhaust Air Damper Actuators shall be Mechanical Spring Return. Capacitors or other non-mechanical forms of fail-safe are not acceptable. The actuator mounting arrangement and spring return feature shall permit normally open or normally closed positions of the damper as required.
5. **Economizer Actuators shall be provided and installed by EMCS contractor. Actuators shall utilize Analog control 2-10 VDC and shall give position feedback for Fault Detection and Diagnostics (FDD) monitoring. Floating control is not acceptable. Actuators shall be Mechanical Spring Return. Equal to Belimo LF-24-SR.**
6. Electric damper actuators (including VAV box actuators) shall be direct shaft mounted and use a V-bolt and toothed V-clamp causing a cold weld effect for positive gripping. Single bolt or setscrew type fasteners are not acceptable.
7. One electronic actuator shall be direct shaft mounted per damper section. No connecting rods or jackshafts shall be needed. Small outside air and return air economizer dampers may be mechanically linked together if one actuator has sufficient torque to drive both and damper drive shafts are both horizontal installed.
8. Multi-section dampers with electric actuators shall be arranged so that each damper section operates individually. One electronic actuator shall be direct shaft mounted per damper section. (See below execution section for more installation details.)

2.10 DAMPERS

A. Control Dampers:

1. Control air dampers shall be parallel blade for two-position control and opposed blade for modulating control applications. Dampers shall be galvanized with nylon bearings. Blade edge and tip seals shall be included for all dampers. Leakage through the damper shall not exceed **4 CFM per square foot at 1" w.c.** Blades shall be 16-gauge minimum and 10" wide maximum and frame shall be of welded channel iron. Dampers over 48" wide shall be equipped with a jackshaft to provide sufficient force throughout the intended operating range.
2. All dampers used for modulating service shall be opposed blade type arrange for normally open or normally closed operation as required. The damper is to be sized so that when wide open the pressure drop is a sufficient amount of its close-off pressure drop for effective throttling.
3. All dampers used for two-position or open-close control shall be parallel blade type arranged for normally open or closed operation as required.
4. Damper linkage hardware shall be constructed of aluminum or corrosion resistant zinc & nickel-plated steel and furnished as follows:
 - a. Bearing support bracket and drive blade pin extension shall be provided for each damper section. Sheet metal contractor shall install bearing support bracket and drive blade pin extension. Sheet metal contractor shall provide permanent indication of blade position by scratching or marking the visible end of the drive blade pin extension.
 - b. Drive pin may be round only if V-bolt and toothed V-clamp is used to cause a cold weld effect for positive gripping. For single bolt or set-screw type actuator fasteners, round damper pin shafts must be milled with at least one side flat to avoid slippage.

B. Multiple Section Dampers:

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1. Size damper sections based on actuator manufacturers specific recommendations for face velocity, differential pressure and damper type. In general:
 - a. Damper section shall not exceed 24 ft-sq. with face velocity £ 1500 FPM.
 - b. Damper section shall not exceed 18 ft-sq. with face velocity £ 2500 FPM.
 - c. Damper section shall not exceed 13 ft-sq. with face velocity £ 3000 FPM.
2. Damper manufacturer shall supply alignment plates for all multi-section dampers.
3. Multiple section dampers of two or more shall be arranged to allow actuators to be direct shaft mounted on the outside of the duct.
4. Multiple section dampers of three or more sections wide shall be arranged with a 3-sided vertical channel (8" wide by 6" deep) within the duct or fan housing and between adjacent damper sections. Vertical channel shall be anchored at the top and bottom to the fan housing or building structure for support. The sides of each damper frame shall be connected to the channels. Holes in the channel shall allow damper drive blade shafts to pass through channel for direct shaft mounting of actuators. Open side of channel shall be faced down stream of the airflow, except for exhaust air dampers.
5. Multiple section dampers to be mounted flush within a wall or housing opening shall receive either vertical channel supports as described above or sheet metal standoff collars. Sheet metal collars (12" minimum) shall bring each damper section out of the wall to allow direct shaft mounting of the actuator on the side of the collar.

2.11 ENCLOSURES

- A. NEMA 2 rated enclosures for inside mounting, provide with weather shield for outside mounting.
- B. All controllers, power supplies, and relays shall be mounted in enclosures.
- C. Enclosures may be NEMA 1 when located in a clean, dry, indoor environment. Indoor enclosures shall be NEMA 12 when installed in other than a clean environment.
- D. Enclosures shall have hinged, locking doors.
- E. Provide laminated plastic nameplates for all enclosures in any mechanical room or electrical room. Include location and unit served on nameplate. Laminated plastic shall be 1/8" thick sized appropriately to make label easy to read.
- F. All direct digital controllers located indoors shall be installed in NEMA 1 enclosures. All direct digital controllers located outdoors shall be installed in NEMA 3R enclosures. Enclosures shall be of suitable size to accommodate all power supplies, relays, and accessories required for the application. Each enclosure shall include a perforated subpanel for direct mounting of the enclosed devices. Include matched key locks for all enclosures provided.

2.12 SENSORS, SWITCHES, CONTROLLERS, TRANSDUCERS, AND MISCELLANEOUS DEVICES

- A. Temperature Sensors:
 1. All temperature sensors to be solid state electronic, factory-calibrated to within 0.5°F, totally interchangeable with housing appropriate for application. Wall sensors to be installed as indicated on drawings. Mount 48 inches above finished floor. Duct sensors to be installed such that the sensing element is in the main air stream. Immersion sensors to be installed in wells provided by control contractor, but installed by mechanical contractor. Immersion wells shall be filled with thermal compound before installation of immersion sensors. Outside air sensors shall be installed away from exhaust or relief vents, not in an outside air intake and in a location that is in the shade most of the day.
- B. Wall Sensor:
 1. Standard wall sensor shall use solid-state sensor identical to intelligent room sensor and shall be packaged in aesthetically pleasing enclosure. Sensor shall provide override function, warmer/cooler lever for set point adjustment and port for plug-in of Field Service

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Tool for field adjustments. Override time shall be stored in controller and be adjustable on a zone-by-zone basis. Adjustment range for warmer/cooler lever shall also be stored in EEPROM on controller. All programmable variables shall be available to Field Service Tool through wall sensor port.

- C. Field Service Tool:
 - 1. Field service tool shall allow technician to view and modify all setpoints and tuning parameters stored in application controller. In addition, technician shall be able to view status of all inputs and outputs on digital readout. Each piece of data shall have a data code associated with it that is customizable.
 - 2. Field service tool shall plug into wall sensor and provide all the functionality specified. Operator workstation shall include the capability to disable operation of the field service tool.
 - 3. Provide Field Service Tool(s) for this project.
- D. Network Connection Tool:
 - 1. Network connection tool shall allow technician to connect a laptop to any MS/TP network or at any MS/TP device and view and modify all information throughout the entire BACnet network. Laptop connection to tool shall be via Ethernet or PTP.
 - 2. Provide quick connect to MS/TP LAN at each controller. Tool shall be able to adjust to all MS/TP baud rates specified in the BACnet standard.
 - 3. Provide 1 Network Connection Tool for this project.
- E. Differential Pressure Switches (Air):
 - 1. Provide differential pressure switches across fans and filters for status indication. Differential pressure switches shall have an adjustable setpoint from 0.05" w.c. to 2" w.c. with a switch differential that progressively increases from 0.02" w.c. at minimum to 0.8" w.c. at maximum. Switch shall be SPDT rated for 15A (non-inductive) at 277VAC.
- F. Float Switches:
 - 1. Provide float switches in condensate drain pans as required by code. Float switches shall utilize a magnetically actuated dry reed switch. Float shall be constructed of seamless polypropylene. Switch shall be SPDT rated for 16A (non-inductive) at 120VAC.
- G. Mixed Air Low Limit Controllers (Freezestats):
 - 1. Mixed air low limit controllers shall be manual reset, adjustable setpoint with 20-foot element serpentine across the entering air face of center cooling coil. Control shall be responsive only to the lowest temperature along the element.
- H. Static High Limit Controllers:
 - 1. Discharge static high limit controllers shall be provided on all VAV AHU systems. When discharge static pressure exceeds setpoint, the supply fan shall be de-energized. Manual reset shall be required.
- I. Static Pressure Transducers (Air):
 - 1. Provide static pressure transducers for monitoring supply duct static pressure. Static pressure transducers shall be 100% solid state and shall include glass on silicon, ultra stable capacitance sensors. Each static pressure transducer shall incorporate short circuit and reverse polarity protection. Transmitter output shall be either 0-10VDC or 4-20mA. Static pressure transducers are to be provided in an enclosure that is suitable for duct mounting. The desired setpoint is to be in the top 50% of the transmitter's operating range.
- J. Differential Pressure Transducers (Air):
 - 1. Provide differential pressure transducers for monitoring air system and airflow measuring station differential pressures. Differential pressure transducers shall be 100% solid state and shall include glass on silicon, ultra stable capacitance sensors. Each differential

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pressure transducer shall incorporate short circuit and reverse polarity protection. Transducer output shall be either 0-10VDC or 4-20mA. Differential pressure transducers are to be provided in an enclosure that is suitable for duct mounting. The desired setpoint is to be in the top 50% of the transducer's operating range.

- K. Airflow Measuring Stations:
1. Where shown on the plans, provide airflow measuring stations utilizing multiple point averaging sensors for total pressure measurement and bullet-nose probes for static pressure measurement. Airflow measuring stations shall be factory assembled units with a sheet metal casing of at least 16 gauge galvanized steel. Airflow measuring stations shall be equipped with 3/8" aluminum hexagon cell straightening vanes. Pressure drop across airflow measuring station shall be less than 0.13" w.c. at 2000 FPM with the straightening vanes installed. Accuracy of airflow measurement shall be +/- 2% at 6000 FPM inlet velocity and +/- 0.5% at 2000 FPM inlet velocity.
- L. Current Sensing Relays:
1. Provide current switches for indication of equipment status. Amperage ratings shall be adjustable with the desired setpoint to be in the top 50% of the current relay's operating range. Current sensing relays shall incorporate trip indication LED's and shall be sized for proper operation with the equipment served.
- M. Relative Humidity Sensors:
1. Relative humidity sensors shall have an accuracy of +/- 2% from 5 to 95% RH. Output signal shall be either be 0-10VDC or 4-20mA. Humidity transmitters shall be factory calibrated and require no field setting.
- N. CO2 Sensors:
1. CO2 sensors shall be space or duct mounted carbon dioxide sensors as required by the application. Space CO2 sensors shall be mounted next to space temperature sensors. The sensor shall have a range of 0-2000 ppm with an accuracy of $\pm 5\%$. The response time for the sensor shall be less than one minute. The sensor shall be capable of providing an analog signal proportional to the CO2 level sensed. The signal shall be either 0-10VDC or 4-20mA.
- O. Duct/Well Sensors:
1. Sensors for duct and water temperature sensing shall incorporate either RTD or Thermistor sensing devices. Sensing element accuracy shall be 0.1% over the sensor span or better. Where the element is being used for sensing mixed air or coil discharge temperatures and/or the duct cross sectional area is in excess of 14 square feet, the element shall be of the averaging type. Averaging duct sensors shall utilize a 6, 12, or 24 foot sensing element. Immersion sensors shall use matched 316 stainless steel bulb wells. All duct and immersion sensors shall be provided with conduit connection housings. Sensors shall be provided with adequate standoffs for insulation installation.
- P. Electronic to Pneumatic Transducers:
1. As required by the sequence of operations, provide electronic to pneumatic transducers. Transducers shall be used for the conversion of a pulse or a 4-20mA DDC analog output signal to a 3 to 18 psi pneumatic signal. Transducers shall be equipped with a 0-30 psi pressure gauge and have an analog feedback feature.
- Q. Selector Switches:
1. Selector switches shall be 2 or 3-position, knob, or key type as required by the sequence of operation. Selector switches shall feature oil tight construction and be fitted with snap-fit contact blocks rated for 10A, 600VAC/DC operation. Labels shall be provided indicating switch position.
- R. Pushbutton Switches:

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1. Pushbutton switches shall be either maintained or momentary as required by the sequence of operation. Pushbutton switches shall feature oil tight construction and be fitted with snap-fit contact blocks rated for 10A, 600VAC/DC operation. Labels shall be provided indicating switch function.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Prior to starting work, carefully inspect installed work of other trades and verify that such work is complete to the point where work of this Section may properly commence.
- B. Notify the owners` representative in writing of conditions detrimental to the proper and timely completion of the work.
- C. Do not begin work until all unsatisfactory conditions are resolved.
- D. Each bid must include all costs associated with providing wiring, conduit, concrete trenching, and earth trenching.

3.2 OPERATION

- A. BACnet Object List:
 1. The following points as defined for each piece of equipment are designated as follows:
 - a. Binary Out (BO) - Defined as any two-state output (start/stop) (enable/disable), etc.
 - b. Binary In (BI) - Defined as any two-state input (alarm, status), etc.
 - c. Analog In (AI) - Defined as any variable input (temperature) (position), etc.
 - d. Analog Out (AO) - Defined as any electrical variable output. 0-20mA, 4-20mA, and 0-10VDC are the only acceptable analog outputs. The driver for analog outputs must come from both hardware and software resident in the controllers. Transducers will not be acceptable under any circumstance.
 2. Each and every point will be checked out by the Contractor and the Owner's Representative will inspect each point with the bidder prior to acceptance. Provide complete written documented inspections, test, and checkout report. Calibrate all equipment.
- B. DDC Object Type Summary:
 1. Provide all database generation.
 2. Displays:
 - a. System displays shall show all analog and binary object types within the system. They shall be logically laid out for easy use by the owner. Provide outside air temperature indication on all system displays associated with economizer cycles.
 3. Run Time Totalization:
 - a. At a minimum, run time totalization shall be incorporated for each monitored supply fan, return fan, exhaust fan, hot water and chilled water pumps. Warning limits for each point shall be entered for alarm and or maintenance purposes.
 4. Trendlog:
 - a. All binary and analog object types (including zones) shall have the capability to be automatically trended.
 5. Alarm:
 - a. All analog inputs (High/Low Limits) and selected binary input alarm points shall be prioritized and routed (locally or remotely) with alarm message per owner's requirements.
 6. Database Save:
 - a. Provide backup database for all stand-alone application controllers on disk.

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3.3 INSTALLATION

A. General:

1. Install in accordance with manufacturer's instructions.
2. Provide all miscellaneous devices, hardware, software, interconnections installation, and programming required to ensure a complete operating system in accordance with the sequences of operation and point schedules.
3. Provide a complete and operational temperature control and building automation system based on the following points and sequence of operation. The system shall be complete as to sequences and standard control practices. The determined point list is the minimum amount of points that are to be provided. If additional points are required to meet the sequence of operation, they will be provided.

B. Location and Installation of Components:

1. Locate and install components for easy accessibility; in general, mount 48 inches above floor with minimum 3'-0" clear access space in front of units. Obtain approval on locations from owner's representative prior to installation.
2. Enclosures and hardware or wiring shall not block or limit accessibility to service compartments of any other equipment.
3. The work shall be coordinated fully, as it pertains to the fire protection system, fire alarm system, and electrical power system. All items shall be terminated in the DDC controllers in a predetermined order as indicated in the submittal drawings.
4. All instruments, switches, transmitters, etc., shall be suitably wired and mounted to protect them from vibration, moisture, and high or low temperatures.
5. Identify all equipment and panels. Provide permanently mounted tags for all panels.
6. Provide stainless steel or brass thermowells suitable for respective application and for installation under other sections - sized to suit pipe diameter without restricting flow.

C. Interlocking and Control Wiring:

1. Provide all interlock and control wiring. All wiring shall be installed neatly and professionally, in accordance with Specification Division 26 and all national, state, and local electrical codes.
2. Provide wiring as required by functions as specified and as recommended by equipment manufacturers, to serve specified control functions. Provide shielded low capacitance wire for all communications trunks.
3. Control wiring shall not be installed in power circuit raceways. Magnetic starters and disconnect switches shall not be used as junction boxes. Provide auxiliary junction boxes as required. Coordinate location and arrangement of all control equipment with the owner's representative prior to rough-in.
4. Provide auxiliary pilot duty relays on motor starters as required for control function.
5. Provide power for all control components from nearest electrical control panel or as indicated on the electrical drawings. Coordinate with electrical contractor.
6. All control wiring in the mechanical, electrical, telephone and boiler rooms to be installed in conduit. All other wiring to be installed neatly and inconspicuously per local code requirements. If local code allows, control wiring above accessible ceiling spaces may be run with plenum rated cable (without conduit).

D. Installation Requirements:

1. Any panels associated with the control system shall be furnished and installed under this section of the work. Panel wiring shall be terminated by connecting to numbered terminals strips. Wire nut connections shall not be allowed. All wiring shall be color coded and shall be tagged for future identification.
2. Unless otherwise specified, all devices, panels, etc., furnished and/or installed by the Contractor shall be located where they can be calibrated and maintained from the floor without use of a ladder. These items shall be identified by means of plates made of plastic suitably engraved, embossed, or punched, plastic tape will not be acceptable. At

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completion of job, the Contractor shall submit record drawings of any changes made during construction. This submittal shall be a condition of final payment.

3. Any conduit on roof shall be absolute minimum and shall have prior written approval.
4. All conduit used indoor and outdoor shall be metal and shall be of type and fittings to minimize corrosion and moisture entry.

E. Cable Installation and Attachments:

1. Control System wiring and equipment installation shall be in accordance with good engineering practices as established by the TIA/EIA and the NEC. Wiring shall meet all state and local electrical codes. All wiring shall test free from all grounds and shorts. All cable shall be supported from the building structure and bundled.
2. The support system shall provide a protective pathway to eliminate stress that could damage the cabling. The cable shall not be crushed, deformed, skinned, crimped, twisted, or formed into tight radius bends that could compromise the integrity of the cabling. Controls cables shall not be run loose on ceiling grid or ceiling tiles. Support shall be provided by mounting appropriate fasteners which may be loaded with multiple cables. Provided that the weight load is carried by the support rod or wire, the support assembly may attach to the ceiling grid for lateral stabilization. The required support wires for the ceiling grid or light fixtures shall not be utilized. Any fastener attached to the ceiling grid shall not interfere with inserting or removing ceiling tiles. All cabling and supports must be positioned at least 12 inches above the ceiling grid.
3. Controls cables shall be run in bundles above accessible ceilings and supported from building structure. Cabling shall be loosely bundled with wire wraps randomly spaced at 30 to 48 inches on center, wire wraps shall not be tight enough to deform cabling and shall not be used to support the cabling.
4. Attachments for cabling support shall be spaced at 48 to 60 inches on center. The cable bundle shall not be allowed to sag more than 12 inches mid-span between attachments. Attachments shall be sized as follows:

Bundles up to 1/2" dia. (Ten 1/4" cables)	2" bridle ring, Caddy #4BRT32 or equivalent
Bundles up to 3/4" dia. (Sixteen 1/4" cables)	3/4" J-Hook, Caddy #CAT12 or equivalent
Bundles up to 1-5/16" dia. (Fifty 1/4" cables)	1-5/16" J-Hook, Caddy #CAT21 or equivalent
Bundles up to 2" dia. (Eighty 1/4" cables)	2" J-Hook, Caddy #CAT21 or equivalent

Split bundles greater than 2" dia. or provide cable tray.
5. Do not mix different signal strength cables on the same J-Hook (i.e. fire alarm, 25 volt speaker cable). Multiple J-Hooks can be on the same attachment point up to the rated weight of the attachment device.
6. Controls cables shall be run in conduit stubs, where stubs are provided, from wall mounted devices to above accessible ceilings. Conduit shall be required only within walls and concealed spaces to provide access. Provide a plastic snap bushing or sleeve on the end of each conduit stub such as Thomas & Betts Catalog no. 443 - 3/4", 424 - 1", 425 - 1 1/4", 427 - 2" or equivalent.
7. Conduit, duct, or track shall be used for controls cable in exposed areas.
8. All conduit, ducts, track and raceways shall be supported from the structure at industry standard intervals for the size specified, utilizing proper anchoring devices and techniques for each type of cable used.
9. All penetrations through fire rated walls or floors shall feature a short length of metal conduit. The hole shall be neatly cut, not oversize or irregular. Seal the interior of the conduit sleeve around the cables and around the outside of the sleeve on each side of the penetration with fire-stop caulk or putty, such as Minnesota Mining & Mfg. Co. (3M) - CP 25WB+ caulk, MPS-2+ putty, or equivalent. Install according to the manufacturers' instructions.

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10. All cable shall have a label on both ends utilizing self-laminating, flexible vinyl film, and non-smear nylon marking pens. Utilize Tyton Corporation Part No. RO175 Rite-On labels and Part No. FTP1 nylon marking pens or equivalent.
11. Each cable run shall include a three foot service loop with wire tie located in the ceiling above the control unit panel. This is to allow for future re-termination or repair.
12. No terminations or splices shall be installed in or above ceilings. Cable shall be continuous from one device termination to the next.
13. Mount all equipment firmly in place. Route cable in a professional, neat, and orderly installation.
14. All cabling shall be placed with regard to the environment, EMI/RFI (interference) and its effect on communication signal transmission.
15. Do not route any controls cable within two feet of any light fixture, HVAC unit service access area, electric panel, or any device containing a motor or transformer.
16. Low voltage controls cable will not be installed in the same conduit, duct or track with line voltage electrical cable.
17. Maximum pulling tension should not exceed 25 lb/ft. or manufactures recommendation, whichever is less.
18. Any pulling compounds utilized must be approved by the cable manufacturer and shall not degrade the strength or electrical characteristics of the cable.
19. Cable bends shall not exceed the manufacturers` suggested bend radius.
20. Provide for adequate ventilation in all equipment panels.
21. Provide wiremold where wiring must run exposed. Obtain advance approval from Architect and Owner before running exposed. Coordinate with Owner and Architect.
22. For all wiring, provide numbering on all terminations (both ends).
23. Label all panels, cans, enclosures, controllers and correlate with air conditioning units served. Labeling shall relate to shop drawings and equipment served. Provide wiring diagram inside each enclosure.
24. Provide a rain-tight enclosure for each rooftop unit controller.
25. Locate outdoor air sensors shielded and on northern exposure.

F. Termination practices:

1. Strip back only as much cable jacket as required to terminate.
2. Preserve wire twists as closely as possible to point of termination (0.5" maximum) to keep signal impairment to a minimum.
3. Avoid twisting cable during installation.
4. Electrical Interlocks:
 - a. All electrical interlocks shall be provided as specified. All electrical interlocks shall be made by means of motor starters or shall be accomplished by separate relays. No motor power lead shall be utilized in an interlock circuit.

3.4 SERVICES

A. Field Services:

1. Prepare and start logic control system under provisions of this section.
2. Start-up and commission systems. Allow sufficient time for start-up and commissioning prior to placing control systems in permanent operation.
3. Provide the capability for off-site monitoring at control contractor`s local or main office. At a minimum, off-site facility shall be capable of system diagnostics and software download. Owner shall provide phone line for this service for 1 year or as specified.
4. Provide Owner`s Representative with spare parts list. Identify equipment critical to maintaining the integrity of the operating system.

B. HVAC Training:

1. Provide application engineer to instruct owner in operation of systems and equipment.
2. Provide system operator`s training to include (but not limited to) such items as the following: modification of data displays, alarm and status descriptors, requesting data, execution of commands, and request of logs. Provide this training to a minimum of 3

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- persons.
- 3. Provide on-site training above as required, up to 16 hours as part of this contract.
- C. Demonstration:
 - 1. Provide systems demonstration under provisions of Section 23 00 00.
 - 2. Demonstrate complete operating system to owner's representative.
 - 3. Provide certificate stating that control system has been tested and adjusted for proper operation.
- D. Programming:
 - 1. Prior to completion of the control installation, schedule time with Owner's designated representatives to evaluate and select programming options and requirements. Contractor shall provide engineer for such meetings and consultations on an as-needed basis. Preparation time for the conference shall be in addition to the "in conference" time, and shall be provided on an as-needed basis without additional cost to the Owner.
 - 2. The Contractor shall also provide additional coordination as needed with the Owner's representative and Engineer to formulate and determine functions, reports, graphics, and alarms most desirable and suitable for the school district and writing the software capability. Programming of these items shall be provided. The Contractor shall program the system using coordinated Owner provided schedules for time of day and holidays.
 - 3. No hardware change shall be required for program changes.
- E. Documentation:
 - 1. The Contractor shall provide a complete documentation package to the owner which shall include floor plans indicating location of EMCS equipment, wiring diagrams, bill of materials, data base information, and sequences of operation. The sequences of operation shall be submitted and approved by the owner in writing prior to installation and programming.
- F. Coordination:
 - 1. For construction project installations where electrical and mechanical contractors are responsible for their respective trade, the electrical contractor is to provide line voltage to required equipment and the mechanical contractor is to install any devices that are to be included in systems. It is the controls contractor's responsibility to provide all devices with diagrams for location and coordinate with mechanical contractor prior to mechanical contractor starting installations. Controls contractor shall coordinate and provide all required work and wiring for duct mounted smoke detectors, control relays for unit shutdown, and interface with any fire alarm system. For installations where controls only work is provided, all necessary work shall be performed by the controls contractor.

PART 4 SEQUENCE OF OPERATION

4.1 SEQUENCE OF OPERATION

- A. The following are sequences of operations which will be accomplished by the EMCS. Coordinate with Owner in operating equipment to maximize comfort and economy. All points required to accomplish the sequences will be provided and connected to the EMCS.
- B. DDC Control - Rooftop Units, Split Systems, DX Units, and Heat Pumps: Each unit shall be started and stopped by the EMCS. Automatic override during low or high ambient temperatures shall be provided. Provide one outdoor air sensor per school. Provide an indoor air space sensor for every unit to monitor space temperature, and be capable of remote resetting space temperature by Owner.
- C. Provide one outside air relative humidity sensor and temperature sensor per campus. It is also acceptable to obtain outside air ambient conditions from a nearby weather station.

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D. Acronyms:

EMCS - Energy Management Control System. The EMCS controls all of the HVAC functions as well as lighting schedules and lawn sprinkler schedules.

TCS - Temperature Control Sensor. This is the device that controls the temperature in the space.

VFD - Variable Frequency Drive.

DDC - Direct Digital Control.

OAU - Outside Air Unit.

CO2 - Carbon Dioxide.

CFM - Cubic Feet per Minute

GPM - Gallons Per Minute

A/H - Air Handler

F/C - Fan Coil Unit

CHW - Chilled Water

HW - Hot Water

VAV - Variable Air Volume

UCP - Unit Control Panel

ppm - Parts Per Million - A measurement of the concentration of one substance within another. In this case, it is the number of CO2 particles in a sample of one million air particles.

Adj - Adjustable - All set points are assumed to be adjustable whether specified or not. The set points specified are values that should be programmed initially but can be changed if necessary.

E. Definitions:

1. Occupancy Period:

a. The period of the day that the owner wants the environmental conditions acceptable for occupancy. Outside air ventilation may not be enabled at all times during the occupancy period. This schedule will be defined for each component of the HVAC system and will not be the same for all components.

2. Outside Air Schedule:

a. The period of the day that outside air ventilation is enabled. This schedule will be defined for each component of the HVAC system.

3. Warm-up Mode:

a. The time between the end of the unoccupied and start of the occupied period during which the space temperature is increased (night setback) to the normal occupancy temperature.

4. Cool-down Mode:

a. The time between the end of the unoccupied and start of the occupied period during which the space temperature is lowered (night setup) to the normal occupied temperature.

5. Unoccupied Period:

a. The period of the day that the temperature control setting is lowered (heating) or raised (cooling) to conserve on the amount of energy required to condition the building. The fans are also turned "OFF" to conserve energy.

F. Documentation:

1. The Contractor shall provide a complete documentation package to the owner which shall include floor plans indicating location of EMCS equipment, wiring diagrams, bill of materials, database information, and sequences of operation. The sequences of operation shall be submitted and approved by the owner in writing prior to installation and programming.

END OF SECTION

SECTION 23 09 23G

SEQUENCE OF OPERATIONS ROOFTOP UNIT SEQUENCES

PART 1 GENERAL

1.1 NOT USED

PART 2 - PRODUCTS

2.1 NOT USED

PART 3 - EXECUTION

3.1 SINGLE ZONE DX RTU WITH IONIZER

- A. General:
 - 1. System consists of a direct expansion (DX) cooling section, heating section, supply fan section, and an outside air damper.
- B. Unit Enabling/Disabling:
 - 1. The occupied/unoccupied mode of operation shall be defined by the EMCS optimum start/stop schedule.
 - 2. During unoccupied times, as required to maintain the unoccupied heating and cooling setpoints 55°F (adj.) heating and 85°F (adj.) cooling as sensed by the space temperature sensor.
 - 3. When the override pushbutton is depressed, the unit shall be indexed to the occupied mode for an adjustable period of time (initially 1 hour). After the override time period has expired, the unit shall revert back to the unoccupied mode.
- C. Fan Control:
 - 1. Fan speed shall be controlled by the unit's internal controls. If unit requires fan speed to be controlled by external source, contractor to provide everything necessary to achieve fan control as noted below.
 - a. Fan shall run in tandem with each associated stage of cooling/heating. Fan speeds shall correlate and be consistent with what is set by TAB.
 - b. For a two stage unit, fan shall have low and high fan speeds to coincide with each stage.
 - c. For a three stage unit, fan shall have low, medium and high fan speeds to coincide with each stage.
 - d. For a four stage unit, fan shall have low, low-medium, medium high and high fan speeds to coincide with each stage.
- D. Outside Air Damper Control:
 - 1. Warm-up or Cool-down:
 - a. The outside air damper shall be closed.
 - 2. Occupied Mode:
 - a. The outside air damper shall be at the minimum position (adj.) as set by TAB.
 - 3. Unoccupied Mode:
 - a. The outside air damper shall be closed.
- E. Temperature Control:
 - 1. Warm-up or Cool-down:

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- a. The EMCS shall determine the required warm-up or cool-down period based on the optimized start algorithm.
 - b. Upon enabling the unit, the unit shall heat and cool as required to maintain the occupied heating and cooling setpoints (initially 70°F heating, 74°F cooling) as sensed by a space temperature sensor.
 - c. Once the occupied setpoint temperature has been reached, the EMCS shall switch the unit to the occupied mode.
 2. Occupied Mode:
 - a. Space setpoint shall be user adjustable within $\pm 2^{\circ}\text{F}$ (adj.).
 - b. In the occupied mode of operation, the unit supply fan shall cycle with a call for heating or cooling.
 - c. The unit shall heat and cool as required to maintain the occupied heating and cooling setpoints (initially 70°F heating, 74°F cooling) as sensed by a space temperature sensor.
 - d. When space temperature rises above occupied cooling setpoint, the DDC controller shall energize the first stage of mechanical cooling. Each stage cooling shall have a 20-minute (adj.) runtime before allowing the next stage to engage. When space temperature continues to rise 2°F (adj.) above occupied cooling setpoint, the DDC controller shall energize all stages of mechanical cooling.
 - 1) Unit shall run in second/medium/high stage cooling until space temperature drops to occupied space cooling setpoint. Unit shall then run in first stage of cooling until space temperature drops 1°F (adj.) below space temperature setpoint and then cycle off.
 - e. When space temperature drops below occupied heating setpoint, the DDC controller shall energize the first stage of heating. When space temperature continues to drop 2°F (adj.) below occupied heating setpoint, the DDC controller shall energize the second stage of heating.
 - 1) Unit shall run in second stage heating until space temperature rises to occupied space heating setpoint. Unit shall then run in first stage heating until space temperature rises 1°F (adj.) above space temperature setpoint and then cycle off.
 3. Unoccupied Mode:
 - a. The EMCS shall enable the unit as required to maintain the unoccupied heating and cooling setpoints (initially 55°F heating and 85°F cooling) as sensed by the space temperature sensor.
 - b. When override button is pushed, the unit shall index to occupied mode for one (1) hour (adj.). After the override time has expired, the unit shall revert to unoccupied mode.
- F. Dry Bulb Economizer Mode:
1. In occupied or unoccupied mode, when space temperature is above space setpoint, outside air temperature is 60°F (adj.) or below and there is a call for cooling, the unit shall be in economizer mode. Outside air damper is to open 100% and to provide free cooling to the space until the space temperature setpoint is satisfied. If space is not satisfied within 10 min (adj.), mechanical cooling will be enabled.
 2. Units equipped with a powered exhaust fan, the fan is to be enabled any time the unit is in economizer mode.
 3. All sensors necessary for economizer mode operation and FDD shall be provided and fully controlled by EMCS contractor.
- G. Dehumidification Mode (Only Applies to Units With Hot Gas Bypass):
1. Hot Gas Re-heat:
 - a. Dehumidification mode shall be energized when the space temperature setpoint is satisfied and the space relative humidity is above 58% (adj.). Reheat shall be controlled to supply neutral air. Dehumidification shall disable when space relative

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humidity is 2% (adj.) below humidity setpoint.

- H. Fault Detection and Diagnostics (FDD):
- Each DX rooftop unit shall have its economizer status monitored by the EMCS. The unit's fault detection and diagnostics shall be capable of generating a visible alarm to be seen by the EMCS should the unit be in economizer when conditions are not met, or vice versa.

I. Control Points:

Description	Type
Fan Amps/Status	AI
Compressor Amps/Status (Each Compressor)	AI
Mixed Air Temperature	AI
Supply Air Temperature	AI
Outside Air Temperature (Global)	AI
Space Temperature	AI
Space Humidity (Only Units with Hot Gas Bypass)	AI
Bipolar Ionization Status	DI
Outside Air Damper Feedback	AI
Fan Start/Stop Command (Each Fan)	DO
Fan Speed (Only If Required by Unit)	AO
Compressor Cooling Command (Each Stage)	DO
Heating Command (Each Stage)	DO
Hot Gas Bypass Reheat (Only Units with Feature)	DO/AO
Outside Air Damper	AO

3.2 VARIABLE AIR VOLUME DX RTU

- A. General:
- The unit shall have supply fan, preheat section, heating, DX coil, and outside air damper. The control system contractor shall provide a dedicated stand-alone DDC controller for each unit.
- B. Unit Enabling/Disabling:
- The occupied/unoccupied mode of operation shall be defined by the EMCS optimum start/stop schedule.
 - During unoccupied times, a minimum number of associated VAV boxes, 40% (adj.), shall request the AHU before AHU is allowed to operate.
- C. Fan Control:
- The unit shall operate when the associated VAV boxes it serves are in occupied mode and operational.
 - The supply fan VFD will be controlled by static pressure transducer 2/3rds of the way down the longest supply duct run. If the static pressure is below setpoint, the supply fan speed will be increased. If the static pressure is above setpoint, the supply fan speed will be decreased.
 - A static pressure reset algorithm shall be used with minimum and maximum limits of .5" to 1.2" (adj.). VAV boxes shall be polled for damper position. Static pressure shall be slowly decreased until 25% (adj.) of the VAV box damper positions are at least 90% open.
- D. Temperature Control:

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1. Warm-up or Cool-down:
 - a. The EMCS shall determine the required warm-up or cool-down period based on the optimized start algorithm.
 - b. Upon enabling the unit, the unit shall heat or cool as required to satisfy the occupied heating or cooling setpoints of 60% (adj.) of the VAV boxes (initially 70°F heating, 74°F cooling) as sensed by a space temperature sensor.
 - c. During warm-up, the supply air discharge temperature shall be 90°F (adj.). During cool-down, the supply air temperature shall be 55°F (adj.).
 - d. Once the occupied setpoint temperature threshold has been reached, the EMCS shall switch the unit to the occupied mode.
 2. Occupied Mode:
 - a. Preheat:
 - 1) The preheat section will modulate to maintain precool discharge air temperature of 50°F (adj.). Preheat coil shall be disabled when ambient outside air temperature is above 55°F (adj.).
 - b. Cooling Coil:
 - 1) Cooling shall be disabled when ambient outside air temperature is less than 50°F (adj.).
 - 2) The cooling coil will modulate to initially maintain unit discharge supply air temperature of 55°F (adj.). There shall be a linear supply air temperature reset algorithm in between:
 - (a) 55°F (adj.) supply air temperature supply when outside air temperature is at or above 80°F (adj.)
 - (b) 60°F (adj.) supply air temperature supply when outside air temperature is at or below 50°F (adj.)
 3. Unoccupied Mode:
 - a. The EMCS shall enable the unit as required to maintain the unoccupied heating and cooling setpoints (initially 55°F heating and 85°F cooling) as sensed by the VAV box space temperature sensors. A minimum number of associated VAV boxes, 40% (adj.), shall request the AHU before AHU is allowed to operate.
- E. Outside Air Damper Control:
1. Warm-up or Cool-down:
 - a. The outside air damper shall be closed.
 2. Occupied Mode:
 - a. The outside air damper shall be at the minimum position (adj.) as set by TAB
 - b. EMCS shall monitor the CO2 level at return air duct/plenum:
 - 1) When CO2 levels are below 1100 ppm (adj.), the outside air damper shall be at the minimum position (adj.) as set by TAB. Reference scheduled CFM.
 - 2) When CO2 levels are above 1200 ppm (adj.), the outside air damper shall be at the maximum position (adj.) as set by TAB. Reference scheduled CFM.
 3. Unoccupied mode:
 - a. The outside air damper shall be closed.
- F. Dry Bulb Economizer Mode:
1. In occupied or unoccupied mode, outside air temperature is 60°F (adj.) or below and there is a call for cooling, the unit shall be in economizer mode. Outside air damper is to open 100% and to provide free cooling. If cold deck setpoint is not met within 10 min (adj.), mechanical cooling will be enabled.
 2. Units equipped with a powered exhaust fan, the fan is to be enabled any time the unit is in economizer mode.
 3. All sensors necessary for economizer mode operation and FDD shall be provided and fully controlled by EMCS contractor.
- G. Dehumidification Mode:

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1. Dehumidification mode shall be activated when the return air relative humidity is above 60% (adj.).
 2. Dehumidification mode shall temporarily disable the cooling supply air temperature reset and maintain constant discharge air temperature at 53°F (adj.).
 3. Dehumidification shall disable when return air relative humidity is 2% (adj.) below humidity setpoint.
- H. Fault Detection and Diagnostics (FDD):
1. Each DX rooftop unit shall have its economizer status monitored by the EMCS. The unit's fault detection and diagnostics shall be capable of generating a visible alarm to be seen by the EMCS should the unit be in economizer when conditions are not met, or vice versa.
- I. Safeties:
1. Static Pressure Switch:
 - a. A high static pressure switch shall be provided to disable the unit and close all dampers when pressure switch is activated.
- J. Control Points:

Description	Type
Fan Amps/Status	AI
Compressor Amps/Status (Each Compressor)	AI
Filter Alarm	DI
Outside Air Temperature	AI
Mixed Air Temperature	AI
Return Air Temperature	AI
Return Air Humidity	AI
Return Air CO2	AI
Preheat Supply Air Temperature	AI
Unit Discharge Air temperature	AI
Duct Static Pressure Sensor	AI
Outside Air Damper Feedback	AI
High Static Alarm	DI
Bipolar Ionization Status (If Scheduled/Equipped)	DI
Fan Start/Stop Command	DO
Fan VFD Speed	AO
Cooling Command (Each Stage)	DO
Cooling Capacity Control (Each Stage)	AO
Heating Command (Each Stage)	DO
Preheat Command (Each Stage)	DO
Outside Air Damper	AO

END OF SECTION

SECTION 23 09 23H

SEQUENCE OF OPERATIONS SPLIT SYSTEM SEQUENCES

PART 1 - GENERAL

1.1 NOT USED

PART 2 - PRODUCTS

2.1 NOT USED

PART 3 - EXECUTION

3.1 SPLIT SYSTEM UNIT - DX AND HEAT AND IONIZER

- A. General:
 - 1. The split system unit shall be provided with a filter, supply fan, cooling coil, heat, and outside air damper. The control system contractor shall provide a dedicated stand-alone DDC controller for each unit.
- B. Unit Enabling/Disabling:
 - 1. The occupied/unoccupied mode of operation shall be defined by the EMCS optimum start/stop schedule.
 - 2. During unoccupied times, as required to maintain the unoccupied heating and cooling setpoints 55°F (adj.) heating and 85°F (adj.) cooling as sensed by the space temperature sensor.
 - 3. When the override pushbutton is depressed, the unit shall be indexed to the occupied mode for an adjustable period of time (initially 1 hour). After the override time period has expired, the unit shall revert back to the unoccupied mode.
- C. Fan Control:
 - 1. Fan speed shall be controlled by the unit's internal controls.
- D. Outside Air Damper Control:
 - 1. Warm-up or Cool-down:
 - a. The outside air damper shall be closed.
 - 2. Occupied Mode:
 - a. The outside air damper shall be at the minimum position (adj.) as set by TAB.
 - 3. Unoccupied Mode:
 - a. The outside air damper shall be closed.
- E. Temperature Control:
 - 1. Warm-up or Cool-down:
 - a. The EMCS shall determine the required warm-up or cool-down period based on the optimized start algorithm.
 - b. Upon enabling the unit, the unit shall heat and cool as required to maintain the occupied heating and cooling setpoints (initially 70°F heating, 74°F cooling) as sensed by a space temperature sensor.
 - c. Once the occupied setpoint temperature has been reached, the EMCS shall switch the unit to the occupied mode.
 - 2. Occupied Mode:
 - a. Space setpoint shall be user adjustable within $\pm 2^{\circ}\text{F}$ (adj.).

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- b. In the occupied mode of operation, the unit supply fan shall cycle with a call for heating or cooling.
 - c. The unit shall heat and cool as required to maintain the occupied heating and cooling setpoints (initially 70°F heating, 74°F cooling) as sensed by a space temperature sensor.
 - d. When space temperature rises above occupied cooling setpoint, the DDC controller shall energize the first stage of mechanical cooling. First stage cooling shall have a 20-minute (adj.) runtime before allowing second stage to engage. When space temperature continues to rise 2°F (adj.) above occupied cooling setpoint, the DDC controller shall energize the second stage of mechanical cooling.
 - 1) First stage cooling - Low speed supply CFM and first stage of compressor(s).
 - 2) Second stage cooling - High speed supply CFM and second stage of compressor(s).
 - (a) Unit shall run in second stage cooling until space temperature drops to occupied space cooling setpoint. Unit shall then run in first stage of cooling until space temperature drops 1°F (adj.) below space temperature setpoint and then cycle off.
 - 3. Unoccupied Mode:
 - a. The EMCS shall enable the unit as required to maintain the unoccupied heating and cooling setpoints (initially 55°F heating and 85°F cooling) as sensed by the space temperature sensor.
 - b. When override button is pushed, the unit shall index to occupied mode for one (1) hour (adj.). After the override time has expired, the unit shall revert to unoccupied mode.
- F. Dry Bulb Economizer Mode:
- 1. In occupied or unoccupied mode, when space temperature is above space setpoint, outside air temperature is 60°F (adj.) or below and there is a call for cooling, the unit shall be in economizer mode. Outside air damper is to open 100% and to provide free cooling to the space until the space temperature setpoint is satisfied. If space is not satisfied within 10 min (adj.), mechanical cooling will be enabled.
 - 2. All sensors necessary for economizer mode operation and FDD shall be provided and fully controlled by EMCS contractor.
- G. Fault Detection and Diagnostics (FDD):
- 1. Each DX unit shall have its economizer status monitored by the EMCS. The unit's fault detection and diagnostics shall be capable of generating a visible alarm to be seen by the EMCS should the unit be in economizer when conditions are not met, or vice versa.
- H. Control Points:

Description	Type
Fan Amps/Status	AI
Compressor Amps/Status (Each Compressor)	AI
Mixed Air Temperature	AI
Supply Air Temperature	AI
Outside Air Temperature (Global)	AI
Space Temperature	AI
Bipolar Ionization Status	AI
Outside Air Damper Feedback	AI
Cooling Command (Each Stage)	DO
Heating Command (Each Stage)	DO
Fan Start/Stop Command	DO
Outside Air Damper	AO

END OF SECTION

SECTION 23 23 00
REFRIGERANT PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions, Division 01 Specifications, and Section 23 00 00, apply to this Section.

1.2 SECTION INCLUDES

- A. Refrigerant piping for split system (including heat pumps) cooling/heating units.

1.3 RELATED SECTIONS

- A. Section 23 00 00 - Basic Mechanical Requirements
- B. Section 23 07 21 - Refrigerant Piping Insulation
- C. Section 23 33 33 - Access Doors

1.4 REFERENCES

- A. ASTM B280 - Seamless Copper Tube for Air Conditioning & Refrigeration Service

1.5 SUBMITTALS

- A. Provide submittal data on all items specified in this section in accordance with Specification Section 23 00 90, General Conditions, and Division 1.

1.6 COORDINATION

- A. Coordinate the refrigerant line sizing, lengths, traps, and all other aspects of the refrigerant systems with the air conditioning unit manufacturer to ensure a completely working and reliable system.
- B. Submit product data on piping materials and fittings.
- C. Provide letter stating air conditioning manufacturer has reviewed refrigerant line design. Provide drawings on any lines that are longer than 80 feet.
- D. If units have to be moved due to line lengths, then all associated costs will be at the Contractor's expense.

PART 2 - PRODUCTS

2.1 PIPING

- A. ACR hard drawn copper tubing, conform to ASTM B280.
- B. ACR soft drawn copper tubing with long bend radius is allowed in concealed locations, such as behind walls. Above ceiling is not considered a concealed location.

2.2 FITTINGS

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- A. Wrought copper fittings
- B. Use silver solder at connections

2.3 VALVES

- A. Manufacturers:
 - 1. Alco Controls
 - 2. Sporlan Valve Company

2.4 ACCESSORIES

- A. Provide strainer-dryer combination and liquid solenoid valves at refrigerant coil and condensing units. Provide and install distributors for multistage units that are suitable for modulating flow rates. Provide specialties such as solenoid valves, sight glasses, accumulators, and filter/dryers as required for proper system operation. Components shall be specifically designed for refrigeration service.

PART 3 - EXECUTION

3.1 MATERIAL PREPARATION

- A. Cut tubing with a sharp pipe cutter.
- B. Ream and thoroughly clean to remove all burrs, filings, dirt, and grease before assembly and soldering.
- C. Remove oxide and discoloration prior to assembly.

3.2 SLEEVES

- A. Sleeve piping as required in accordance with Section 23 05 29 - Hangers and Supports for HVAC Piping and Equipment.
- B. All refrigerant piping passing under slab shall be sleeved.
- C. Sleeves shall be of an adequate size to permit removal of the piping at a later date.

3.3 HANGER SUPPORTS

- A. Support as required in accordance with Section 23 05 29 - Hangers and Supports for HVAC Piping and Equipment.
- B. Do not fasten liquid and suction lines together unless there is insulation between them. Use wire ties. Duct tape not allowed.
- C. Insulate all refrigerant lines from structure.

3.4 INSTALLATION

- A. Route with building lines, vertical lines to be plumb, grade horizontal suction lines to compressor.
- B. All brazing shall be done with 2-8 psig dry nitrogen purge.
- C. Protect all valves and paint from excessive heat.
- D. Keep refrigerant lines sealed from atmosphere during construction.

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- E. All refrigerant line sets to receive insulation.
- F. No welded or mechanical joints in concealed areas, such as walls. Soft drawn copper is acceptable.
- G. Follow A/C manufacturer's instructions.

END OF SECTION

SECTION 23 31 13

METAL DUCTWORK

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions, Division 01 Specifications, and Section 23 00 00, apply to this Section.

1.2 SECTION INCLUDES

- A. Furnishing and installation of all ductwork as shown on the construction documents. Acoustical and thermal linings and wrappings; flexible ductwork and connections; combination smoke and fire dampers, smoke dampers, and fire dampers; duct access doors; air diffusers, grilles, and registers; air volume control devices; hangers and supports; plenums and casings; turning vanes; air filters; installation of temperature control dampers, and other appurtenances necessary for a complete and operational system.
- B. All work shall be preceded by taking measurements at the job site, fully coordinating all work with other disciplines, verifying available spaces for ductwork, and developing shop drawings.

1.3 RELATED SECTIONS

- A. Section 23 00 00 - Basic Mechanical Requirements
- B. Section 23 05 93 - Testing, Adjusting and Balancing for HVAC
- C. Section 23 07 13 - Duct and Grille Insulation
- D. Section 23 33 33 - Access Doors
- E. Section 23 34 16 - HVAC Fans
- F. Section 23 37 13 - Diffusers, Registers, and Grilles
- G. Section 23 81 19 - Packaged HVAC Units
- H. Section 23 81 26 - Split System HVAC Units

1.4 REFERENCES

- A. AMCA 500 - Test Methods for Louvers, Dampers, and Shutters
- B. AMCA 511 - Certified Ratings Program for Air Control Devices
- C. ASTM A653/A653M - Sheet Metal, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvanized) by the Hot-Dip Process
- D. ASTM A924/A924M - Hot Dip Galvanized Coils & Sheets - Tolerances
- E. ASTM A463/A463M - Steel Sheet Aluminum Coated by the Hot-Dip Process
- F. NFPA 90A - National Fire Protection Association - Installation of Air Conditioning and Ventilation Systems
- G. NFPA 92 - Smoke Control Systems

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- H. SMACNA - Sheet Metal and Air Conditioning Contractors Association
- I. SMACNA HVAC Duct Construction Standards, Latest Edition, for Metal and Flexible Ducts
- J. UL - Underwriter's Laboratories
- K. UL 555 - Standard for Safety; Fire Dampers
- L. UL 555S - Standard for Safety; Leakage Rated Dampers for Use in Smoke Control Systems

1.5 SYSTEM DESCRIPTION

- A. Design static pressure:
 - 1. 1-inch w.g. minimum for all low-pressure ductwork applications.
 - 2. 3-inch w.g. minimum for all medium pressure ductwork applications.

1.6 SUBMITTALS

- A. Product Data:
 - 1. Provide submittal data on all equipment specified in this section in accordance with Section 23 00 90, General Conditions, and Division 01.
 - 2. Submit product data indicating typical catalog of information including arrangements.
 - 3. Submit product data sheets indicating dimensions, general assembly, and materials used in fabrication.
 - 4. Indicate mechanical and electrical service locations and requirements of equipment.
 - 5. Submit manufacturer's installation instructions.
- B. Shop Drawings:
 - 1. Submit 1/4" per foot shop drawing(s) showing all ducts, piping, and equipment shown by plans and specifications. Submit drawings on all mechanical rooms. Before starting shop drawings or fabrication of any ductwork, the Contractor must be coordinated with structural and electrical and have an approved reflected ceiling plan with which he can coordinate location of air outlets, lights, tile patterns, etc. Provide sections for all congested areas and mechanical rooms. Submit prior to construction of ductwork.

1.7 QUALITY ASSURANCE

- A. All equipment and materials shall be new and of the quality as specified herein. All work shall comply with the Local Building Code, Mechanical Code, Fire Code, and all other applicable State and Local Codes or ordinances.
- B. All equipment and materials shall be installed in a workmanlike manner by trained and experienced sheet metal technicians and mechanics as recommended by the manufacturers of the products installed.
- C. All ductwork to be manufactured, constructed, installed, sealed, joined, reinforced, supported, tested and conform in accordance with the latest SMACNA standards.
- D. Where the standards and requirements of this specification exceed those of SMACNA, the requirements herein shall govern.

1.8 WARRANTY

- A. Warranty all ductwork and dampers for 1 year from the date of final acceptance. The warranty will cover workmanship, noise, chatter, whistling, and vibration. Ductwork must be free from pulsation under all conditions of operation.

PART 2 PRODUCTS

METAL DUCTWORK
EMA

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Engineering & Consulting

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2.1 RECTANGULAR AND ROUND RIGID DUCTS

- A. Material:
 - 1. New, prime grade sheet or coil steel
- B. Gauge:
 - 1. Select gauge in accordance with latest SMACNA Duct Construction Standards Tables
- C. Auditorium and stages:
 - 1. Increase two gauges (heavier) for the first 20 feet of supply and return duct.
- D. Coating:
 - 1. Type:
 - a. Continuous, hot-dip, galvanized coating
- E. Application:
 - 1. 1-1/4 ounces per 1 square foot, two-sided sheet
 - 2. Comply with ASTM A653/A653M
- F. Identification:
 - 1. Sheet steel:
 - a. Stencil each sheet with manufacturer's name and gauge.
- G. Elbows:
 - 1. Elbows shall be mitered with double thickness turning vanes or smooth radius long sweep elbows.
- H. Coil steel:
 - 1. Stencil coils on 10-foot centers with manufacturer's name and gauge.
- I. Construction:
 - 1. Manufacture in accordance with latest SMACNA Round Duct Standards Tables
 - 2. Pre-manufactured round duct may be used if approved by the Architect/Engineer.

2.2 EXHAUST DUCTS FOR TYPE I KITCHEN HOODS AND COMMERCIAL DISHWASHERS

- A. Manufacturers:
 - 1. Duravent
 - 2. Jeremias
 - 3. Metal-Fab
 - 4. Van Packer
 - 5. Schebler
 - 6. Selkirk
- B. Material for Kitchen Hoods:
 - 1. Factory Prefabricated Double Wall Built system listed to UL-1978 and UL-2221 Standard for Factory Built Grease Ducts and Integral 2-Hour Rated Shaft Assembly, with stainless steel inner liner, insulation, stainless steel outer jacket, and all-stainless steel supports and accessories for 100% maintenance free system. Duct shall be designed for internal 500°F continuous and 2000°F for 30 minutes and external 2000°F for 2-hours with through penetration firestops.
 - 2. Conform to NFPA96 Standard for ventilation control and fire protection of commercial cooking operations
- C. Material for Commercial Dishwashers:
 - 1. Factory Prefabricated Single Wall Built system listed to UL-1978 Standard for Factory Built Grease Ducts with all stainless steel construction, including the supports and guides

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for 100% maintenance free system. Duct shall be designed for 500°F continuous and 2000°F for 30 minutes

2.3 ACCESS DOORS

- A. Install access doors to facilitate cleaning as required by code.
- B. Install access doors as required for access to fire protection devices.

2.4 EXHAUST DUCTS FOR SHOWER ROOMS

- A. Aluminum:
 - 1. Gauge in accordance with the latest SMACNA Standards.

2.5 EXHAUST DUCTS FOR FUME HOODS IN SCIENCE LABS

- A. Materials:
 - 1. Gauge in accordance with the latest SMACNA standards.
 - 2. Stainless steel - welded or Factory Prefabricated Single Wall system

2.6 DOUBLE-WALL INSULATED SPIRAL/RECTANGULAR DUCTWORK

- A. Types:
 - 1. Round
 - 2. Flat Oval
 - 3. Rectangular
- B. Materials:
 - 1. Duct: Sheet metal, select gauge in accordance with the latest SMACNA Standards.
 - 2. Perforated: Galvanized steel
 - 3. Insulation liner:
 - a. 1-inch fiberglass with R-value greater than 6.0 for conditioned areas (gyms)
 - b. 2-inch fiberglass with R-value greater than 6.0 inside building unconditioned space.
 - c. 3-inch fiberglass with R-value greater than 8.0 for exterior duct.
- C. Conform to ASTM A653/A653M and ASTM A924/A924M.
- D. Conform to ASTM 463 for aluminized ductwork
- E. Construction:
 - 1. Double wall insulated
 - 2. Spiral with lockseams
 - 3. "Paint grip" finish on outer shell for exposed ductwork
 - 4. Conform to ASTM A653/A653M
 - 5. Fittings:
 - a. Spot welded and bonded construction
 - 6. Outer joints:
 - a. Use flanged couplings that will withstand the maximum design pressure with no leakage.
 - 7. Inner Liner Joints:
 - a. Use a separate slip coupling to connect the inner liner sections at duct to duct joints to allow for expansion/contraction.
 - b. Do not mechanically fix or seal inner lining couplings.
- F. Flanged Joints:
 - 1. Seal with a duct sealant that has a synthetic elastomeric base.
 - 2. Sealant:
 - a. Formulated to withstand temperatures from -20 to 150 degrees F.

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- b. Formulated so that no surface preparation or solvent cleaning is necessary.
 - c. UL classified.
 - G. Control Dampers:
 - 1. Construct with a 2-inch insulation layer and a solid inner liner.
 - 2. Press stainless steel bearing sleeves into the frame of the outer shell to support the damper axle.
 - 3. Extend the axle 6 inches from the outer shell body.
 - 4. Attach a 1½ inch x 1½ inch reinforcement to the damper.
 - H. Elbow Radius:
 - 1. 90-degree: 1-1/2 times duct diameter with 5 gores
 - 2. 45-degree: 1-1/2 times duct diameter with 3 gores
 - I. Manufacturer/Model:
 - 1. United McGill Corporation
 - 2. Lewis & Lambert, LLP
 - 3. Linx Industries
 - 4. Precision Spiral Pipe
 - 5. Spiral Pipe of Texas Corporation, Inc.
- 2.7 SINGLE-WALL, ROUND, AND FLAT OVAL DUCT AND FITTINGS (FOR MEDIUM PRESSURE APPLICATION)
- A. Medium Pressure (3-inch w.g.) rectangular duct not allowed.
 - B. Material:
 - 1. New, prime grade sheet or coil steel.
 - a. Select gauge in accordance with latest SMACNA Duct Construction Standards.
 - C. Fittings:
 - 1. By Duct Manufacturer
 - D. Coatings:
 - 1. Type:
 - a. Continuous, hot-dip galvanized coating.
 - E. Application:
 - 1. 1-1/4 ounces per 1 square foot, two-sided sheet.
 - 2. Comply with ASTM A653/A653M.
 - F. Identification:
 - 1. Sheet Steel
 - 2. Stencil each sheet with manufacturer's name and gauge.
 - G. Construction:
 - 1. Manufacture in accordance with the latest SMACNA Standards.
 - H. Approved Manufacturers:
 - 1. United McGill Corporation
 - 2. Lewis & Lambert, LLP
 - 3. Linx Industries
 - 4. Precision Spiral Pipe
 - 5. Spiral Pipe of Texas Corporation, Inc.
- 2.8 FLEXIBLE DUCTS
- A. Material: In accordance with the latest SMACNA Metal and Flexible Duct Standards,

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- B. Construction:
 - 1. Factory insulate with high-density fiberglass to a minimum R-value of 6.
 - 2. Provide a positive interior air seal permanently bonded to a carbon steel spring helix.
 - 3. Sheath seal in a Class 1 vapor barrier and factory seal at both ends.
 - 4. Conform to UL 181, NFPA 90A
- C. Manufacturer/Model:
 - 1. ATCO 30 Series or equal

2.9 VOLUME CONTROL DAMPERS

- A. Manufacturer:
 - 1. Nailor Industries Series 1020, 1021, or equal.
- B. Type:
 - 1. Manually operated single-blade or multi-blade
 - 2. Conform to the latest SMACNA Duct Standards (Metal & Flexible)
- C. Application:
 - 1. Provide in all branches, splits, and taps whether indicated on plans or not.
- D. Construction:
 - 1. Provide an indicating device with lock to hold damper in proper position.
 - 2. All manual dampers installed above hard ceilings or at other inaccessible areas shall be supplied with a cable operated damper equal to Young Regulator Model 830A-CC. Damper(s) to be opposed blade type constructed of .050 minimum heavy duty extruded aluminum frames and blades. All necessary hardware to ensure compatibility with remote cable control system shall be included. Damper blades to include individual blade bushings for smooth and quiet operation. Damper blades shall rotate between a matched pair of formed and punched 306 stainless steel connecting slide rails which facilitate smooth blade movement and ensure alignment.

2.10 TURNING VANES

- A. Provide in all rectangular supply elbows.
- B. Conform to the latest SMACNA Duct Standards

2.11 DUCT SEALANT

- A. Equal to Glenkote "Seal-Flex" duct sealer, Hardcast "Irongrip 601", Foster 32-19" or "Childers CP-146"

2.12 FIRE DAMPERS

- A. Manufacturer/Model:
 - 1. Fire Dampers - Pottorff, Ruskin, Greenheck, National Controlled Air or Nailor
 - 2. Ceiling Fire Dampers/Thermal Blankets - CK-2000-1 thermal blanket and Model CFSR-2 ceiling damper for supply outlets (round or square) and CFSR-2 for return outlets (square).
- B. Type:
 - 1. 212°F fusible link fire damper.
 - 2. Fire protection rating: 1.5 hours
 - 3. Conform to UL 555 and be UL labeled
 - 4. Tested in accordance with AMCA 500.
- C. Application:

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1. Provide at locations shown on plans and where required by Local and State ordinances.
- D. Features:
 1. Maximum leakage 8 cfm at 4-inch S.P.
 2. Vertical or horizontal installation
 3. Radiation blanket
 4. Blades 16 gauge galvanized, maximum 6-inch width.
 5. 5-year warranty
- E. Manufacturer/Model:
 1. Ceiling Fire Dampers:
 - a. Pottorff Ceiling Fire Dampers/Thermal Blankets - Series CFD
 - b. Equals by Nailor Industries, NCA, United Air, Ruskin, Greenheck

2.13 DUCT SILENCERS/SOUND ATTENUATORS

- A. Manufacturers:
 1. Price
 2. IAC Acoustics
 3. Kinetics Noise Control
 4. McGill Airflow LLC.
 5. Ruskin Co.
 6. Vibro-Acoustics
- B. Rectangular Silencer Outer Casing:
 1. ASTM A653/A653M, G90 Galvanized sheet steel, 0.034-inch thick.
- C. Inner Casing and Baffles:
 1. ASTM A653/A653M, G90 Galvanized sheet metal, 0.034-inch thick, with 1/8-inch diameter perforations.
- D. Connection size: Match connecting ductwork, unless otherwise noted.
- E. Sound Absorbing Mechanism:
 1. Controlled impedance membranes and broadly tuned resonators without absorptive media.
 2. Dissipative type with fill media
 - a. Fill material - inert and vermin-proof fibrous material, packed under moisture-proof non-fibrous material.
 - b. Erosion barrier - polymer bag enclosing fill, heat sealed before assembly.
- F. Fabricate silencers to form rigid units that will not pulsate, vibrate, rattle, or react to system pressure variations. Do not use mechanical fasteners for unit assemblies. Units shall be completely factory fabricated. No field assembly required.

2.14 SMOKE DAMPERS

- A. Manufacturer/Model:
 1. Pottorff Model SD Series to have 120 VAC `fail-safe` operation motor. Motor normally energized, any power interruption to activate damper to the closed position.
 2. Equals by Nailor Industries, Air Balance, Inc., United Air
- B. Type:
 1. Resettable smoke dampers.
 2. Leakage rated, no fire protection rating required
 3. Conform to UL 555S, Leakage Class I
 4. UL labeled.
 5. Tested in accordance with AMCA-500, AMCA 511

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- C. Application:
 - 1. Provide at locations shown on plans and where required by Local and State ordinances.
 - 2. All smoke/fire dampers under 16" in height shall be oversized and transitioned down to duct size to maximize free area. Where it is impossible to oversize duct/openings, then a flat top and bottom frame style shall be used.
- D. Features:
 - 1. Resettable thermostat 212°F control point with 120 volt AC Belimo motor.
 - 2. 120 VAC motor
 - 3. Vertical or horizontal installation
 - 4. Radiation blanket
 - 5. Maximum leakage to be 8 CFM at 4-inch S.P.
 - 6. Interface with fire alarm
 - 7. Blades 16 gauge galvanized, maximum 6-inch width.
 - 8. 5-year warranty

2.15 COMBINATION FIRE/SMOKE DAMPERS

- A. Manufacturer/Model:
 - 1. Pottorff Model FSD Series to have 120 VAC `fail-safe` operation motor. Motor normally energized, any power interruption to activate damper to the closed position.
 - 2. Pottorff Ceiling Fire Dampers/Thermal Blankets - Series CFD Pottorff, Ruskin, or Greenheck.
 - 3. Equals by Nailor Industries, Air Balance, Inc., United Air
- B. Type:
 - 1. Resettable combination fire/smoke dampers.
 - 2. Fire protection rating: 1.5 hours
 - 3. Conform to UL 555S, Class II-250°F
 - 4. UL labeled
 - 5. Tested in accordance with AMCA-500, AMCA 511
- C. Application:
 - 1. Provide at locations shown on plans and where required by Local and State ordinances.
 - 2. All smoke/fire dampers under 16" in height shall be oversized and transitioned down to duct size to maximize free area. Where it is impossible to oversize duct/openings, then a flat top and bottom frame style shall be used.
- D. Features:
 - 1. Resettable thermostat 212° F control point with 120 volt AC Belimo motor.
 - 2. 120 VAC motor
 - 3. Vertical or horizontal installation
 - 4. Radiation blanket
 - 5. Maximum leakage to be 8 CFM at 4-inch S.P.
 - 6. Interface with fire alarm
 - 7. Blades 16 gauge galvanized, maximum 6-inch width.
 - 8. 5-year warranty

2.16 FIRE SAFETY FUNCTIONS - DUCT MOUNTED SMOKE DETECTORS, CONTROL RELAYS, AND SMOKE FIRE DAMPER CONTROL

- A. At minimum, duct mounted smoke detectors required on all air handlers, fan coil units, fan powered boxes, and packaged rooftop units rated at 2000 CFM or more. Control relays required on all air handlers, fan coil units, fan powered boxes, and packaged rooftop units feeding any path of egress or corridors.

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- B. The Fire Alarm Contractor shall provide the Duct Mounted Smoke Detectors, Control Modules, Power Relays, and Control Relay devices and perform the final low-voltage hook-up to the fire alarm system.
- C. Duct-mounted smoke detector housings and sample tubes shall be furnished by the Fire Alarm Contractor and mounted by the Mechanical Contractor.
- D. Line voltage hook-up shall be by the Electrical Contractor.
- E. Fire Alarm Safety Control Functions, which may include the operation of fire alarm Control Relays CR associated with duct mounted smoke detector D/air handler shut down, high volume low speed (HVLS) fan shut down, fire door hold-back and release, smoke fire damper motor control, et cetera, shall be initiated via Control Relays which shall be de-energized under fire alarm conditions. These Control Relays shall be provided and mounted by the Fire Alarm Contractor and located within three feet of the unit. These Control Relays shall be controlled by a fail-safe Fire Safety Control Function circuit. For each controlled device, the contractor providing the device shall wire it internally for fail-safe shut-down and provide a labeled 3' coil of cable outside the unit to allow the fire alarm contractor to make final connection to the Common and N.O. or N.C. dry contacts on the fire alarm SPDT Control Relay. Each Fire Safety Control Function circuit controlled device shall be configured such that when the fire alarm system safety control circuit is re-energized, by the fire alarm control panel, the device shall return to normal operation (e.g. be ready to re-start) without a need for manual or environmental control system intervention.

2.17 FIRE SAFETY FUNCTIONS - DUCT MOUNTED SMOKE DETECTORS, CONTROL RELAYS, AND SMOKE FIRE DAMPER CONTROL

- A. At minimum, duct mounted smoke detectors required on all air handlers, fan coil units, fan powered boxes, and packaged rooftop units rated at 2000 CFM or more. Control relays required on all air handlers, fan coil units, fan powered boxes, and packaged rooftop units feeding any path of egress or corridors.
- B. The Mechanical Contractor shall employ a Fire Alarm sub-contractor that is licensed by the State of Texas Fire Marshal and a factory authorized distributor for the brand of existing fire alarm system to provide the devices and perform the final low-voltage hook-up. Duct mounted smoke detector housings and sample tubes shall be furnished by the Fire Alarm sub-contractor and mounted by the Mechanical Contractor. Line voltage hook-up shall be by the Electrical Contractor.
- C. Fire Alarm Safety Control Functions, which may include the operation of fire alarm Control Relays CR associated with duct mounted smoke detector D/air handler shut down, high volume low speed (HVLS) fan shut down, fire door hold-back and release, smoke fire damper motor control, et cetera, shall be initiated via Control Relays which shall be de-energized under fire alarm conditions. These Control Relays shall be provided and mounted by the Fire Alarm Contractor and located within three feet of the unit. These Control Relays shall be controlled by a fail-safe Fire Safety Control Function circuit. For each controlled device, the contractor providing the device shall wire it internally for fail-safe shut-down and provide a labeled 3' coil of cable outside the unit to allow the fire alarm contractor to make final connection to the Common and N.O. or N.C. dry contacts on the fire alarm SPDT Control Relay. Each Fire Safety Control Function circuit controlled device shall be configured such that when the fire alarm system safety control circuit is re-energized, by the fire alarm control panel, the device shall return to normal operation (e.g. be ready to re-start) without a need for manual or environmental control system intervention.
- D. Duct mounted smoke detector housings with addressable or conventional photoelectric detector heads (to match the existing fire alarm system) shall be provided where shown on the drawings, or as required. Detectors shall operate by the photoelectric light-scattering principal

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using an LED light source to measure smoke density and shall, on command from the control panel, send data to the panel representing the analog level of smoke density. The detector shall operate in air velocities of 300 to 4,000 ft./min. without a shift in sensitivity. Each detector shall be resettable from the FACP.

- E. The unit shall include a 16-gauge steel or Noryl molded plastic enclosure with molded integral conduit knockouts. The unit shall be provided with gasket seals to provide proper sealing of housing to mechanical ductwork and to ensure proper airflow into the detector sampling chamber. Duct housing shall be designed for mounting to rectangular or round ducts.
- F. Each duct mounted detector housing shall be labeled in a visible area with its device hardware address or zone utilizing self-laminating, flexible vinyl film, non-smear, machine printed labels.
- G. The Duct Detector Unit shall be UL listed to the most current UL 268A standard and be cross-listed for use with the fire alarm control panel. Each duct unit shall be equipped with sampling tubes protruding into the associated ductwork. For ducts up to 3' wide, the supply tube shall be 1" shorter than the duct width. For ducts 3' to 8' wide the sampling tube to be 1" longer than the duct width and protrude through the opposite side of the duct for support. Duct widths greater than 8' will require internal bracing. Sampling tubes shall be configured to provide adequate airflow through the detector housing and fitted with an integral porosity filter system to aid in reducing detector contamination. Detectors shall be installed per NFPA 90A and the manufacturer's instructions.
- H. When smoke is detected by a duct mounted smoke detector, it shall activate a supervisory fire alarm condition at the fire alarm control panel. Duct mounted smoke detectors shall indicate a supervisory alarm unless otherwise directed, duct mounted smoke detectors are not a substitute for area detection. In either case, the activation of any duct mounted smoke detector shall actuate all related fire alarm safety control functions.
- I. Each smoke detector shall be attached to a SLC and set to a distinct address and internal identification code, which the control panel shall use to identify the location, status, and type of device. Duct detectors must be powered from the fire alarm system.
- J. Each detector shall be provided with a remote power/status LED. The remote LED indicator shall be located in the nearest corridor ceiling unless otherwise directed. The status LED shall flash under normal conditions, indicating that the detector is operational and in regular communication with the control panel. The LED shall be placed into steady illumination when a supervisory condition has been detected.
- K. Each remote LED faceplate shall have an engraved plastic nameplate permanently attached indicating the HVAC unit number, type, and device identification number as programmed in panel. Labels shall be 1/16" thick two-ply black/white acrylic sheet engraving stock with all sides beveled.
- L. Each HVAC unit for which a Duct mounted Smoke detector is installed shall also have a blower shutdown relay as listed below.
- M. Provide housing with base and photoelectric detector head, sampling tube, and remote LED.
- N. Fire Safety Function HVAC Unit Blower Shut-Down and Smoke Fire Damper Operation:
 - 1. Provide a power relay for each fire safety control circuit as required to operate smoke fire dampers, control relays for shut-down of each air handler, et cetera, as indicated on plans.
- O. Fire Safety Function Control Module:
 - 1. Addressable Control/Relay Modules shall be provided where required to provide NAC interface or relay controlled fire alarm functions. The control module will mount in a standard 4-inch electrical box. The control module shall provide a dry contact (form C)

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relay with SPDT dry contacts rated at 2.0 amps @ 24 VDC and 0.5 Amps @ 120 VAC (pilot duty).

- P. Power to operate the relay actuation shall be provided by the SLC. Each control module shall be operated by events as programmed in the control panel (i.e. operate on alarm condition). Control modules shall feature status LEDs to indicate the module is operational and when the relay is energized.
- Q. Each control module shall be set to a distinct address and internal identification code on the SLC, which the control panel shall use to identify the location, status, and type of device.
- R. Each control module shall have an engraved plastic nameplate permanently attached indicating the devices function and control panel device identification number. Labels shall be 1/16" thick two-ply black/white acrylic sheet engraving stock with all sides beveled.
- S. Fire Safety Function Power Relay:
 - 1. Power Relays shall be provided as required to control each fire safety control functions circuit, one or two circuits may be controlled by each relay. Each relay shall be operated by a 120 VAC coil and feature DPDT dry contacts rated 30 Amps @ 120 VAC. Each relay shall be mounted in a surface mount metal enclosure with conduit knockouts. Relays shall be UL recognized and rated for ten million mechanical operations.
 - 2. Air Products & Controls model MR-199X-14/C, 120 VAC coil, heavy-duty power relay with metal enclosure or approved equivalent.
- T. Fire Safety Function Control Relays:
 - 1. Control Relays shall be provided where a relay control interface is required to perform fire safety control functions; air handler shut-down, fire door control, et cetera. Each relay shall be operated by a multi-voltage coil (24 VDC, 24 VAC, or 120 VAC), feature SPDT dry contacts rated 10 Amps @ 120 VAC, and a status LED to indicate the relay is energized. Each relay shall be mounted in a surface mount metal enclosure with a status LED viewing hole and conduit knockouts. Relays shall be UL recognized and rated for ten million mechanical operations.
 - 2. Air Products & Controls model MR-101/C, multi-voltage coil, control relay with metal enclosure or approved equivalent.

2.18 FIRE SAFETY FUNCTIONS - DUCT MOUNTED SMOKE DETECTORS, CONTROL RELAYS, AND SMOKE FIRE DAMPER CONTROL

- A. At minimum, duct mounted smoke detectors required on all air handlers, fan coil units, fan powered boxes, and packaged rooftop units rated at 2000 CFM or more. Control relays required on all air handlers, fan coil units, fan powered boxes, and packaged rooftop units feeding any path of egress or corridors.
- B. The Mechanical Contractor shall furnish and install standalone duct mounted smoke detectors, housings, and sample tubes in accordance with the manufacturer's instructions.
- C. Line voltage hook-up shall be by the Electrical Contractor.
- D. The HVAC Control System Contractor shall wire the stand alone duct mounted smoke detector auxiliary contacts for each individual air handler so that the control circuit will de-energize when an alarm condition is detected. The HVAC Control System shall not bypass or replace this shut-down function. The HVAC Control System shall be configured such that when the stand alone duct mounted smoke detector is manually reset, the unit shall return to normal operation (e.g. start running again) without intervention of the control system.
- E. The Duct Detector Unit shall be UL listed to the most current UL 268A standard and be cross-listed for use with the fire alarm control panel. Each duct unit shall be equipped with sampling tubes protruding into the associated ductwork. For ducts up to 3' wide, the supply tube shall

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be 1" shorter than the duct width. For ducts 3' to 8' wide the sampling tube to be 1" longer than the duct width and protrude through the opposite side of the duct for support. Duct widths greater than 8' will require internal bracing. Sampling tubes shall be configured to provide adequate airflow through the detector housing and fitted with an integral porosity filter system to aid in reducing detector contamination. Detectors shall be installed per NFPA 90A and the manufacturer's instructions.

F. Manufacturer/Model:

1. System Sensor DH100ACDCLP, or equivalent, 4-wire photoelectric duct detector with low-flow technology with ST-x Series sampling tube, width as required. Unit power input terminals to accept 24 VDC, 24 VAC 50-60 HZ, 120 VAC 50-60 HZ, or 220/240 VAC 50-60 HZ. Unit to feature two alarm auxiliary contacts for fan shutdown, etc. rated at 10A @ 30 VDC resistive, 10A @ 250 VAC, or 100 mA minimum @ 5 VDC. Utilize auxiliary contacts for air handler shut-down and when required to operate smoke fire dampers as indicated on plans.
2. Each duct mounted detector housing shall be labeled in a visible area indicating the HVAC unit number, type, and location identification utilizing self-laminating, flexible vinyl film, non-smear, machine printed labels.
3. For each duct mounted smoke detector, furnish one System Sensor SSK451, or equivalent, Multi-Signaling Accessory with Key-activated test/reset functions and sounder horn. Device shall feature status LEDs for Power (green), Trouble (amber), and Alarm (red). Unit shall be suitable for wall or ceiling mount in a double-gang standard electrical box. Mount Multi-Signaling Accessory device in the nearest corridor ceiling or on wall at 8'-0" A.F.F. where no ceiling or high ceilings exist.
4. Each remote Multi-Signaling Accessory faceplate shall have an engraved plastic nameplate permanently attached indicating the HVAC unit number, type, and location identification. Labels shall be 1/16" thick two-ply black/white acrylic sheet engraving stock with all sides beveled.

G. Acceptable Manufacturers:

1. Air Products & Controls
2. BRK
3. Pittway
4. System Sensor

PART 3 EXECUTION

3.1 INSTALLATION

- A. Erect all ductwork in the general locations shown.
- B. Conform to all structural and finish conditions of the building.
- C. Ductwork shall not be allowed to pass through or over designated electrical rooms.
- D. Before fabricating any ductwork, check the physical conditions at the job site and make all necessary changes in cross sections, offsets, and similar items, whether they are specifically indicated or not.
- E. Where ductwork is shown to be lined on the inside with duct liner, the sizes shown on the plans are the inside dimensions. Therefore, sheet metal dimensions shall be increased accordingly.
- F. Seal all joints both transverse and longitudinal seams, with duct sealant.
- G. Install 1" roll type filter media on all return duct openings prior to starting blowers. Leave in place and change as necessary during construction.

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- H. Before installing grilles, operate air conditioning unit fans and remove all debris or foreign matter.
- I. Rectangular ductwork:
 - 1. Construct in accordance with the latest SMACNA, Duct Construction Standards for the specific duct pressure classification involved. Do not use radius ells with square throats.
- J. Round ductwork:
 - 1. Connect with slip type joints using a minimum of three sheet metal screws per joint and in accordance with the latest SMACNA Duct Construction Standards.
- K. Flexible ductwork:
 - 1. All flexible ducts shall be demountable and individual lengths shall not be in excess of seven feet. Flexible ducts are not allowed to substitute rectangular return air ductwork unless approved by engineer.
 - 2. Use only factory-made connectors.
 - 3. Flexible ducts should be installed fully extended, free of sags and kinks.
- L. Kitchen Hood and Commercial Dishwasher Exhaust Ductwork:
 - 1. Complete with: no-weld hood transitions, thimbles, plates, caps, access panels, supports, guides, expansion joints, and connection to fans. All items as specifically required by National and Local Codes.
 - 2. Submit CAD Drawings with Sizing/Balancing Calculations showing that the grease duct exhaust system is in complete compliance with Code, the hood manufacture(s), and the fan manufacture(s) installation instructions.
 - 3. All horizontal ductwork to be sloped in accordance with NFPA 96 and manufacturer recommendations.
 - 4. Provide access and drains per NFPA 96.
 - 5. Prior to the use or concealment of any portion of a grease duct system, a leakage test shall be performed. Ducts shall be considered concealed where installed in shafts or covered by coatings, wraps, or insulation that prevents the ductwork from being visually inspected on all sides. The permit holder shall be responsible to provide the necessary equipment to perform the grease duct leakage test. A light test shall be performed to determine that all welded and brazed joints are liquid tight.
- M. Science Lab and Fume Hood Exhaust Ducts:
 - 1. Provide a liquid tight continuous external weld on all seams and joints in the ductwork.
 - 2. Provide access doors to duct and shaft.
 - 3. Fume hood exhaust ductwork shall not pass through any fire rated wall.
- N. Shower Room Exhaust Ductwork:
 - 1. Provide shower room with aluminum or stainless steel exhaust ductwork as specified for standard duct construction for sheet metal ductwork.
 - 2. Make all joints in the bottom of horizontal runs watertight.
 - 3. Slope horizontal runs to exhaust grille.
 - 4. Use unlined duct in all shower room installations.
- O. Double-wall insulated spiral/rectangular ductwork:
 - 1. Install without exposed insulation in all exposed ceiling areas.
 - 2. Provide ductwork installation that is high quality, very neat, and aesthetically pleasing.
 - 3. The final appearance of the ductwork shall be approved by the Architect/Engineer.
- P. Exterior Ductwork:
 - 1. Exterior ductwork shall use a Ductmate Industries connection and sealing system. Install per manufacturers recommendations.
 - 2. All exterior ductwork to be protected and sealed with a weather-proofing, protective finishing system such as Alumaguard All Weather, Venture Clad System, or equivalent.

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Both insulation and protective finish cover system shall be pitched in order to shed water. Level or flat covers will not be accepted.

- Q. Reinforcement:
1. Reinforce all ducts to prevent buckling, breathing, vibration, or unnecessary noise.
 2. Reinforcing shall be in accordance with the latest SMACNA Duct Construction Standards (Metal and Flexible), plus any additional reinforcing to meet job conditions.
 3. All ducts shall be supported in accordance with the latest SMACNA Duct Construction Standards (Metal and Flexible).
- R. Flexible Connections:
1. Where ducts connect to fans or air handling units, make flexible airtight connections using "Ventglas" fabric.
 2. The fabric must be fire-resistant, waterproof, and mildew resistant with a weight of approximately 30 ounces per square yard.
 3. Provide a minimum of 1/2 inch slack in the connections, and a minimum of 2-1/2 inches distance between the edges of the ducts.
 4. Provide a minimum of 1-inch slack for each inch of static pressure on the fan system.
 5. Securely fasten fabric to apparatus and to adjacent ductwork by means of galvanized flats or draw bands.
 6. Do not install outdoors, except where detailed on plans.
 7. Where connections are made in outdoor locations, seal fabric to metal with mastic.
- S. Access Doors:
1. Install ductwork access doors in structural angle frames and provide with sash locks and hinges arranged for convenient access.
 2. Construct doors which occur in insulated ducts with an insulation filler.
 3. All access doors shall be appropriately labeled.
- T. Flashing and Opening Sealing:
1. Ducts passing through roofs or exterior walls:
 - a. Provide suitable flashing to prevent rain or air currents from entering the building as detailed on plans.
 - b. The flashing shall be minimum No. 24 gauge galvanized steel.
- U. Ducts passing through mezzanine walls:
1. Completely seal the penetration with acoustic sealant and fill all gaps between the ductwork and the wall materials.
 2. Sealant must be capable of preventing sound from exiting the mechanical rooms through these openings.
- V. Ducts penetrating the floor:
1. Make the entire penetration watertight by installing appropriate flashing and/or application of G.E. silicone sealant.
 2. The penetration must be capable of maintaining standing water in the mechanical area without allowing any water through the opening.
- W. Duct Leakage:
1. Seal ductwork in accordance with the latest SMACNA HVAC Duct Construction Standards - Metal and Flexible.
 2. Minimal leakage is expected for ductwork constructed to these standards but in no case shall the total leakage exceed 1% of designed CFM.
 3. All joints to be sealed with duct sealant.
- X. Fire and Smoke Dampers:
1. Install fire and smoke dampers at locations shown on plans, and where required by local and state ordinances.

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2. Do not compress or stretch SFD, FD frame into duct or opening.
3. Install dampers square and free from racking with blade running horizontally.
4. Handle damper using sleeve or frame. Do not lift damper using blades actuator, or jackshaft.
5. Install bracing for multiple section assemblies to support assembly weight and to hold against system pressure. Install bracing as needed.
6. Provide access doors in attached ductwork for inspection.
7. Stencil each door "Fire Damper Access" per UL 555 Standard.
8. Install fire dampers in openings utilizing steel angles, sleeves, and other materials, and practices required to provide an installation equivalent that used by manufacturer when dampers were tested at UL.
9. Install in accordance with damper manufacturer's published recommendations and instructions and NFPA 90A.

3.2 BALANCING DAMPERS

- A. Volume Control Dampers:
 1. Install manually operated volume control dampers in all branch ducts, splits, or taps whether indicated on the drawings or not. Install a minimum of 5'-0" from grille/diffuser.
 2. Provide indicating device with lock to hold damper in position.
- B. Cable Operated Dampers:
 1. Install a minimum of 5'-0" from grille/diffuser.
 2. Install to facilitate smooth blade movement and ensure alignment.
- C. Back Draft Dampers:
 1. Install back draft dampers as shown on plans.
 2. Manufacturer: Nailor Industries Series 1300 or equal.
- D. Air Intake Ducts:
 1. Insulate all outside air intake ducts.

3.3 DAMPER IDENTIFICATION

- A. Provide a securely attached red band and a label reading "Damper Location" at the location of all concealed manual dampers.
- B. All manual dampers which are not readily visible after duct insulation installation shall be identified in this manner.

3.4 DUCTWORK SUPPORT

- A. All ducting must be supported from building structure.
- B. Duct straps are not allowed to be screwed to roof decks, support from cross bridging, or supported from bottom chord of joists.
- C. Do not support from roof or floor deck joist bridging.
- D. Support sizes and spacing shall conform to the latest SMACNA Standards.

END OF SECTION

SECTION 23 33 33

ACCESS DOORS

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions, Division 01 Specifications, and Section 23 00 00, apply to this Section.

1.2 SECTION INCLUDES

- A. Access doors and their installation requirements.

1.3 RELATED SECTIONS

- A. Division 28 - Fire Alarm System
- B. Section 22 05 24 - Valves - General
- C. Section 22 11 17 - Domestic Water Piping and Appurtenances
- D. Section 22 13 17 - Soil, Waste, and Sanitary Drain Piping, Vent Piping, and Appurtenances
- E. Section 22 13 18 - Condensate Piping
- F. Section 22 16 01 - Natural Gas Piping and Appurtenances
- G. Section 22 40 01 - Plumbing Fixtures and Fixture Carriers
- H. Section 22 66 54 - Chemical Waste and Vent Piping
- I. Section 23 00 00 - Basic Mechanical Requirements
- J. Section 23 05 93 - Testing, Adjusting, and Balancing for HVAC
- K. Section 23 09 23 - Energy Management Control System
- L. Section 23 21 13 - Hydronic Piping, Valves, and Appurtenances
- M. Section 23 31 13 - Metal Ductwork

1.4 SUBMITTALS

- A. Provide submittal data on all items specified in this section in accordance with Specification Section 23 00 90, General Conditions, and Division 01.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Acudor
- B. Elmdor
- C. Mifab

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2.2 ACCESS DOORS

- A. Locations requiring access doors:
 - 1. Concealed valves
 - 2. Traps
 - 3. Trap primers
 - 4. Controls
 - 5. Cleanouts
 - 6. Dampers
 - 7. Ducts adjacent to fire doors, fire dampers, and smoke detectors.
 - 8. Equipment above hard ceilings.
 - 9. Other equipment requiring accessibility for operation and maintenance.
- B. Type:
 - 1. Hinged flush-type steel framed door with straps and exposed narrow border.
- C. Minimum size:
 - 1. 18" x 18" unless otherwise indicated.
 - 2. 24" x 24" trap primers.
 - 3. 24" x 24" for equipment above hard ceilings.
 - 4. Conform to architectural panel pattern for acoustical ceilings.
 - 5. Confirm size with Building Inspector and Engineer.
- D. Construction:
 - 1. Hinges: Concealed continuous type.
 - 2. Locking Device: Flush cam type, screwdriver operated.
- E. Fire Rating:
 - 1. Same or better fire rating than the surrounding area.
- F. Access doors located in kitchens, restrooms, or areas where water is present shall be stainless steel.

2.3 FACTORY PAINTING

- A. Apply prime coat of rust inhibiting paint, unless located in wet area.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install in accordance with manufacturer's instructions and recommendations.
- B. In suspended acoustical ceilings, provide a beaded pin or other approved means for identification and easy removal where necessary.
- C. Access doors shall only be installed in areas/locations that are readily accessible.
- D. Doors shall be installed in such a manner that door will open 180 degrees.

END OF SECTION

SECTION 23 43 23

BIPOLAR IONIZATION AIR PURIFICATION SYSTEM

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions, Division 01 Specifications, and Section 23 00 00, apply to this Section.

1.2 DESCRIPTION OF WORK

- A. This section describes the design, performance, and installation of a bipolar ionization air purification system intended for use on the project.
- B. Where the air purification system is intended to reduce outside ventilation air in accordance with the International Mechanical Code and ASHRAE Std 62.1, the manufacturer shall provide calculations to justify such reduction.

1.3 RELATED SECTIONS

- A. Section 23 00 00 - Basic Mechanical Requirements
- B. Section 23 05 93 - Testing, Adjusting, and Balancing for HVAC
- C. Section 23 31 13 - Metal Ductwork
- D. Section 23 37 13 - Diffusers, Registers, and Grilles

1.4 SUBMITTALS

- A. Provide submittal data on all items specified in this section in accordance with Specification Section 23 00 90, General Conditions, and Division 01.
- B. Submit product data indicating typical catalog data, including arrangements, dimensions, general assembly, and materials used in fabrication.
- C. Provide in table form a schedule similar to drawings with data listing all units, information, accessories, etc.
- D. Indicate mechanical and electrical service locations and requirements.

1.5 QUALITY ASSURANCE

- A. The air purification system shall be a product of an established manufacturer with a minimum of 10 outside air reduction installations in successful operation in the USA. Technologies that do not operate through a gas disassociation process like UV lights, powered particulate filters, and/or polarized media filters, will not be considered.
- B. The air purification system products shall be tested and listed by UL and ETL according to UL Standard 2998 - Electrostatic Air Cleaners. Air purification system products shall specifically be tested and passed UL 2043 to ensure plenum rating.
- C. The operation of bi-polar ionization units shall conform to UL 867 with respect to ozone generation.

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- D. The manufacturer must submit Indoor Air Quality calculations to confirm acceptable indoor conditions at the scheduled air flows in accordance with ASHRAE Std 62.1. The calculations shall be independently validated to verify accuracy of the IAQ calculations and conformance with ASHRAE Std 62.1 by third-party testing on a previous installation.

1.6 RELATED WORK PERTAINING TO OTHER SPECIFICATIONS

- A. Electrical wiring
- B. Ductwork

PART 2 - PRODUCTS

2.1 APPROVED MANUFACTURERS

- A. Plasma Air International
- B. Bioclimatic
- C. GPS
- D. Phenomenal Air
- E. Air Oasis
- F. Other qualified manufacturers meeting the requirements of this specification may be
 - 1. submitted for approval 10 business days prior to bid date.

2.2 PERFORMANCE CRITERIA

- A. The bipolar ionization system shall operate and be a zero ozone product.
- B. Each piece of air handling equipment, so designated on the plans, details, equipment schedules, and/or specifications shall contain a plasma ion generator with bipolar ionization output as described here within.
- C. The Bi-polar Ionization system shall be capable of:
 - 1. Effectively neutralizing microorganisms downstream of the bipolar ionization equipment (mold, bacteria, virus, etc.).
 - 2. Controlling gas phase contaminants generated from human occupants, building structure, furnishings, and outside air contaminants.
 - 3. Reducing space static charges.
 - 4. Reducing space particle counts.
 - 5. When mounted to the air entering side of a cooling coil, keep the coil free from pathogen and mold growth.
 - 6. All manufacturers shall provide documentation by an independent accredited laboratory that proves the product has minimum neutralized rates for the following pathogens given the allotted time and in space conditions.
 - a. MRSA - 99.75% in 30 minutes
 - b. Influenza Virus (H1N1) - 80.5% in 30 minutes, 86.6% in 60 minutes
 - c. E. Coli - 99.43 % in 120 minutes
 - d. Cladosporium Cladosporiodes - 97.7% in 120 minutes
 - e. Aspergillus Niger - 97.1% in 120 minutes
 - f. Staphylococcus Aureus - 81.7% in 120 minutes
 - 7. Manufacturers not providing the equivalent space neutralized rates shall not be acceptable. All manufacturers requesting prior approval shall provide to the engineer independent test data from an accredited independent lab confirming the neutralized

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rates and time per the above.

- D. The bipolar ionization system shall operate in such a manner that equal amounts of positive and negative ions are produced. Single pole ion devices shall not be acceptable.
 - 1. Airflow rates may vary through the full operating range of a VAV system. The quantity of air exchange shall not be increased due to requirements of the air purification system.
 - 2. Velocity Profile: The air purification device shall not have a maximum velocity profile.
- E. Humidity: Plasma Generators shall not require preheat protection when the relative humidity of the entering air exceeds 85%. Relative humidity from 0 - 100%, condensing, shall not cause damage, deterioration, or dangerous conditions to the air purification system.

2.3 EQUIPMENT REQUIREMENTS

- A. Electrode Specifications (Bi-polar Ionization):
 - 1. Each plasma generator with bipolar ionization output shall include the required number of electrodes and power generators sized to the air handling equipment capacity.
 - 2. Electrodes shall be energized when the main unit disconnect is turned on and the fan is operating.
 - 3. Ionization output from each electrode shall be a minimum of 5 million ions/cc when tested at 2" from the ion generator.
 - 4. Manufacturer shall demonstrate that no voltage potential exists due to exposed electrical components in the duct system or plenum.
- B. Air Handler mounted units
 - 1. Where so indicated on the plans and/or schedules, Plasma generators shall be supplied and installed. Ion generators for air handling units shall be furnished in a linear or rack mounted configuration so as to minimize the space required for installation. Ionization "rack" shall be no more than 3" deep in the direction of airflow.
 - 2. The mechanical contractor shall mount the plasma ionization rack and wire it to the remote mount power supply panel using only low voltage wiring. Low voltage wiring shall be defined as 24V. The use of line voltage (120V or 230V) or high voltage cabling (600V or higher) shall not be acceptable due to safety concerns.
 - 3. The remote mount power supply panel shall be capable of accepting voltage ratings of 12V DC, 24V AC, 120V AC, or 230V AC. The panel shall have an on/off switch, power indicator LED, and a set of dry contacts which will indicate ionizer functionality. Dry contacts that indicate power available only shall not be acceptable.
- C. Duct mounted units
 - 1. Where so indicated on the plans and/or schedules, plasma ion generators shall be supplied and installed by the mechanical contractor. The contractor shall follow all manufacturer IOM instructions during installation.
 - 2. Ion generators shall be furnished with a factory-equipped gasketed mounting flange to prevent air leakage. Gasketed flange shall be a minimum of 1 1/8" wide around the perimeter of the ionizer to ensure no leakage occurs.
 - 3. Ion generators shall be field installed in a location that is convenient for visual inspection, removal, and servicing. They shall include an ion indicator light clearly visible from below the installed location.
 - 4. Ion generators shall be wired from the 24V AC fan and common terminal of the control power circuit. Ion generators shall be capable of directly accepting 24V AC power. The use of loose step down transformers or power converters shall not be acceptable.

2.4 ELECTRICAL AND CONTROL REQUIREMENTS

- A. Ion generators shall contain a built-in power supply and operate on 24V AC and shall connect to the fan and common terminals of the fan coil unit or air handling unit served. Ion generators requiring a loose 24V, 120V, or 230V transformer or power supply will not be accepted.

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- B. Wiring, conduit, and junction boxes shall be furnished and installed by the electrical contractor within housing plenums and shall be UL and NEC NFPA 70 approved.
- C. All plasma ion generators shall include internal short circuit protection, overload protection, and automatic fault reset. Overload protection and associated automatic fault reset shall occur internally to the unit and be performed through circuitry on the unit's PCB. Manual fuse replacement and manual fault reset of each unit shall not be accepted.
- D. All plasma ion generators shall include an external BMS interface to indicate ion generator status and alarm.

PART 3 - EXECUTION

3.1 INSTALLATION REQUIREMENTS

- A. Ionization units shall be installed per manufacturer's installation instructions and requirements.

3.2 ASSEMBLY AND INSTALLATION

- A. Assemble ionization units and install in supply ductwork downstream of all coils and upstream of the first supply tap. Ionization units are not to be installed in return air ductwork.
- B. Ionization units to be installed inside unit cabinet. No screws or penetrations will be allowed to attach inside unit. The preferred mounting location is upstream of the fan inlet, downstream from unit particle filter(s), and upstream of unit's cooling coil.
- C. Electrical contractor shall complete single point power connections.
- D. Protect equipment from water and damage before and after installation.

3.3 WARRANTY

- A. Equipment shall be warranted by the manufacturer against defects in material and workmanship for a period of twelve months after shipment or eighteen months from owner acceptance, whichever occurs first. Labor to replace equipment under warranty shall be provided by the installing contractor.

END OF SECTION

SECTION 23 81 19
PACKAGED HVAC UNITS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions, Division 01 Specifications, and Section 23 00 00, apply to this Section.

1.2 SECTION INCLUDES

- A. Rooftop mounted or ground mounted packaged HVAC units.

1.3 RELATED SECTIONS

- A. Section 22 13 18 - Condensate Piping
- B. Section 22 16 01 - Natural Gas Piping and Appurtenances
- C. Section 23 00 00 - Basic Mechanical Requirements
- D. Section 23 05 29 - Hangers and Supports for HVAC Piping and Equipment
- E. Section 23 05 93 - Testing, Adjusting, and Balancing for HVAC
- F. Section 23 09 23 - Energy Management Control System
- G. Section 23 31 13 - Metal Ductwork

1.4 REFERENCES

- A. Underwriters Laboratory UL Listed
- B. NFPA 90A & NFPA 90B - Installation of Air Conditioning and Ventilation Systems and Installation of Warm Air Heating and Air Conditioning Systems.
- C. ANSI/ASHRAE Std 15 - Safety Code for Mechanical Refrigeration.
- D. AHRI 360 - Commercial and Industrial Unitary Air Conditioning Equipment testing and rating standard.
- E. AHRI 340 - Commercial and Industrial Unitary Heat pump Equipment.
- F. ANSI/ASHRAE 37 - Testing Unitary Air Conditioning and Heat Pump Equipment.
- G. ANSI/ASHRAE/IES 90.1 - A Energy Conservation in New Building Design Standard.
- H. ANSI/UL 465 - Central Cooling Air Conditioners Standard for safety requirements.
- I. AHRI 210/240 - Unitary Air Conditioning Equipment and Air-Source Heat Pump Equipment.
- J. AHRI 270 - Sound Rating of Outdoor Unitary Equipment.
- K. ANSI/NFPA 70-1990 - National Electric Code (NEC).
- L. AGA - American Gas Association

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1.5 SUBMITTALS

- A. Product Data:
 - 1. Provide submittal data on all equipment specified in this section in accordance with Section 23 00 90, General Conditions, and Division 01.
 - 2. Included with submittal shall be a line by line specifications compliance. Manufacturers must clearly define any exceptions made to Plans and Specifications. Mechanical Contractor is responsible for expenses that occur due to exceptions made.
 - 3. Submit product data indicating typical catalog of information including arrangements.
 - 4. Submit product data sheets indicating dimensions, general assembly, and materials used in fabrication. List all accessories available for units and clearly mark accessories being provided. List all field-installed items.
 - 5. Provide in table form a schedule similar to drawings with data listing all information, capacities, fan data, voltages, accessories, etc.
 - 6. Indicate mechanical and electrical service locations and requirements.
 - 7. Submit manufacturer's installation instructions.
- B. Shop Drawings:
 - 1. Submit 1/4" per foot shop drawing(s) showing all piping, ductwork, and equipment shown by drawings and specifications. Submit drawings on all mechanical rooms. The drawings shall be coordinated with structural, electrical, and fire sprinkler drawings.
- C. Equipment Start-up Report:
 - 1. Submit an equipment start-up report as provided by the equipment manufacturer. Start-up report shall include the following, but not limited to: verification of system airflow, proper operation of all motors and fans, proper tensioning of belts and pulleys, proper operation of on-board microprocessor control system, proper control of economizer damper, proper compressor operation, and proper operation of cooling, heating, and dehumidification modes.

1.6 QUALITY ASSURANCE

- A. UL listed and must display UL label on all units.
- B. All units must comply with ASHRAE Standard 90.1 and the applicable International Energy Conservation Code.
- C. Unit performance data must be rated in accordance with AHRI 210/240 and must display the AHRI symbol on all standard units.
- D. Conform to applicable ANSI/NFPA 70 code for internal wiring of factory wired equipment.
- E. AGA, with label.
- F. Tested in accordance with DOE.
- G. The air-conditioning equipment manufacturer shall be solely responsible for their equipment that does not comply with the performance of their published catalogs and specifications.

1.7 OPERATION AND MAINTENANCE DATA

- A. Submit operation and maintenance data.
- B. Include manufacturer's descriptive literature, operating instructions, installation instructions, maintenance, and repair data, including filter replacement and unit lubrication.

1.8 WARRANTY

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- A. Complete 1-year parts and labor warranty on all equipment.
- B. 5-year warranty provided for the compressors.
- C. 15-year warranty provided for heat exchangers.

PART 2 - PRODUCTS

2.1 EQUIPMENT

- A. All units are to comply with ASHRAE Standard 90.1.
- B. All units are to be tested in accordance with AHRI 340/360 (I-P), AHRI 210/240, and Bear Label.

2.2 MANUFACTURERS

- A. Aeon
- B. Lennox
- C. Carrier
- D. Daikin

2.3 PACKAGED HEATING/COOLING UNITS

- A. All units to have standard mechanical thermostat terminal strip for 3rd party control. Units with OEM branded controls and/or integration boards not allowed. Controls to be provided by others.
- B. All units 3 tons to 6 tons to be nominal 17 SEER and/or 16 SEER2 rated with direct drive fans, two stage compressor and a minimum two speed fan.
- C. All units 7.5 tons to 17.5 tons are to have a minimum 3 stages of cooling with at least two compressors .
- D. All units 20 tons and above are to have a minimum 4 stages of cooling with at least two compressors.
- E. Minimum Cooling Efficiencies:
 - 1. EER ratings by AHRI 210/240 and AHRI 340/360 (I-P):
 - a. All unit SEER/EER, SEER2/EER2 or IEER values shall meet or exceed Energy Efficiency Ratios shown on schedule.
 - b. All units to comply with latest International Energy Conservation Code.
 - c. All units shall comply with the latest Department of Energy Requirements.
- F. Supply Fan Section:
 - 1. Units shall have plenum fans with ECM or VFD.
- G. Gas Furnace Design:
 - 1. Heating capacities:
 - a. Equal to or greater than those shown on plans. Bear AGA label.
 - 2. Ignition:
 - a. Electronic pilot ignition
 - b. Standing pilot not allowed
 - 3. Efficiency:
 - a. Minimum 81% A.F.U.E. rating.

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- H. Three Phase Electrical Power:
 - 1. Impose an equal electrical load on all phases of heater.
 - 2. Electrical resistance elements which are not balanced over all three phases are not acceptable.
- I. Mixing Box Section:
 - 1. All units shall have return air and outside air compartment. Units shall have at minimum: barometric relief, ultra low leak outside air damper and fully modulating 0-100% outside air actuator. Actuators to be modulating 0-10v, spring return with position sensing feedback. Proprietary actuators not allowed.
 - 2. Class I motorized outside air dampers. All outside air dampers to be ultra low leak dampers. Dampers shall have an air leakage rate not greater than 4 cfm/sqft. and shall be labeled by an approved agency when tested in accordance with AMCA 500-D.
- J. Construction:
 - 1. Design for roof curb mounting with "down shot" duct connection. Full perimeter curb only.
 - 2. Units which require the installation of a separate plenum (such as side discharge units) are not acceptable.
 - 3. Coils: copper tubes, aluminum fins, factory test 450 psig, metal hail guards for all condenser coils. Aluminum microchannel condenser coils are acceptable.
 - a. Features:
 - 1) Easy access to filters, 2" filter rack
 - 2) Factory installed 1" filters
 - 3) Low voltage terminal board
 - 4) All blowers shall deliver a minimum of 450 cfm/ton at .5" E.S.P.
 - 5) Filter racks to be provided at each unit.
 - 6) High efficiency motors.
 - 4. Stainless steel heat exchanger.
 - 5. Single point electrical power entry through bottom of unit inside curb perimeter.
 - 6. Cabinet: Galvanized Steel, enamel paint, all sides & edges.
 - 7. Hinged service doors.
 - 8. Top of cabinet to be one piece, level, no step downs.
 - 9. Unit to be completely wired, piped, etc.
 - 10. Designated location to install electrical disconnect
 - 11. Fused disconnect provided by electrical contractor. Do not install fused disconnect on any access panels or over unit information tag(s).
 - 12. All sides shall be enclosed. All-access panels shall be metal.
 - 13. R-410A refrigerant.
 - 14. Comply with ASHRAE 62.
 - 15. Comply with NFPA 90A.
 - 16. Condensate drain pan with float switch
 - 17. All unit components to be UL listed.
- K. Accessories:
 - 1. 2-Stage Compressor Unit:
 - a. All rooftop units that are shown and/or scheduled as two stage shall have a minimum of two stage compressors and two fan speeds. In first stage cooling, the compressor is to be in first stage, and the fan is to be set to low speed. In second stage cooling, the compressor is to be in second stage, and the fan is to be set to high speed.
 - 2. Unit With Hot Gas Reheat:
 - a. All rooftop units that are shown and/or scheduled with hot gas reheat shall be provided with hot gas condenser reheat.
 - 3. Unit with Economizer Module and Fault Detection and Diagnostics:

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- a. All units that are shown and/or scheduled with F.D.D Economizer shall be provided with a dry bulb economizer. When outdoor dry bulb conditions are met, and the space temperature sensor is calling for cooling, the economizer mode of the unit shall provide free cooling to the space.
- b. All units 10 tons and above that are shown and/or scheduled to be provided with a dry bulb economizer and a power exhaust fan. The powered exhaust fan shall be sized to be at least 50% of total supply CFM. Powered exhaust shall only be enabled during economizer mode.
- c. All units with fault detection and diagnostics shall be capable of reporting faults to a fault management application system or displayed on the zones thermostat. The fault detection system shall be capable of detecting the following faults:
 - 1) Air temperature sensor failure.
 - 2) Not economizing when the unit should be economizing.
 - 3) Economizing when the unit should not be economizing.
 - 4) Dampers not modulating.
 - 5) Excess outdoor air.
- L. Other:
 - 1. Furnish crankcase heaters, timed off control, freeze thermostats, low ambient to 45°F, high pressure switch, and expansion valves on all units.
 - 2. Provide extra set of filters MERV 8, pleated 2" thick.
 - 3. List all accessories available for units and identify which accessories are being provided in submittals.
- M. See Specification Section 23 05 32 for roof curb requirements.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Contractor is not to open refrigeration system to install accessories.
- B. Install in accordance with all manufacturer's instructions and requirements.
- C. Install all units so that they are LEVEL on curbs.

3.2 IDENTIFICATION

- A. Provide identification per Section 23 05 53.

3.3 EQUIPMENT START-UP

- A. Follow all manufacturers' directions.
- B. Equipment manufacturer to provide start-up.
- C. Start-up by contractor will not be allowed.
- D. Equipment manufacturer/supplier to provide equipment performance checkout with contractor and provide report to Engineer.
- E. Make wiring changes as required to control transformer to accommodate job voltage.
- F. Provide 1" roll filter media on each return air opening during construction if blower is operational. Replace as required.
- G. Start-up Data and Report:
 - 1. Follow all manufacturers' directions and requirements.

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- H. Measure:
 - 1. Outside air temperature, entering and leaving conditions of evaporators and condensers, compressor amps, indoor blower amps, gas pressure, pressure drop across evaporator coil.
 - 2. Operate all units in heating and cooling modes with make-up air units operating.
 - 3. Provide start-up report with final request for payment.
 - 4. Install new, clean MERV 8 - 2" thick filters prior to test and balance.
- I. Test and Balance:
 - 1. Coordinate with Test and Balance Contractor after units are started.

END OF SECTION

SECTION 23 81 26

SPLIT SYSTEM HVAC UNITS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions, Division 1 Specifications, and Section 23 00 00, apply to this Section.

1.2 SECTION INCLUDES

- A. Split system HVAC units.

1.3 RELATED SECTIONS

- A. Section 22 13 18 - Condensate Piping
- B. Section 22 16 01 - Natural Gas Piping and Appurtenances
- C. Section 23 00 00 - Basic Mechanical Requirements
- D. Section 23 05 29 - Hangers and Supports for HVAC Piping and Equipment
- E. Section 23 05 93 - Testing, Adjusting and Balancing for HVAC
- F. Section 23 09 23 - Energy Management Control System
- G. Section 23 23 00 - Refrigerant Piping
- H. Section 23 31 13 - Metal Ductwork

1.4 REFERENCES

- A. Refer to Section 23 00 00 for complete names of references identified in this section.
 - 1. AGA - American Gas Association
 - 2. AHRI 210/240 - Unitary Air-Conditioning and Air Source Heat Pump Equipment
 - 3. AHRI 270 - Sound Rating of Outdoor Unitary Equipment
 - 4. ANSI/ASHRAE Std 15 - Safety Code of Mechanical Refrigeration
 - 5. ASHRAE Std 90.1 I-P-2001 - Energy Standard for Buildings Except Low Rise Residential Buildings
 - 6. ASHRAE Std 62.1-2001 - Ventilation for Acceptable Indoor Air Quality
 - 7. D.O.E. - Department of Energy
 - 8. IECC - International Energy Conservation Code
 - 9. NFPA 70 N.E.C. National Electrical Code
 - 10. UL - Underwriters Laboratory

1.5 SUBMITTALS

- A. Product Data:
 - 1. Provide submittal data on all equipment specified in this section in accordance with Section 23 00 90, General Conditions, and Division 1.
- B. Submittals shall include:
 - 1. Unit model number
 - 2. Refrigerant type

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3. Sound rating in accordance with AHRI 270
 4. Cooling efficiency in accordance with AHRI 210/240
 5. All accessories
- C. Submit product data indicating typical catalog of information including arrangements.
 - D. Submit product data sheets indicating dimensions, general assembly, and materials used in fabrication.
 - E. Provide in table form a schedule similar to drawings with data listing all unit information, data, accessories, etc.
 - F. Indicate mechanical and electrical service locations and requirements.
 - G. Submit letter from air conditioning manufacturer stating refrigerant line design has been reviewed.
 - H. Submit manufacturer's installation instructions.
 - I. Shop Drawings: (adjust as required)
 1. Submit 1/4" per foot shop drawing(s) showing all piping, ductwork, and equipment shown by drawings and specifications. Submit drawings on all mechanical rooms. The drawings shall be coordinated with structural, electrical, and fire sprinkler drawings.
 - J. Equipment Start-up Report
 1. Submit an equipment start-up report as provided by the equipment manufacturer. Start-up report shall include the following, but not limited to: verification of system airflow, proper operation of all motors and fans, proper tensioning of belts and pulleys, proper operation of on-board microprocessor control system, proper control of economizer damper, proper compressor operation, and proper operation of cooling, heating, and dehumidification modes.

1.6 QUALITY ASSURANCE

- A. UL listed and must display UL label on all units.
- B. All units must comply with ASHRAE Standard 90.1 and the applicable International Energy Conservation Code.
- C. Unit performance data must be rated in accordance with AHRI 210/240 and must display the AHRI symbol on all standard units.
- D. Conform to applicable ANSI/NFPA 70 code for internal wiring of factory wired equipment.
- E. Air conditioning manufacturer to visit site and inspect installation of units and refrigerant lines, and provide letter stating installation conforms to installation instructions.
- F. Tested in accordance with the Department of Energy.
- G. The air conditioning equipment manufacturer shall be solely responsible for their equipment that does not comply with the performance of their published catalogs and specifications.

1.7 OPERATION AND MAINTENANCE DATA

- A. Submit operation and maintenance data.
 1. Include manufacturer's descriptive literature, operating instructions, installation instructions, maintenance, and repair data, including filter replacement and unit lubrication.

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- B. Air conditioning manufacturer to visit site and inspect installation of units and refrigerant lines, and provide letter stating installation conforms to installation instructions.

1.8 WARRANTY

- A. Complete 1-year warranty on all equipment.
- B. 5-year warranty provided for the compressors.
- C. 15-year warranty provided for stainless steel heat exchangers.
- D. The warranted compressor assembly consists of the starter, rotor, eccentric shaft, eccentric rods, pistons, wrist pins, suction valves, discharge valves, unloading mechanisms, oil pump, and the housing in which these parts are enclosed.
- E. The warranty shall indicate model, serial number of the unit, and commencing date. The commencing date of the warranty shall be after the building has been accepted for occupancy.

PART 2 - PRODUCTS

2.1 MANUFACTURERS: SPLIT SYSTEM, HEAT PUMP, GAS FURNACE, ELECTRIC HEAT

- A. Lennox
- B. Carrier
- C. Daikin
- D. York/JCI
- E. Rheem

2.2 SPLIT SYSTEM HEATING/ COOLING UNITS

- A. All units to have standard mechanical thermostat terminal strip. Units with OEM branded controls and/or integration boards not allowed.
- B. All units 2 ½ tons or less units to be at minimum 16.0 SEER2 nominal.
- C. All units 3 to 5 tons to be at minimum 16 SEER2 nominal. All units to have two stage compressor and a minimum two speed fan.
- D. All units 6 to 10 tons to be a minimum of 15 IEER. All units to have two stage compressor and a minimum two speed fan.
- E. All units over 10 tons to be a minimum of 14.2 IEER. All units to have a minimum of 2 stages of cooling and a minimum two speed fan.
- F. Minimum Cooling Efficiencies:
 - 1. EER ratings by AHRI 210/240 and AHRI 340/360 (I-P):
 - a. All units SEER/EER values shall meet or exceed Energy Efficiency Ratios shown on schedule.
 - b. All units to comply with ASHRAE 90.1.
 - c. All units to comply with latest International Energy Conservation Code.
- G. Natural Gas Furnaces:
 - 1. Heating capacities:
 - a. Equal to or greater than those scheduled on plans.

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2. Ignition:
 - a. Equip with electronic pilot standard ignition
 - b. Standing pilot not allowed
 3. Efficiency:
 - a. Minimum 92% AFUE rating
 4. Heat exchanger material:
 - a. Stainless Steel
 - b. Bear AGA label.
- H. Condensing Units:
1. Features:
 - a. Crankcase heaters
 - b. Timed off control
 - c. Low Ambient cooling to 45°F
 - d. Hi/Low pressure switches
 - e. Over current protection
 - f. Filter Dryer
 - g. Provide Hail Guards on all Condensing Units
 - h. Provide any reference specialties that manufacturer requires
 - i. Refrigerant 410-A
- I. All Air Handlers:
1. Features:
 - a. 2-inch filter racks to be provided at each air handler.
 - b. Easy access to filters
 - c. Provide extra set of filters, Farr 3030 pleated 2" thick. MERV ³ 6.0.
 - d. Low voltage terminal strip
 - e. All blowers shall deliver a minimum of 450 cfm/ton at .5" E.S.P.
 - f. Furnish and install auxiliary drain pans below each air handler. Provide float switches for all auxiliary drain pans.
 2. Class I motorized outside air dampers. All outside air dampers to be low leak dampers. Dampers shall have an air leakage rate not greater than 4 cfm/sqft. and shall be labeled by an approved agency when tested in accordance with AMCA 500D.
- J. Accessories:
1. Unit with Economizer Mode and Fault Detection and Diagnostics:
 - a. All units 6 tons and above are to be provided with a dry bulb economizer. When outdoor dry bulb conditions are met, and the temperature sensor is calling for cooling, the economizer shall provide free cooling to the space. The dehumidification cycle and heating modes shall be disabled during economizer mode.
 - b. All economizers must be equipped with fault detection and diagnostics. The motorized, modulating dampers shall be capable of reporting faults to a fault management application system or displayed on the zones thermostat. The fault detection system shall be capable of detecting the following faults:
 - 1) Air temperature sensor failure.
 - 2) Not economizing when the unit should be economizing.
 - 3) Economizing when the unit should not be economizing.
 - 4) Dampers not modulating.
 - 5) Excess outdoor air.
 - c. Economizer operation, fault detection, and control shall be the responsibility of the controls contractor. There shall be no interlock between the Energy Management Control System and the unit's integral controls in regard to economizer operation. (i.e. Honeywell JADE Controllers are not allowed.)

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- d. The motorized, modulating outside air damper(s) and motorized return air damper(s) shall be provided and installed by the mechanical contractor. The controls contractor shall provide the 0-100% actuator to control the motorized, modulating outside air damper and the actuator to control the motorized damper in the return section.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install in accordance with the plans, manufacturer's instructions, and approved shop drawings.
- B. Contractor to provide and install all supports, stands, platforms, plenum boxes and associated components to accommodate units.
- C. Contractor to provide and install thermostat wire from air handler to condensing units.
- D. Contractor to provide and install flexible watertight conduit for wiring.
- E. Contractor to provide and install at minimum, 4" concrete housekeeping pad for each condensing unit that will sit on ground.
- F. Coordinate with plumbing contractor on all condensate piping including condensate from furnace/flue.
- G. Install roll type filter media overall return air openings during construction if unit is operated. Replace as required.

3.2 IDENTIFICATION

- A. Provide identification per Section 23 05 53.

3.3 EQUIPMENT START-UP

- A. Equipment manufacturer to provide start-up.
- B. Install and make hook-up to float switches.
- C. Measure:
 - 1. Outside air temperature, entering and leaving conditions of evaporators and condensers, compressor amps, indoor blower amps, gas pressure, pressure drop across evaporator coil.
 - 2. Operate all units in heating and cooling modes with outside air in operation.
 - 3. Provide report with final request for payment.
 - 4. Install new, clean filters prior to test and balance.
 - 5. Provide connection to refrigeration piping system and evaporators.

END OF SECTION

SECTION 23 81 27

SMALL CAPACITY SPLIT SYSTEM UNITS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions, Division 1 Specifications, and Section 23 00 00, apply to this Section.

1.2 SECTION INCLUDES

- A. Split system cooling units for elevator machine rooms, electrical rooms, MDF, and IDF Rooms as noted in schedule and shown on drawings.

1.3 RELATED SECTIONS

- A. Section 22 13 18 - Condensate Piping
- B. Section 22 16 01 - Natural Gas Piping and Appurtenances
- C. Section 23 00 00 - Basic Mechanical Requirements
- D. Section 23 05 29 - Hangers and Supports for HVAC Piping and Equipment
- E. Section 23 05 93 - Testing, Adjusting and Balancing for HVAC
- F. Section 23 09 13 - Programmable Control Devices for HVAC
- G. Section 23 09 23 - Energy Management Control System
- H. Section 23 23 00 - Refrigerant Piping
- I. Section 23 31 13 - Metal Ductwork

1.4 REFERENCES

- A. Refer to Section 23 00 00 for complete names of references identified in this section.
- B. ARI 210/240 - Unitary Air-Conditioning and Air Source Heat Pump Equipment
- C. ARI 270 - Sound Rating of Outdoor Equipment
- D. ARI 270 - Sound Rating of Outdoor Unitary Equipment
- E. ANSI/ASHRAE Std 15 - Safety Code of Mechanical Refrigeration

1.5 SUBMITTALS

- A. Product Data:
 - 1. Provide submittal data on all equipment specified in this section in accordance with Section 23 00 90, General Conditions, and Division 1.
 - 2. Submittals shall include:
 - a. Unit model number
 - b. Refrigerant type
 - c. Sound rating in accordance with ARI 270

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- d. Cooling efficiency in accordance with ARI Standard 210
 - e. All accessories
 - 3. Submit product data indicating typical catalog of information including arrangements.
 - 4. Submit product data sheets indicating dimensions, general assembly, and materials used in fabrication.
 - 5. Indicate mechanical and electrical service locations and requirements.
 - 6. Submit manufacturer's refrigerant piping.
 - 7. Submit manufacturer's installation instructions.
- B. Shop Drawings: (adjust as required)
- 1. Submit 1/4" per foot shop drawing(s) showing all piping and equipment shown by drawings and specifications. Submit drawings on all mechanical rooms. The drawings shall be coordinated with structural, electrical, and fire sprinkler drawings.

1.6 QUALITY ASSURANCE

- A. UL listed and must display UL label on all units.
- B. Unit performance data must be rated in accordance with ARI Standard 210/240 and must display the ARI symbol on all standard units.
- C. Conform to applicable ANSI/NFPA 70 code for internal wiring of factory wired equipment.
- D. Manufacturer to size refrigerant lines.

1.7 OPERATION AND MAINTENANCE DATA

- A. Submit operation and maintenance data.
- B. Include manufacturer's descriptive literature, operating instructions, installation instructions, maintenance, and repair data, including filter replacement and unit lubrication.

1.8 WARRANTY

- A. Complete 1-year warranty on all equipment
- B. Additional 5-year warranty provided for the compressors and heat exchangers.
- C. The warranted compressor assembly consists of the starter, rotor, eccentric shaft, eccentric rods, pistons, wrist pins, suction valves, discharge valves, unloading mechanisms, oil pump, and the housing in which these parts are enclosed.
- D. The warranty shall indicate model, serial number of the unit, and commencing date. The commencing date of the warranty shall be after the building has been accepted for occupancy.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Daikin
- B. Mitsubishi
- C. LG
- D. Carrier
- E. Lennox

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F. Samsung

G. Rheem

2.2 CONDENSING UNITS

A. Features:

1. Crankcase heaters
2. Timed off control
3. Low Ambient to 50°F
4. Hi/Low pressure switches
5. Over current protection
6. Filter Dryer

2.3 CONTROLS

A. Controller Features:

1. Manually activated "dry" mode. Low speed indoor fan, high speed compressor.
2. Temperature Settings/Display
3. 24 Hour Timer
4. Fan Speed Indicator
5. Mode Settings (auto, cool/dry)
6. BACnet EMCS Gateway

2.4 ALL AIR HANDLERS

A. Features:

1. Easy access to filters
2. Low voltage terminal strip
3. All blowers shall deliver a minimum of 450 cfm/ton at .5" E.S.P.
4. Filter racks to be provided in each air handler.
5. Condensate pump to be Aspen pumps Mini White

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install in accordance with the plans, manufacturer's instructions, and approved shop drawings.
- B. Contractor to provide and install at minimum, 4" concrete housekeeping pad for each condensing unit that will sit on ground.
- C. Both suction and liquid lines are to be insulated.
- D. Do not install condensate pumps over any equipment panels.
- E. Condensate pumps are to operate any time the unit is in the cooling mode and water is in drain pan. Follow manufacturer's instructions.
- F. Install new, clean filters. Cover return air with filter media until construction is complete.
- G. Provide connection to refrigeration piping system and evaporators.

3.2 IDENTIFICATION

- A. Provide identification per Section 23 05 53.

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3.3 EQUIPMENT START-UP

- A. Provide start-up.
 - 1. Start-up Data and Report:
 - a. Follow all manufacturers' directions.
- B. Measure:
 - 1. Outside air temperature, entering and leaving conditions of evaporators and condensers, compressor amps, indoor blower amps, gas pressure, pressure drop across evaporator coil.
 - a. Operate all units in each mode.
 - b. Provide report with final request for payment.

END OF SECTION

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DIVISION 26 – ELECTRICAL

Division 26 Electrical

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DIVISION 26

ELECTRICAL

General Requirements

Perform all work in strict accordance with the requirements and recommendations stated in the below list of codes and on these plans except when requirements are modified by the contract documents. Provide a complete and properly operating electrical system.

Perform all work per, but not limited to, the latest version of the following standards: NECA (standards for installation), NFPA, National Electric Code (NEC), all applicable State and Local Codes and Ordinances, OSHA Standard 2207 – Construction Industry Standard, and OSHA 29 CFR 1926 - Regulation of Excavation.

All materials and components furnished under this contract shall be UL listed and approved for the purpose intended. Additionally, they shall be new, free from defects of any kind and of the quality and design hereinafter specified and as required.

It shall be the contractor's responsibility to obtain all necessary applicable manufacturer's instructions and install all product in accordance with the manufacturer's instructions. It shall be the Contractor's responsibility to install all equipment, materials, and devices shown on the plans and as called out in these specifications even if manufacturer's instructions are absolutely unattainable.

This Contractor shall keep a set of plans on the job, noting daily all changes made in connection with the final installation including exact dimensioned locations of all new and existing switchgear, devices, luminaires, equipment and new or existing site utilities and lights.

The Contractor will examine the site, verify all requirements, service points, and availability of all services required to complete this project. No consideration will be granted for any alleged misunderstanding of the materials and labor to be provided as necessitated by nature of the site including those items which may be fairly implied as essential to the execution and completion of any and all parts of this project. All proposals shall take these existing conditions into consideration and the lack of specific information on the drawings shall not relieve the Contractor of any responsibility. Verify location and check for existing underground utilities and lines before ditching.

Work must be performed by workmen skilled in their trade. The installation must be complete whether the work is concealed or exposed.

Conceal electrical work in walls, floors, chases, under floors, underground and above ceilings. Branch circuits shall not be installed in the slab or under the slab unless shown or required on the drawings.

All equipment shall be new. Refurbished or used equipment will not be allowed.

General Requirements to support Other Trades

Throughout the project, the Electrical Contractor shall coordinate installation of all portions of the electrical system with the General Contractor, Mechanical, Plumbing, Communications and other Contractors to insure a complete working system for the Owner.

This contractor shall coordinate and provide all conduit and back boxes required for other trades.

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All conduit and boxes for thermostats and/or sensors shall be provided by this contractor. A thermostat or sensor junction box and 1/2" conduit to accessible attic and/or to corridor shall be provided for each room served with HVAC equipment. Coordinate with Division 23 for exact locations and requirements.

Details on Electrical drawings showing HVAC/Mechanical/Control Equipment providing of various relays devices, wiring and other equipment shall be provided by this Contractor as directed and as required per drawing.

Warranty

This Contractor shall warranty all work against defective materials and workmanship for a period of one year from and after date of acceptance of the installation by the owner.

Submittals

This contractor shall provide electronic submittals on all devices and equipment used on this project.

They shall be provided in PDF format. Paper submittals will be rejected. Submittals to include the manufacturer, model/series, and list all required accessories for a complete system.

Provide shop drawings for the following items: panelboards, luminaires and battery packs, lighting control system, motor starters and safety switches.

Existing conditions

Verify existing field measurements, circuiting arrangements, wiring and equipment served in areas as shown on the Drawings. Adjust all circuiting, wiring and materials to be provided as required by job conditions. Verify abandoned wiring and equipment serving only abandoned facilities. These construction drawings are based on casual field observation and existing record documents. Report discrepancies to the Engineer before disturbing existing installation. The Contractor accepts the existing conditions when beginning demolition.

Provide temporary wiring and connections to maintain required existing systems in service during construction. When work must be performed on energized equipment or circuits, use personnel experienced in such operations. Verify phasing on existing equipment and coordinate new phasing before energizing revised service.

Wiring / Conductors

Conductors shall be manufactured in the United States by Encore, Southwire, Cerro or General Cable.

Minimum wire size shall be #12. Wire sizes #12 and #10 shall be solid and larger sizes may be stranded. All feeders and branch circuit conductors shall be soft-drawn annealed copper / aluminum rated for at least 600V. The insulation for branch circuit conductors shall be type THWN-2 or THHN/THWN or better.

The insulation for service entrance and feeder conductors shall be type XHHW or better.

Provide a separate neutral conductor for each circuit. Multiple circuits shall not share a common neutral. Neutral conductors shall be sized as large as the phase conductors. Neutral conductors shall not be of a reduced size.

There shall be no more than three current carrying conductors in each conduit run. For three-phase balanced loads, the neutral need not be included in this requirement.

The insulation of each feeder run and each branch circuit shall be tested with a megger. The test shall be

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performed after the conductors have been pulled into the conduit and after terminations have been added, but before final connections are made.

All wiring, regardless of voltage, shall be enclosed in conduit or raceway in all exposed areas such as gymnasium, shops, stages, or similar locations.

Grounding and bonding

Provide grounding and bonding per NEC, ANSI/IEEE 142 - Recommended Practice for Grounding of Industrial and Commercial Power Systems and ANSI/UL 467 - Safety Standard for Grounding and Bonding Equipment.

Conduit, fittings and back boxes

All conduit and fittings shall be provided of the proper type and installed using methods per NEC. Acceptable conduit types include PVC, EMT and Rigid Galvanized. MC Cable is / is NOT allowed on this project.

Conduit shall NOT be used as the means of grounding. Provide a grounding electrode conductor in all feeder and branch circuit conduits sized per NEC.

Apply fire caulking as required. All conduits shall be internally sealed on each end as required by the NEC.

Wherever possible and unless otherwise indicated on the drawings, install conduit concealed in walls, partitions and above the ceiling. Install conduit exposed in ceiling area at the structure in electrical rooms, mechanical rooms and other rooms where ceilings are not present or scheduled. All conduits and back boxes shall be installed per NEC.

Mounting height of a wall-mounted outlet box means the height from finished floor to bottom of box. Install and support boxes per NEC 314-23 as required and as directed.

Exterior conduits and conduit risers above grade shall be rigid galvanized.

Leave a pull-wire in all empty conduits.

Identification / Labeling

Provide all proper identification, labeling and signs for equipment, devices, etc. including values and conditions as shown on drawings and as required by NEC.

All labeling on equipment (panels, switchgear, transformers, disconnects, etc.) shall be black melamine plastic laminate with white engraving and affixed with permanent stainless steel fasteners.

Testing

Provide testing on all feeders and grounding per manufacturer's printed testing procedures, applicable industry standards, ANSI standards, IEEE standards, NEMA standards and as directed by the Engineer. Provide testing equipment in good working order and which complies with the applicable industry standards and manufacturer's requirements. Include a list of testing equipment used and date of last calibration.

Fuses

All fuses shall be manufactured by Bussman, Littlefuse or Mersen and shall be Class RK-1 dual element, time delay. (No Exceptions)

Fuses at service entrance shall be Class R minimum.

Prior to ordering fuses or fuse holders, coordinate fuse ratings with the mechanical contractor to verify that

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fuses for HVAC equipment matches the MOCP values of the HVAC equipment being provided.

Enclosed Safety Switches / Disconnects

Safety switches and disconnects shall be from the same manufacturer as the panelboards and switchgear where possible.

In accordance with the service indicated, use 240 or 600 volt switches, single throw, fusible, horsepower rated, 100% load break and make rated, designed for locking in "ON" or "OFF" position, in code gauge steel cabinets, as required by the application and the NEC.

Provide NEMA 1 enclosures indoors and NEMA 3R Heavy Duty enclosures outdoors (or where otherwise required).

SPDs

SPDs shall be manufactured by ACT Communications, Eaton, Emerson ABB, Mersen, Square-D or SSI. Provide UL rated SPD protection where indicated on the drawings. Protection shall be of the MOV type with at least seven mode protection (L-N, L-G, N-G) with discrete protection elements on each mode.

SPD shall be tested and performance rated per UL1449.

SPDs at rooftop units and condensers shall be in a NEMA 4X enclosure suitable for outdoor installation and have SCCR: 100kAIC and be Squared D SDSA series or equivalent.

END OF SECTION