PROJECT MANUAL

EMA PROJECT NO. 1 001 0959 001

January 25, 2022

REQUEST FOR COMPETITIVE SEALED PROPOSAL
2022 HVAC RENOVATION TO RAINS JUNIOR HIGH SCHOOL
RAINS INDEPENDENT SCHOOL DISTRICT
EMORY, TEXAS

MRS. JENNIFER JOHNSON
SUPERINTENDENT

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

REGISTRATION NO. F-893

EMA
DESIGN SOLVE ENHANCE

SEALS PAGE

EMA PROJECT NUMBER 1 001 0959 001

1-25-2022

ENGINEER: **EMA**
Engineering & Consulting
328 South Broadway
Tyler, Texas 75702
903.581.2677 (Phone)

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DIVISION 0 - BIDDING AND CONTRACT REQUIREMENTS

SECTION 00 02 00 - INVITATION TO BID

PROJECT: 2022 HVAC RENOVATIONS
TO RAINS JUNIOR HIGH SCHOOL
RAINS INDEPENDENT SCHOOL DISTRICT

EMA PROJECT NUMBER: 1 001 0959 001

BID/ PROPOSAL DATE AND TIME: February 24, 2022 at 2:00 pm

OPENING OF PROPOSALS: Rains Independent School District
1759 US Highway 69
Emory, Texas 75440

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

Sealed competitive proposals are requested for the ***2022 HVAC Renovations to Rains Junior High School. Rains Independent School District.***

2022 HVAC Renovations to Rains Junior High School, Rains Independent School District work includes replacing selected HVAC units at Rains Junior High School.

Sealed proposals will be received by the Rains ISD Facilities Department at the following location: 1759 US Highway 69 Emory, Texas 75440. Proposals received after bid date and time will not be accepted. All interested parties are invited to attend. Successful bidder will be contacted at a later date.

Electronic drawings and specifications may be obtained from the Rains Independent School District website.

Bid Security in the amount of 5% of bid 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. All contractors must comply with all federal, state, and local labor laws including Article 5159a, Vernon's Annotated Revised Civil Statues of the State of Texas which requires that the contractor pay not less than the Prevailing Wage Scale.

Contractors shall comply with all aspects of Article 5159a, Vernon's Civil Statue, including keeping records on each laborer, workman, or mechanic employed for each calendar day or portion thereof.

The Owner reserves the right to waive irregularities and to reject any or all Bids. The Rains Independent School District reserves the right to separate or eliminate any item it deems necessary to accommodate budgetary and/or operational requirements. The Rains 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 Rains Independent School District. The Rains Independent School District also reserves the right to award to other than the lowest bidder under statutory mandate 271.027(b) Local Government Code.

The Contractor shall be a General Contractor or Mechanical Contractor with a Texas Mechanical license 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, Labor and Material Payment Bond and Performance Bond are required of the Mechanical Contractor.

The Mechanical Contractor shall be required to provide Bid Bond 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.

SELECTION CRITERIA: In accordance with Texas Education Code as amended, Rains 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; (70 Points)
2. The reputation of the vendor and of the vendor's goods or services; (5 Points)
3. The quality of the vendor's goods or services; (5 Points)
4. The vendor's past relationship with the district; (3 Points)
5. Specific experience in public schools of the scope of the proposed project; (7 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 February 10, 2022 at 10:00 A.M. at the Rains Independent School District Administration Building. It is highly recommended that companies submitting proposals attend.**

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

Rains ISD encourages the participation of qualified historically underutilized businesses.

Rains Independent School District
Jennifer Johnson
Superintendent
Emory, 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 district reserves the right to reject or accept any bidders that have not 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, they 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 Rains 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 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 of 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. Mechanical 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 C-520 (2013 Edition). Standard Form of Agreement Between Owner and Contractor on The Basis of A Stipulated Price.

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.

Rains ISD has ascertained the General Prevailing rate of Per Diem Wages for each craft of 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.

harmless the Rains 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 Rains 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. The insurance company must also be listed in the Federal Register, Part II, Circular 570, latest edition. The 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 Rains Independent School District. Submit one (1) copy of coverage policies.

24. Rains Independent School District shall issue an official Rains 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 Rains Independent School District.

28. The Owner's representative is Mr. Jeff Fisher, Assistant Superintendent of Finance, Rains ISD, 1759 US Highway 69 Emory, Texas 75440 (Phone: 903-473-2222).

The address of the school is as follows:

School	***Address***
Rains Junior High School	1755 West US Highway 69 Emory, Texas 75440

30. General Description of Work:

This work includes but is not limited to the following. All work shall be complete and turn-key. New HVAC equipment, Energy Management Controls, and Electrical Renovations to Rains Junior High School

Exhibit "A"
PREVAILING WAGE RATE
Rains 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.

See rates included in this section.

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

PREVAILING WAGE RATES

The Schedule of Prevailing Wage Rates as listed, provided by the US Department of Labor, reflects the prevailing wage rate for the East Texas area, however, if the Prevailing Wage Rate listed below is lower than the minimum wage rate of pay as set forth by the US Department of Labor, then the minimum wage rate of $7.25 shall prevail for all covered, non-exempt workers.

BUILDING CONSTRUCTION
PREVAILING WAGE RATES
EAST TEXAS AREA

CLASSIFICATION	PREVAILING RATE
Acoustical Installer	10.55
Asbestos Worker, Journeyman	15.00
Asbestos Worker, Trainee	8.00
Bricklayer, Skilled	12.40
Bricklayer, Trainee	7.00
Carpenter, Journeyman	12.50
Carpenter, Trainee	7.00
Cement Mason	11.25
Cement Mason, Trainee	7.50
Concrete Finisher	10.90
Drywall Hanger	10.75
Electrician, Journeyman	12.75
Electrician, Trainee	7.00
Elevator Constructor	17.20
Elevator Constructor, Trainee	10.85
Glazier	11.28
HVAC Mechanic	12.20
HVAC Mechanic, Trainee	6.75
Insulator	11.40
Iron Worker, Structural	11.50
Iron Worker, Trainee	8.00
Laborer	5.95
Laborer Mason Tender	6.50
Laborer Pipe Layer	8.65
Lather	17.75
Millwright	15.25
Millwright, Trainee	9.50
Operating Engineer, Heavy	13.50
Operating Engineer, Light	11.75
Operating Engineer, Trainee	9.00
Painter	10.25
Painter, Trainee	6.10
Pipefitter	13.20
Pipefitter, Trainee	8.00
Plasterer	15.70
Plasterer, Trainee	8.00
Plumber	11.90
Plumber, Trainee	7.70
Roofer	9.30
Roofer, Trainee	6.50
Sheetmetal Worker	12.10
Sheetmetal Worker, Trainee	7.00
Sprinkler Fitter	13.10
Sprinkler Fitter, Trainee	8.10
Truck Driver	8.00
Tile Mechanic	13.00
Marble Setter	12.20
Marble / Terrazzo Mechanic	15.00
Marble / Terrazzo Mechanic, Trainee	8.00
Welder	11.75
Welder, Trainee	8.00

END OF INSTRUCTIONS TO BIDDERS/PROPOSERS

Rains Independent School District
Purchasing Department
Administration Building
1759 US Highway 69
Emory, TX 75440
Attention: Jeff Fisher

PROPOSAL FORM/BID FORM
2022 ESSER HVAC Renovations
TO Junior High School
Rains Independent School District
EMA Project No. 1 001 0959 001

I have received plans, and specifications for the project listed above as prepared by EMA Engineering & Consulting I have also received addenda Nos. _____ and have included their provisions in my proposal. I have examined these documents, all of the existing site, 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. To start work on receipt of contract and to furnish all requirements. To coordinate with the on-going school programs. I will substantially complete all work by the following schedule and complete all work by the following schedule.

   I will substantially complete all work by **July 29, 2022** and complete all work by **August 5, 2022**. Work may begin on site after contract is executed, provided that classes and school activities are not disrupted. It is the intent of the Owner to complete work as soon as possible.

6. To deliver within ten 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 this page and the following page. Bids shall be entered in appropriate spaces of this Proposal Form. I understand that Rains 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.

   Base Bid

   a) I will provide complete turn-key work (including all related work) that includes, but is not limited to HVAC, ELECTRICAL and EMCS renovations for the total lump sum price of _____ _____($_____).

   Alternate Proposal – Vocational Building

   b) I will provide complete turn-key work (including all related work) that includes, but is not limited to HVAC, ELECTRICAL and EMCS renovations for the total lump sum price of _____ _____($_____).

The above lump sum for 'Base Proposal' includes an **allowance of $85,000.00 for construction contingency**.

The proposal price includes the contingency allowance noted above as specified in Section 01 00 00 and Section 00 02 00. Include contingency allowance in base bid.

8. Base bid and qualifications shall be used to select the successful contractor.

9. I understand a Performance and Payment Bond is required and a Bid Bond is required.

10. I also certify that I have visited 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.

11. The cost of all bonds, insurance and guarantees are included in my bid prices.

12. I understand liquidated damages apply from date of substantial completion until all work is complete at all sites and acceptable by Engineer and Owner (See General Conditions and Supplementary Conditions).

13. Enclosed with this bid is a complete list of subcontractors that I will use on this project.

14. I am enclosing with the bid, the qualification form as specified in 00 32 00-1.

15. 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: _____

FAX: _____

TEXAS MECHANICAL LICENSE NO.: _____
(If Applicable)

CERTIFICATION BY CORPORATE BIDDER

2022 HVAC Renovations
Rains Junior High School
Rains Independent School District
Emory, Texas 75791
EMA Project Number 1 001 0959 001

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

BIDDER'S QUALIFICATION FORM

2022 HVAC Renovations
Rains Junior High School
Rains Independent School District
Emory, Texas 75791
EMA Project Number 1 001 0959 001

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, Estes, McClure, and Associates Inc., 328 S. Broadway Avenue, 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

2022 HVAC Renovations
Rains Junior High School
Rains Independent School District
Emory, Texas 75791
EMA Project Number 1 001 0959 001

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: RAINS INDEPENDENT SCHOOL DISTRICT
1759 US Highway 69
Emory, Texas 75440
Attention: Jeff Fisher

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) _____

EMCS Contractor: _____

Electrical: _____

Test & Balance: _____

Date: _____ BIDDER: _____
(Company Name)

_____
(Signature)

_____
(Address)

By: _____

Title: _____

Mechanical Contractor shall be Bidder.

AGREEMENT FORM

2022 HVAC Renovations
Rains Junior High School
Rains Independent School District
Emory, Texas 75791
EMA Project Number 1 001 0959 001

Contract shall be prepared on "Standard Form of Agreement Between Owner and Contractor". On the Basis of A Stipulated Price, Form EJCDC C-520.

PERFORMANCE BOND FORM

2022 HVAC Renovations
Rains Junior High School
Rains Independent School District
Emory, Texas 75791
EMA Project Number 1 001 0959 001

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.

Performance and Payment Bond required from Mechanical Contractor.

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

LABOR AND MATERIAL PAYMENT BOND

2022 HVAC Renovations
Rains Junior High School
Rains Independent School District
Emory, Texas 75791
EMA Project Number 1 001 0959 001

Contractor(s) and subcontractors (as specified) shall furnish a Labor and Material Bond for 100% of the value of the work. The 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 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.

GENERAL CONDITIONS

GENERAL:

A. National Society of Professional Engineers, Document EJCDC No. C-700, "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 S. Broadway, 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, EJCDC® C-700 (2013 Edition). All provisions that are not so amended or supplemented remain in full force and effect.

The terms used in these Supplementary Conditions have the meanings stated in the General Conditions. Additional terms used in these Supplementary Conditions have the meanings stated 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:

Amend the first sentence to read as follows:

Owner shall furnish to Contractor [NA] copies of the Contract Documents (including one fully executed counterpart of the agreement), and one copy in electronic portable document format (PDF).

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.

Delete the part of paragraph section 5.04.B7 which requires two years operational insurance after final payment.

Add the following sentences after paragraph 5.04.A.1.

Such insurance shall include protection from all claims under the Texas Employer's Liability ($500,000) and Worker's Compensation Law and that all insurance policies must be issued by acceptable companies licensed to do business in Texas and with an A.M. Best Rating of A-X (A-10) or better. The CONTRACTOR is to certify in writing that he provides workers' compensation insurance coverage for all employees of the CONTRACTOR employed on the project. A Subcontractor shall provide such a certificate to the GENERAL CONTRACTOR, relating to the coverage of the Subcontractor's employees, and the GENERAL CONTRACTOR shall provide such certificate to the OWNER. (Texas Labor Code Sections: 406.096 & 401.011)

Add the following new paragraph immediately after paragraph 5.04.B.

The insurance required by Section 5.04 shall be written for not less than the following, or greater if required by law:

1. Worker's Compensation:
    (a) State: Statutory

    (b) Applicable Federal: Statutory

    (c) Employer's Liability: $500,000/$500,000/$500,000

    (d) Benefits Required by Union
        Labor Contracts: As applicable

2. Comprehensive General Liability
    $1,000,000 each occurrence

Comprehensive General Liability and Commercial General Liability to include Broad Form CGI Endorsement. Such coverage shall include the following:

Premises-operations; Independent CONTRACTOR'S; Product/Completed Operations; Contractual Liability; Personal Injury and Advertising Liability; Premises Medical Payments - $1,000; Host Liquor Liability; Fire Legal Liability - $50,000; Broad Form Property Damage; Incidental Medical Malpractice; Limited World Wide Coverage; Employees as additional insured; Non-owned Watercraft Liability: Automatic Coverage-Newly Acquired Organization: XCU Coverage; 30 day notice of cancellation; and the OWNER as additional insured.

(a) Bodily Injury:

$500,000 Each Occurrence
$500,000 Aggregate, Products and Completed Operations
$1,000,000 Combined Coverage Limit

(b) Property Damage:

$500,000 Each Occurrence
$500,000 Aggregate
$1,000,000 Combined Coverage Limit

(c) Products Completed Operations Insurance shall be maintained for a minimum period of 1 year after final payment, and CONTRACTOR shall continue to provide evidence of such coverage to OWNER on an annual basis during the aforementioned period.

(d) Property Damage Liability Insurance shall include coverage for X, C, and U hazards.

(e) Contractual Liability (Hold Harmless Coverage):
(1) Bodily Injury: $500,000 Each Occurrence
(2) Property Damage: $500,000 Each Occurrence
$500,000 Aggregate

(f) Personal Injury, with Employment Exclusion deleted:
$500,000 Aggregate

3. Comprehensive Automobile Liability (owned, non-owned, hired)
$500,000 combined single interest:

(a) Bodily Injury:

$500,000 Each Person
$500,000 Each Accident

(b) Property Damage:

$250,000 Each Occurrence

(c) Combined Coverage Limit $750,000

Property Insurance:

Delete paragraph 5.06.A in its entirety and insert the following in its place.

5.06.A The OWNER will provide no special Property Insurance to cover operations under this Contract. The OWNER'S blanket policy covering all property of the District will continue in force, for existing structures. Substitute the following paragraph.

The CONTRACTOR shall purchase and maintain property insurance upon the entire Work at the site to the full insurable value thereof. Such insurance shall be with a company which operates under a Certificate of Authorization issued by the State of Texas and which has obtained an A.M. BEST rating of A-X (A-10) or better.

1. Include the interests of OWNER, CONTRACTOR, Subcontractors, ENGINEER, ENGINEER'S Consultants and any other individuals or entities identified in the Supplementary Conditions, and the officers, directors, partners, employees, agents, and other consultants and Subcontractors of any of them each of whom is deemed to have an insurable interest and shall be listed as an insured or additional insured;
2. Be written on a Builder's Risk "all-risk" or open peril or special causes of loss policy form that shall at least include insurance for physical loss and damage to the Work, temporary buildings, falsework, and materials and equipment in transit and shall insure against at least the following perils or causes of loss: fire, lightning, extended coverage, theft, vandalism and malicious mischief, earthquake, collapse, debris removal, demolitions occasioned by enforcement of Laws and Regulations, water damage, and such other perils or causes of loss as may be specifically required by the Supplementary Conditions.
3. Include expenses incurred in the repair or replacement of any insured property (including but not limited to fees and charges of ENGINEERS and architects);
4. Cover materials and equipment stored at the Site or at another location that was agreed to in

writing by OWNER prior to being incorporated in the Work, provided that such materials and equipment have been included in an Application for Payment recommended by ENGINEER; and

5. Allow for partial utilization of the work by OWNER;
6. Include testing and startup; and
7. Be maintained in effect until final payment is made unless otherwise agreed to in writing by OWNER, CONTRACTOR and ENGINEER with 30 days written notice to each other additional insured to whom a certificate of insurance has been issued.
8. CONTRACTOR shall be responsible for any deductible or self-insured retention.
9. The policies of insurance required to be purchased and maintained by CONTRACTOR in accordance with this paragraph SC-5.06 shall comply with the requirements of paragraph 5.06.C of the General Conditions.
10. If by the terms of this insurance any mandatory deductibles are required, or if the CONTRACTOR should elect, with the concurrence of the OWNER, to increase the mandatory deductible amounts, or purchase this insurance with voluntary deductible amounts, the CONTRACTOR shall be responsible for payment of the amount of the deductible in the event of a paid claim.

Delete paragraph 5.06.B in its entirety and insert the following in its place.

The OWNER will provide no special steam boiler and machinery insurance to cover operations under this Contract.

Partial Utilization - Property Insurance:

5.10.A. Add the following at the end of the paragraph.

Some of the work in this contract may be accomplished during the months when school is not in session, and some will be accomplished with partial or normal occupancy. OWNER may have their custodial, maintenance, office, other personnel, other CONTRACTOR on site during this time. If there are conditions where the work is not complete before the end of the summer and school starts, or if some work is initiated before the summer school session starts, the building will be occupied for normal use by OWNER. In any event, paragraph 5.10.A is modified to require full coverage of insurance as required in other paragraphs of Article 5 and no changes or deletions or transfer of insurance shall occur because of partial occupancy until all work at the site is complete, and then any changes shall be in accordance with Contract Documents. This insurance by CONTRACTOR shall not be canceled or lapsed on account of any partial occupancy or use. Consent of the CONTRACTOR and the insurance companies to such occupancy or use shall not be unreasonably withheld.

Certificates of Insurance and Other Requirements:

Add the following paragraphs at the end of Article 5.

5.11. Notwithstanding any other provisions in the Contract, Certificates of insurance acceptable to the OWNER for all insurance shall be filed with the OWNER prior to commencement of the Work. In addition to the Certificates, certified copies of all policies shall be provided to the OWNER prior to commencement of work. The certification on all policies shall contain a provision that the policies shall not be canceled until 30 days prior written notice has been received by the OWNER.

5.12. All insurers must be licensed to do business in Texas and must be approved by OWNER. CONTRACTOR shall provide OWNER written proof that insurance companies are licensed and authorized to do business in Texas.

5.13. If the OWNER is damaged by the failure to maintain all required insurance, the CONTRACTOR shall bear all such damages. The general indemnification granted by the CONTRACTOR elsewhere in the Contract Documents shall not be compromised or limited by the amount of insurance coverage, and express reference is hereby made to such indemnification.

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.

<u>Concerning Subcontractors, Suppliers and Others:</u>

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 of 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 state in the Agreement, the OWNER will retain 10% 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 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 dispute resolution.

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 and/or Engineer, 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 at no additional cost to the owner. 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.

17.09.1 It is understood and agreed between the OWNER and the CONTRACTOR that, if the said CONTRACTOR shall neglect, fail to refuse to complete the Work on the schools within the time called for, or any proper extension thereof granted by the OWNER, then the CONTRACTOR does hereby agree, as part consideration for the awarding of this Contract, to pay the OWNER the amount of Three Hundred Dollars ($300.00), not as penalty, but as liquidated damages for such breach of Contract as hereinafter set forth, for each and every calendar day that the CONTRACTOR shall be in default after the time stipulated in the Contract for substantially completing and for completing the Work. Liquidated damages apply to each project as specified above.

17.09.1.1 The said amount is fixed and agreed upon by and between the CONTRACTOR and the OWNER because of the impracticability and extreme difficulty of fixing and ascertaining the actual damages the OWNER would in such event sustain, and said amount is agreed to be the amount of damages which the OWNER would sustain.

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. Alcoholic beverages, smoking and other use of tobacco products on the campus is prohibited.

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

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 as a validation and security measure per the 24 advance request for site visit. At no time will a person who does not meet the legal requirements to be on a school property be part of the services included in the scope of this project.

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 USD 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 their subcontractors shall comply with Texas Government Code §2258.053 which requires payment to each worker employed in the execution of this contract to be paid not less than the prevailing rates as shown in Section 00 10 00 of the project manual as exhibit “A”. A contractor or subcontractor who violates this section shall pay owner $60.00 for each worker employed for each calendar day or part of the day that the worker is paid less than the required rates.

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 GENERAL CONDITIONS

Employment Eligibility Verification

Department of Homeland Security
U.S. Citizenship and Immigration Services

USCIS
Form I-9
OMB No. 1615-0047
Expires 10/31/2022

►START HERE: Read instructions carefully before completing this form. The instructions must be available, either in paper or electronically, during completion of this form. Employers are liable for errors in the completion of this form.

ANTI-DISCRIMINATION NOTICE: It is illegal to discriminate against work-authorized individuals. Employers **CANNOT** specify which document(s) an employee may present to establish employment authorization and identity. The refusal to hire or continue to employ an individual because the documentation presented has a future expiration date may also constitute illegal discrimination.

Section 1. Employee Information and Attestation *(Employees must complete and sign Section 1 of Form I-9 no later than the **first day of employment**, but not before accepting a job offer.)*

Last Name *(Family Name)*	First Name *(Given Name)*	Middle Initial	Other Last Names Used *(if any)*

Address *(Street Number and Name)*	Apt. Number	City or Town	State	ZIP Code

Date of Birth *(mm/dd/yyyy)*	U.S. Social Security Number	Employee's E-mail Address	Employee's Telephone Number
	☐☐☐ - ☐☐ - ☐☐☐☐		

I am aware that federal law provides for imprisonment and/or fines for false statements or use of false documents in connection with the completion of this form.

I attest, under penalty of perjury, that I am (check one of the following boxes):

☐ 1. A citizen of the United States

☐ 2. A noncitizen national of the United States *(See instructions)*

☐ 3. A lawful permanent resident (Alien Registration Number/USCIS Number): _____

☐ 4. An alien authorized to work until (expiration date, if applicable, mm/dd/yyyy): _____
Some aliens may write "N/A" in the expiration date field. *(See instructions)*

Aliens authorized to work must provide only one of the following document numbers to complete Form I-9: An Alien Registration Number/USCIS Number OR Form I-94 Admission Number OR Foreign Passport Number.

1. Alien Registration Number/USCIS Number: _____

OR

2. Form I-94 Admission Number: _____

OR

3. Foreign Passport Number: _____

Country of Issuance: _____

QR Code - Section 1
Do Not Write In This Space

Signature of Employee	Today's Date *(mm/dd/yyyy)*

Preparer and/or Translator Certification (check one):

☐ I did not use a preparer or translator. ☐ A preparer(s) and/or translator(s) assisted the employee in completing Section 1.

(Fields below must be completed and signed when preparers and/or translators assist an employee in completing Section 1.)

I attest, under penalty of perjury, that I have assisted in the completion of Section 1 of this form and that to the best of my knowledge the information is true and correct.

Signature of Preparer or Translator	Today's Date *(mm/dd/yyyy)*

Last Name *(Family Name)*	First Name *(Given Name)*

Address *(Street Number and Name)*	City or Town	State	ZIP Code

STOP *Employer Completes Next Page* STOP

Section 2. Employer or Authorized Representative Review and Verification

(Employers or their authorized representative must complete and sign Section 2 within 3 business days of the employee's first day of employment. You must physically examine one document from List A OR a combination of one document from List B and one document from List C as listed on the "Lists of Acceptable Documents.")

Employee Info from Section 1	Last Name *(Family Name)*	First Name *(Given Name)*	M.I.	Citizenship/Immigration Status

List A Identity and Employment Authorization	OR	List B Identity	AND	List C Employment Authorization
Document Title		Document Title		Document Title
Issuing Authority		Issuing Authority		Issuing Authority
Document Number		Document Number		Document Number
Expiration Date *(if any) (mm/dd/yyyy)*		Expiration Date *(if any) (mm/dd/yyyy)*		Expiration Date *(if any) (mm/dd/yyyy)*
Document Title				
Issuing Authority				
Document Number				
Expiration Date *(if any) (mm/dd/yyyy)*				
Document Title				
Issuing Authority				
Document Number				
Expiration Date *(if any) (mm/dd/yyyy)*				

Additional Information

QR Code - Sections 2 & 3
Do Not Write In This Space

Certification: I attest, under penalty of perjury, that (1) I have examined the document(s) presented by the above-named employee, (2) the above-listed document(s) appear to be genuine and to relate to the employee named, and (3) to the best of my knowledge the employee is authorized to work in the United States.

The employee's first day of employment *(mm/dd/yyyy)*: _____ ***(See instructions for exemptions)***

Signature of Employer or Authorized Representative	Today's Date *(mm/dd/yyyy)*	Title of Employer or Authorized Representative

Last Name of Employer or Authorized Representative	First Name of Employer or Authorized Representative	Employer's Business or Organization Name

Employer's Business or Organization Address (*Street Number and Name*)	City or Town	State	ZIP Code

Section 3. Reverification and Rehires *(To be completed and signed by employer or authorized representative.)*

A. New Name *(if applicable)*			**B.** Date of Rehire *(if applicable)*
Last Name *(Family Name)*	First Name *(Given Name)*	Middle Initial	Date *(mm/dd/yyyy)*

C. If the employee's previous grant of employment authorization has expired, provide the information for the document or receipt that establishes continuing employment authorization in the space provided below.

Document Title	Document Number	Expiration Date *(if any) (mm/dd/yyyy)*

I attest, under penalty of perjury, that to the best of my knowledge, this employee is authorized to work in the United States, and if the employee presented document(s), the document(s) I have examined appear to be genuine and to relate to the individual.

Signature of Employer or Authorized Representative	Today's Date *(mm/dd/yyyy)*	Name of Employer or Authorized Representative

LISTS OF ACCEPTABLE DOCUMENTS
All documents must be UNEXPIRED

Employees may present one selection from List A
or a combination of one selection from List B and one selection from List C.

LIST A Documents that Establish Both Identity and Employment Authorization	OR	LIST B Documents that Establish Identity	AND	LIST C Documents that Establish Employment Authorization
1. U.S. Passport or U.S. Passport Card		**1.** Driver's license or ID card issued by a State or outlying possession of the United States provided it contains a photograph or information such as name, date of birth, gender, height, eye color, and address		**1.** A Social Security Account Number card, unless the card includes one of the following restrictions: (1) NOT VALID FOR EMPLOYMENT (2) VALID FOR WORK ONLY WITH INS AUTHORIZATION (3) VALID FOR WORK ONLY WITH DHS AUTHORIZATION
2. Permanent Resident Card or Alien Registration Receipt Card (Form I-551)		**2.** ID card issued by federal, state or local government agencies or entities, provided it contains a photograph or information such as name, date of birth, gender, height, eye color, and address		**2.** Certification of report of birth issued by the Department of State (Forms DS-1350, FS-545, FS-240)
3. Foreign passport that contains a temporary I-551 stamp or temporary I-551 printed notation on a machine-readable immigrant visa		**3.** School ID card with a photograph		**3.** Original or certified copy of birth certificate issued by a State, county, municipal authority, or territory of the United States bearing an official seal
4. Employment Authorization Document that contains a photograph (Form I-766)		**4.** Voter's registration card		**4.** Native American tribal document
5. For a nonimmigrant alien authorized to work for a specific employer because of his or her status: **a.** Foreign passport; and **b.** Form I-94 or Form I-94A that has the following: (1) The same name as the passport; and (2) An endorsement of the alien's nonimmigrant status as long as that period of endorsement has not yet expired and the proposed employment is not in conflict with any restrictions or limitations identified on the form.		**5.** U.S. Military card or draft record		**5.** U.S. Citizen ID Card (Form I-197)
		6. Military dependent's ID card		**6.** Identification Card for Use of Resident Citizen in the United States (Form I-179)
		7. U.S. Coast Guard Merchant Mariner Card		**7.** Employment authorization document issued by the Department of Homeland Security
		8. Native American tribal document		
		9. Driver's license issued by a Canadian government authority		
		For persons under age 18 who are unable to present a document listed above:		
6. Passport from the Federated States of Micronesia (FSM) or the Republic of the Marshall Islands (RMI) with Form I-94 or Form I-94A indicating nonimmigrant admission under the Compact of Free Association Between the United States and the FSM or RMI		**10.** School record or report card		
		11. Clinic, doctor, or hospital record		
		12. Day-care or nursery school record		

Examples of many of these documents appear in the Handbook for Employers (M-274).

Refer to the instructions for more information about acceptable receipts.

FELONY CONVICTION NOTIFICATION

Texas Education Code, 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:

VENDOR’S NAME:_____

AUTHORIZED COMPANY OFFICIAL’S NAME (printed):_____

DATE: _____

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:_____

End of Section

Certification for Criminal History Check

in Compliance with Texas Education Code § 22.0834(a)

Definitions

"Covered employee"—A "covered employee" is a person who is an employee, applicant, agent or Subcontractor of the Contractor or of any Subcontractor of the Contractor, if (a) the person has or will have
work duties related to the Project that will be performed on District property or at another location on a regular or repeated basis, (b) students are regularly present at such location, and (c) the person will have verbal or physical interaction with, or be in direct proximity to, one or more students.

"Direct contact with students"-The contact that results from activities that provide substantial opportunity for verbal or physical interaction with students that is not supervised by a certified educator or other professional district employee. Contact with students that results from services that do not provide substantial [the] opportunity for unsupervised interaction with a [an individual] student or students, such as addressing an assembly, officiating a sports contest, or judging an extracurricular event, is not, by itself, direct contact with students. However, direct contact with students does result from any activity that provides substantial [the] opportunity for unsupervised contact with students, which might include [such as], without limitation, the provision of [individualized] coaching, tutoring, or other services to students.

"Disqualifying conviction"—A "disqualifying conviction" is a conviction of (a) any felony under the Texas Penal Code, (b) any offense for which the person is required to register as a sex offender under Chapter 62 of the Texas Code of Criminal Procedure, (c) any equivalent offense under the laws of the United States or any other state, (d) any offense against a child, (e) misdemeanor possession of a controlled substance within 10 years, (f) any weapon offense, (g) theft, larceny, fraud, issuance of a bad check, theft by check above the class C misdemeanor level, or more than one offense at the class C level, (h) forgery, (i) altering an Official Document, (j) perjury, or (k) securing executing of a document by deception.

On behalf of _____ ("Contractor"), I certify that [check one]:

[ ] None of Contractor's employees are *covered employees,* as defined above.
The service contractor shall also certify that it will take reasonable steps to ensure that the conditions or precautions that have resulted in a determination that any person is not a covered contract employee continue to exist throughout the time that the contracted services are provided.
Or
[ ] Some or all of Contractor's employee are *covered employees.* If this box is selected, I further certify that:

(1) Contractor has obtained all required criminal history record information, through the Texas Department of Public Safety, regarding its covered employees. None of the covered employees has a disqualifying conviction.

(2) If Contractor receives information that a covered employee has a disqualifying conviction, Contractor will immediately remove the covered employee from contract duties and notify the District in writing within 3 business days that it has done so.

Noncompliance by Contractor with this certification may be grounds for contract termination.

_____
Title Signature

Date: _____

FINGER PRINTING PROVISIONS

The successful proposer will, before beginning performance and at least annually during performance of any Agreement, obtain criminal history record information at its own expense concerning all covered employees, and will certify that to the District that it has done so on a form to be provided by District. A "covered employee" is a person who is an employee, applicant, agent or Subcontractor of the Proposer or of any Subcontractor of the Proposer, if (a) the person has or will have work duties related to the Project that will be performed on District property or at another location on a regular or repeated basis, (b) students are regularly present at such location, and (c) the person will have verbal or physical interaction with, or be in close proximity to, one or more students. A successful proposer shall be required to immediately remove from District's property or other location where students are regularly present any covered person who has been convicted of (a) any felony under the Texas Penal Code, (b) any offense for which the person is required to register as a sex offender under Chapter 62 of the Texas Code of Criminal Procedure, (c) any equivalent offense under the laws of the United States or any other state, (d) any offense against a child, (e) misdemeanor possession of a controlled substance within 10 years, (f) any weapon offense, (g) theft, larceny, fraud, issuance of a bad check, theft by check above the class C misdemeanor level, or more than one offense at the class C level, (h) forgery, (i) altering an Official Document, 0) perjury, or (k) securing executing of a document by deception.

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. The contractor shall have an English speaking supervisor on the job at all times while employees are on the job site. 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. International Building Code, 2000
   h. Vernon's Law - State of Texas
   i. International Electrical Code, 2000
   j. International Plumbing Code, 2000
   k. Environmental Protection Agency
   l. Standard Gas Code - 1988 Edition with 1989, 1990 revisions
   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 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 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, Material Men 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.

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 1, Division 2, Division 23, Division 26 and all other divisions listed in the Table of Contents of the Bidding Documents provisions supplement and modify the Contract Documents and shall form a part of the Contract and all Subcontracts.

9. The project sites 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 distractive to the classes or office. Contractor work schedules during the school term and office hours shall be coordinated with the Principal and 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.

c. Work accomplished during the non-regular school term and hours shall be coordinated with Owner's Representative or project manager 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 be permitted, however, the Contractor will be responsible for cleaning after his employees and subcontractors.

g. Maintain the building in a secure, 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.

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, grounds, structure 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.

14. Exposed conduit will not be allowed in occupied areas or spaces. Exposed conduit will not be allowed in the halls below the ceiling. Exposed conduit in normally unoccupied areas will be permitted only after approval of Engineer and Owner. Any exposed conduit permitted shall be wiremold.

15. This project shall be accomplished in a neat and good workmanship manner using accepted methods. Wiring, panels, etc. shall be neat and orderly in appearance. Loose, tangled wires, etc. will not be accepted. The final work shall be complete and finished.

16. Each Contractor and Subcontractor is responsible for cleaning up and removing their own debris, dust, trash, etc. Any damage to the school or school equipment or school supplies requiring repair shall be accomplished by Contractor or Subcontractor doing damage. Spillage, over spray, collections of dust and debris, and damage to Owner occupied spaces shall be cleaned or remedied immediately by the responsible trade. Clean up all surfaces, remove equipment, salvage and debris, and return in condition suitable for use by the Owner as quickly as possible.

17. Asbestos and asbestos containing materials will not be allowed in this project. Upon completion of the project the Contractor and all Subcontractors shall provide Owner with a letter stating that no asbestos and asbestos containing materials were provided at the projects.

18. All wiring shall be in metallic conduit. Conduit on the roof shall be an absolute minimum.

19. CONTINGENCY ALLOWANCE - to be included in base bid. This allowance is for contingencies and shall only be spent on prior written approval of Owner and Engineer. At the end of the contract, unused contingency allowance shall be returned to the Owner.

20. Cutting and Patching.

"Cutting and patching" includes cutting into existing construction to provide for the installation or performance of other work and subsequent fitting and patching required to restore surfaces to their original condition.

"Cutting and patching" is performed for coordination of the work, to uncover work for access or inspection, to obtain samples for testing, to permit alterations to be performed or for other similar purposes.

Do not cut structural members.

21. Schedule, Reports, Meetings, and Payments.

Contractor shall provide and keep current a construction schedule.

Contractor shall prepare a schedule of values on AIA forms.

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

- Drinking water
- Temporary enclosures 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

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.

22. 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 and ensure immediate repairs are coordinated with the OWNER (to ensure the repairs are in compliance with the District's Design and Construction Standards.

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

The Contractor shall protect all school surfaces, school equipment, and school property. Any damage shall be repaired or replaced to meet the intent of the design requirements. 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.

24. The Contractor shall be responsible for and insure that the electrical equipment, controls, and electrical work are fully compatible and coordinated. Precautions will be made by the CONTRACTOR to mitigate damages potentially caused by heavy vehicles and Material Handling Equipment (MHE).

25. 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.

26. 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.

27. Telephone

The Contractor shall not make any long distance phone calls on school phones. Use of Owner's telephone shall be only after specific prior approval of Owner.

28. Pre-Construction Site Visit With Owner

Contractor shall make a pre-construction site visit with Owner and note (document in an original date stamped (metadata) photographs) any existing damage in work areas. Contractor shall be responsible for any damage to school property, building, equipment, furnishings, site or school items.

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

END OF SECTION

SECTION 02 07 00

SELECTIVE DEMOLITION

PART 1 - GENERAL

RELATED DOCUMENTS:

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

DESCRIPTION OF WORK:

Extent of selective demolition work is indicated on drawings.

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:

- Removal of selective piping and items.
- Removal of rooftop units, curbs, ductwork etc. as shown on plans or as required.
- Other items shown on plans and required for new installation.
- Other items required for installation of work. Replace as required and necessary.
- Other items not needed for new installations.

Related Work specified elsewhere:

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.

Relocation of pipes, conduits, ducts, other mechanical and electrical work are specified by respective trades.

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.

SUBMITTALS:

Schedule:

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.

Provide detailed sequence of demolition and removal work to ensure uninterrupted progress of Owner's on-site operations.

Coordinate with Owner's occupation of portions of existing building.

JOB CONDITIONS:

Occupancy:

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.

Condition of Structures:

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

Partial Demolition and Removal:

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.

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

Protections:

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

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.

Erect temporary covered passageways as required by authorize having jurisdiction.

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.

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

Protect floors with suitable coverings when necessary.

Protect all equipment, furnishings and school property.

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.

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.

Remove protections at completion of work.

Damages:

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

Traffic:

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.

Explosives:

Use of explosives will not be permitted.

Utility Services:

Maintain existing utilities keep in service and protect against damage during demolition operations.

Do not interrupt existing utilities serving occupied or used facilities, except when authorized in writing by authorized having jurisdiction. Provide temporary services during interruptions to existing utilities, as acceptable to governing authorities.

Environmental Controls:
Comply with governing regulations pertaining to environmental protection.
Do not burn on the site.

PART 2 - PRODUCTS - (Not Applicable)

PART 3 - EXECUTION

PREPARATION:

Cease operations and notify the Owner's representative immediately if safety of structure appears to be endangered. Take precautions to support structure until determination is made for continuing operations.

Cover and protect furniture, equipment and fixtures to remain from soiling or damage when demolition work is performed in rooms or areas from which such items have not been removed.

Erect and maintain dust-proof partitions and closures as required to prevent spread of dust or fumes or occupied areas or areas not involved in renovation work.

Provide weatherproof closures for exterior openings from demolition work.

Protection of Roof:

The Contractor and Subcontractors shall accomplish work in such a manner to protect roof. Do not roll equipment across roof. Contractor shall be responsible for any damage to roof.

Demolition:

Perform selective demolition work in a systematic manner. Use such methods as required to complete work indicated on Drawings in accordance with demolition schedule and governing regulations.

Demolish concrete and masonry in small sections. Cut concrete and masonry at junctures with construction to remain using power-driven masonry saw or hand tools; do not use power-driven impact tools.

Locate demolition equipment throughout structure and promptly remove debris to avoid imposing excessive loads on supporting walls, floors or framing.

Provide services for effective air and water pollution controls as required by local, state, and federal authorities having jurisdiction.

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.

Disposal of Demolition Materials:

Remove debris, rubbish and other materials resulting from demolition operations from building site. Transport and legally dispose of materials off site.

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.

Burning of removed materials is not permitted on project site.

Refrigerants shall not be released to the environment.

Clean-Up and Repair:

Upon completion of demolition work, remove tools, equipment and demolished materials from site. Remove protections and leave interior areas broom clean.

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

SECTION 09 50 00

ACOUSTICAL CEILING SYSTEMS

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 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.

1.3 RELATED SECTION:

A. Selective Demolition - Section 02 07 00.

1.4 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).

1.5 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.

1.6 QUALITY ASSURANCE:

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

1.7 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.

1.8 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.

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

PLUMBING

DIVISION 22

22 00 10 Basic Plumbing Requirements
22 00 90 Plumbing Submittal Procedures
22 05 30 Pipe and Pipe Fittings - General
22 05 54 Plumbing Identification
22 07 20 Piping Insulation
22 13 18 Condensate Piping

SECTION 22 00 10

BASIC PLUMBING REQUIREMENTS

PART 1 GENERAL

1.1 DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions, Division 01 Specifications and Section 22 00 10, apply to this Section.

1.2 SECTION INCLUDES

A. Basic plumbing requirements necessary to provide complete installation of all Division 22 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 plumbing 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 Structural, Mechanical, Heating, Ventilating, Air Conditioning, Plumbing 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.

C. 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.

D. Plumbing Contractor is responsible for all final connections to specified plumbing fixtures and all owner furnished equipment requiring plumbing (drain, water, gas, condensate, air).

1.4 RELATED SECTIONS

A. The conditions of the Division 01 requirements and the contract requirements which include the General Conditions and the Supplementary Conditions apply to the work of this division.

1.5 CODES & REFERENCE STANDARDS

A. General
   1. Perform all Division 22 work in strict accordance with the requirements and recommendations stated in the codes and standards except when requirements are modified by the contract documents.
   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.

1.6 APPLICABLE CODES AND STANDARDS FOR ALL DIVISIONS 22 WORK

A. International Building Code

B. International Gas Code

C. International Plumbing Code

D. International Mechanical Code

E. Uniform Plumbing Code

F. Uniform Mechanical Code

G. International Energy Conservation Code

H. National Electrical Code

I. American Society of Heating, Refrigerating and Air Conditioning Engineers Standards.

J. Occupational Safety and Health Administration Standards:
   1. OSHA Standard 2207 - Construction Industry Standards
   2. OSHA 29 CFR Part 1926 - Regulation of Excavation
   3. Texas Underground Facility Damage Prevention Act (H.B. 2295)
   4. All other applicable standards

K. National Fire Protection Association:
   1. NFPA No. 90A Installation of Air Conditioning and Ventilating Systems

L. Fire Sprinkler System:
   1. NFPA 13
   2. NFPA 14
   3. NFPA Life Safety Code 101 Section 8-3
   4. All other applicable codes

M. National Appliance Energy Conservation Act of 1987

N. Texas State Board of Insurance Standards

O. Clean Air Act and Clean Air Act Amendments of 1990

P. State Codes:
   1. Texas Department of Labor Boiler Rules and Regulations
   2. All other applicable codes

Q. Local Municipal Codes and Ordinances

R. Schedule of Abbreviations:

1. Reference Standards are listed in Division 22 using abbreviations listed below:

AABC	Associated Air Balance Council
AASHTO	American Association of State Highway and Transportation Officials
ADA	Americans with Disabilities Act
AGA	American Gas Association
ANSI	American National Standards Institute
ASME	American Society of Mechanical Engineers
ASPE	American Society of Plumbing Engineers
ASTM	American Society for Testing and Materials
AWE	American Welding Society
AWWA	American Water Works Association
CISPI	Cast Iron Soil Pipe Institute
CS	Commercial Standard
CSA	Canadian Standards Association
DIPRA	Ductile Iron Pipe Research Association
DOT	Department of Transportation
DOC	Department of Commerce
FCC	Federal Communications Commission
FM	Factory Mutual
FS	Federal Specification
IBC	International Building Code
ITL	Independent Testing Laboratories
NEC	National Electric Code
NFPA	National Fire Protection Association
NSF	National Sanitation Foundation
OSHA	Occupational Safety and Health Administration
PDI	Plumbing and Drainage Institute
SMACNA	Sheet Metal and Air Conditioning National Association
TDH	Texas Department of Health
TWC	Texas Water Commission
UL	Underwriters Laboratories

1.7 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 plumbing equipment and fixtures shall be the same brand unless scheduled differently on plans.

1.8 CONTRACTOR'S RESPONSIBILITY

A. Erect barricades, protective fencing, and signs to prevent injury to personnel on site.

B. Make permanent connection to utilities or existing lines. Determine depth and location, and bid accordingly.

C. Relocate and repair any existing lines cut by general construction work.

D. Pay all costs in connection with metering devices.

E. Plans do not show exact location and elevations of lines, nor do they show all offsets required.

F. Deviate from plans as required to conform to the general construction and provide proper grading.

G. Maintain all utility services during construction to existing portions of job that remain.

H. Procure and pay for all necessary permits or licenses to carry out the work.

I. Obtain and pay for all the necessary certificates of approval which must be delivered to the Engineer before final acceptance of the work.

J. Periodically remove rubbish, clean or repair all surfaces marred by the work required under this contract.

K. Protect work from damage by other trades.

L. Make all tests required by law; pay all costs in connection with the testing.

M. Where job conditions require changes in indicated locations and arrangement, make such changes without extra cost to Owner.

N. Provide motor starters, controls, relays, all low-voltage wiring, conduit and wiring related to plumbing and other equipment and devices to form a complete working system. See Division 26 00 00.

1.9 DEFINITIONS

A. Approval:
   1. It is understood that approval must be obtained from the Engineer in writing before proceeding with the proposed work.
   2. Approval by the 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.
   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.

1.10 WARRANTY

A. The Contractor shall warranty his work against defective materials and workmanship for a period of one year from 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.

1.11 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.

1.12 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.

B. Upon submitting his request for final payment, he shall turn over to the Engineer, 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 Engineer for checking and subsequent delivery to the Owner:
   1. All warranties, guarantees and manufacturer's directions on equipment and material covered by the Contract.
   2. Approved fixture brochures.
   3. Copies of reviewed shop drawings.
   4. Set of operating instructions. Operating instructions shall also include recommended maintenance.
   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.
   7. The first page, or pages, shall have the names, addresses, and telephone numbers of the following:
      a. General Contractor and all sub-contractors.
      b. Major Equipment Suppliers.

1.13 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 plumbing 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.

1.14 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 Engineer.

E. The 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.

1.15 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, Engineer, 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.

F. Contractor is responsible for coordination of all existing and new utilities at site. Contractor is responsible for protecting and repairing any utilities damaged by installation of pipe. All existing and new landscaping/trees to remain and to be protected unless directed otherwise by Owner.

1.16 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 ten working days prior to the schedule date for opening of bids.

C. The Engineer will consider all such submittals and 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.

G. After Award of the Contract, substitutions will be considered only under one or more of the following circumstances:
   1. The substitution is required for compliance with subsequent interpretations of code or insurance requirements.
   2. The specified product is unavailable through no fault of the Contractor.
   3. The manufacturer refuses to warranty the specified products as required.
   4. Subsequent information that the specified product is unable to perform properly or to fit in the designated space.
   5. In the Engineer's sole judgment, the substitution would be in the Owner's best interest.

H. Revisions to the plumbing 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.

1.17 PROTECTION OF EQUIPMENT AND MATERIALS

A. The Contractor shall take such precautions as may be necessary to properly protect his apparatus from damage.

B. 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.

C. 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.

D. 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.

1.18 FINAL INSPECTION

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 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 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.

1.19 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 Engineer.

D. No joists, beams, girders or columns shall be cut by any Contractor without first obtaining written permission of the Engineer.

E. Patching of openings and/or alterations shall be provided by the General Contractor.

F. All openings in firewalls and floors, such as thimbles, shall be completely sealed after installation for a completely airtight and watertight 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.

1.20 IDENTIFICATION

A. Refer to Section 22 05 54.

1.21 MANUFACTURER'S INSTRUCTIONS

A. All equipment and devices shall be 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.

1.22 RELATED WORK

A. The various specification sections for this division may or may not include related work listings.

B. All related work shall be coordinated and provided by the Contractor regardless whether specifically identified or not.

1.23 ELECTRICAL WIRING AND EQUIPMENT FOR PLUMBING 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 this Contractor.

B. The Electrical Contractor shall only provide line voltage (including hook-up) to all plumbing equipment.

C. All 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. The Plumbing 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 plumbing equipment or device be changed or approved from those which are shown or noted, all electrical and/or plumbing changes shall be made at the expense of the trade or Contractor initiating the change with no expense to the Owner, Engineer or their representatives.

E. 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.

F. All conduit and boxes required in all walls for control purposes (thermostats, switches, etc.) shall be provided by electrical contractor.

G. All conduit required in attic, clear spaces, or on roof shall be by electrical Contractor.

1.24 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 plumbing piping, condensate lines, plumbing equipment, etc.) is accomplished in a manner and completeness to provide the appearance of new construction work.

B. Abandoned plumbing fixtures 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 sealed and securely capped below the slab.

1.25 OPERATION PRIOR TO COMPLETION

A. When any piece of plumbing 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.

1.26 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.

1.27 FLAME SPREAD PROPERTIES OF MATERIALS

A. All materials and adhesives used for plumbing and insulation shall conform to NFPA and UL life and flame spread properties of materials.

B. The composite classifications shall not exceed 25 for a flame spread rating and 50 for a smoke developed rating as listed for the basic material, the finishes, adhesives, etc., specified for each system and shall be such when completely assembled.

1.28 ASBESTOS

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

1.29 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.

1.30 REFRIGERANTS

A. Chlorofluorocarbons (CFCs) shall not be allowed in any equipment on this project.

B. Comply with ASHRAE Standards 15 and 34.

1.31 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.

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

1.32 ACCESS CLEARANCE

A. Proper access to all installed equipment shall be provided. This 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, this Contractor shall immediately notify the General Contractor to correct this condition.

D. When equipment is installed above lay-in ceiling this 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

A. Not Applicable

PART 3 EXECUTION

3.1 TESTING

A. After all plumbing 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 plumbing equipment.

B. Perform a smoke test on all sanitary sewers and camera all lines and provide owner with a video tape.

C. Perform gas piping pressure test to comply with HB 1611 and all required City or governing body tests.

D. Make adjustments as required to ensure proper functioning of all systems.

E. Special tests on individual systems are specified under individual sections.

3.2 AS BUILT DRAWINGS

A. Upon substantial completion, Contractor shall submit as built drawings showing all deviations between contract drawings and actual installed conditions.

B. Show location of all valves in gas and water piping. Submit to Owner.

END OF SECTION

SECTION 22 00 90

PLUMBING SUBMITTAL PROCEDURES

PART 1 GENERAL

1.1 SUMMARY

A. This section supplements Division 01 Submittal Procedures and contains additional requirements applicable to Division 22 submittals.

1.2 SECTION INCLUDES

A. This section includes, but is not limited to:
   1. Plumbing submittal procedures
   2. List of required Division 22 submittals to the engineer
   3. This section applies only to the Division 22 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.

B. Manufacturers: Manufacturers submitted shall be as per the acceptable manufacturers listed in each specification section or referenced schedule. For additional manufacturers requiring approval, reference the Substitution of Products article in Section 22 00 10.

C. Required Submittals: Refer to the Submittals article of each individual Division 22 specification section for the required items to 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 web site, 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 and approved 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 unapproved 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:
   1. 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 catalog, 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. Scale and measurements: Make shop drawings accurately to a scale sufficiently large to show all pertinent aspects of the item.
   2. Electronic shop drawing submittals are required.
   3. Shop drawings must include domestic water entry rooms with backflow prevention and all water heater rooms.

1.6 QUALITY ASSURANCE / CONTROL SUBMITTALS

A. Quality assurance and quality control submittals may be in the form of documentation, or may be in the form of completed physical work that is offered for review by the engineer, architect, or owner.

B. If documentation is the subject, then submit in a manner similar to the initial submittal package.

C. If completed physical work is the subject, then the work shall not be concealed, nor shall subsequent work be performed, until the engineer's representative has reviewed the work. If the work is concealed, or if subsequent work is performed, before the engineer's representative has reviewed the work, then the contractor shall be liable for removal and replacement at no additional expense to the owner.

D. Sequencing:
   1. Within 30 calendar days after the contractor has received the owner's notice to proceed, provide the complete submittal package.
   2. After the engineer has reviewed the submittal package, make necessary revisions to the submittals as directed by the engineer and resubmit.
   3. After the submittal has been reviewed by the engineer, proceed to purchase materials and perform the work.

E. Scheduling:
   1. Failure to submit items that meet the requirements of the contract documents in ample time for review shall not entitle the contractor to an extension of contract time, and no claim for extension by reason of such default shall be allowed. The contractor may be held liable for delays so occasioned.

PART 2 PRODUCTS

A. Not applicable

PART 3 EXECUTION

3.1 SUBMITTALS

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 22, and additional requirements of each individual Division 22 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 check list. 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 22 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:
      a. 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.
   2. Complete rejection:
      a. 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:
      a. 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:
    a. 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 corrected:
    a. 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:
    a. The contractor may proceed to provide all materials and equipment.

E. Close-out Submittals:
1. Provide close-out submittals in accordance with the requirements of Division 1.

Section	Submit on the following	1	2	3	4	Arch Sub #
22 05 30	**Pipe and Pipe Fittings**					
	Hangers					
	Dissimilar Metals Union					
	Unions					
	Escutcheons					
	Sleeves					
	Hanger rods					
	Concrete anchors					
	Beam Clamps					
	Fire Penetration Products					
22 05 54	**Plumbing Identification**					
	Valve tags and chains					
	Valve chart					
	Piping markers					
	18 gauge copper wire for underground gas piping					
	Equipment labels					
	Nametag fasteners					
	Underground warning tape					
22 07 20	**Piping Insulation**					
	Closed cell only in concrete masonry walls					
	2” wrap for concealed roof drain piping					
	2” wrap at roof drain deck pan					
	2” rigid on exposed roof drains or					
	2” wrap with PVC jacketing on exposed roof drains					
	Domestic hot and cold water pipe insulation					
	(1” for hot water and 1” for lines in exterior walls)					
	Flange, fitting, valve Insulation					
	Insulation metal shield					
	Sealant, adhesive, finish					
22 13 18	**Condensate Piping**					
	Schedule 40 PVC painted exterior w/ 4’-0” oc hangers					
	Schedule 40 CPVC painted exterior w/ 4’-0” oc hangers					
	Insulation thickness and thermal conductivity (K)					
	Hangers- see 22 05 30					
	Insulation-See piping insulation					
	Fittings, unions					

1 - Reviewed
2 - Furnish as corrected in comments, resubmit not required
3 - Revise and Resubmit based on comments

Section	Submit on the following	1	2	3	4	Arch Sub #
4 - Rejected based on comments						

END OF SECTION

SECTION 22 05 30

PIPE AND PIPE FITTINGS - GENERAL

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions, Division 01 Specifications and Section 22 00 10, apply to this Section.

1.2 SECTION INCLUDES

A. Pipe

B. Pipe fittings

1.3 RELATED SECTIONS

A. Section 22 00 10 - Basic Plumbing Requirements

B. Section 22 07 20 - Piping Insulation

C. Section 22 13 18 - Condensate Piping

1.4 REFERENCES

ASME	American Society of Mechanical Engineers
ASTM C564-97	Standard Specification for Rubber Gaskets for Cast Iron Soil Pipe and Fittings
ASTM D2665-02a	Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Drain, Waste, and Vent Pipe and Fittings
ASTM E84-01	Standard Test Method for Surface Burning Characteristics of Building Materials
UL	Underwriters Laboratory
NFPA 90 A & B	Installation of Air Conditioning & Ventilation Systems and Installation of Warm Air Heating and Air Conditioning Systems
CISPI-310	Cast Iron Soil Pipe Institute
CSA	Canadian Standards Association

1.5 QUALITY ASSURANCE

A. Valves:
   1. All valves to be from a single manufacturer.

B. The welder, employed on this project, shall have passed qualification tests as prescribed by the National Pipe Welding Bureau, or other reputable testing laboratory using qualification procedures as recommended by the ASME Boiler Construction Code or the American Welding Society Standards.

1.6 SUBMITTALS

A. Provide submittal data on all items specified in this section in accordance with Specification Section 22 00 10, General Conditions, and Division 01.

B. Submit product data indicating dimensions, general assembly and use.

PART 2 PRODUCTS

2.1 PIPE AND FITTINGS

A. The type of pipe and fittings necessary for each system is specified in the section on that system.

2.2 DISSIMILAR MATERIALS

A. Use approved adapters such as Di-Electric Unions manufactured for making piping connections between dissimilar materials such as copper and brass or copper and steel.

2.3 ESCUTCHEONS

A. Usage:
   1. All exposed lines passing through floors, walls and ceilings.

B. Material:
   1. Chrome plated steel

C. Flange size:
   1. As necessary to cover penetrated openings.

D. Plate size:
   1. As necessary to fit pipe or insulation and securely lock in place.

E. Manufacturer/Model:
   1. Engineered Brass Company, Type CF

2.4 SLEEVES

A. Application:
   1. Provide sleeves for all pipes and conduits which pass through or enter a concrete slab, masonry wall/concrete wall, sheetrock wall (fire rated or not fire rated), roof or other portion of the building structure.

B. Above Grade and/or dry locations:
   1. Material:
      a. 20 or 22 gauge galvanized steel.
   2. Size:
      a. As necessary to allow free passage of the insulated pipe.

C. Below Grade and/or moist locations:
   1. Material:
      a. ASTM D-2665 Schedule 40 PVC. When PVC not allowed by code, use schedule 40 galvanized steel.
      b. Return Air Plenum:
         (1) Schedule 40 galvanized steel.

D. Passing through fire-rated enclosures:
   1. Material:
      a. Galvanized or black steel pipe.
      b. Non-combustible.
      c. PVC will not be allowed.

E. Penetration Seal: (All Sleeved Penetration Locations- fire rated or non-fire rated)
   1. Seal penetration with 3M Fire Barrier Sealant CP 25WB+ or one-component ceramic fiber-based putty fill, void or cavity material, UL rated material classified for use in through-penetration firestop systems nos. 124, 125, 150 and 151.
   2. Flame Spread/Smoke Contribution:
      a. 0/0 in accordance with ASTM E-84.

2.5 VALVES, UNIONS, STOP COCKS, ETC.

A. Applications:
   1. Ball Valves:
      a. Provide accessible valves at each group of plumbing fixtures and at each piece of equipment on all piping systems for isolation of fixtures and equipment. All valves shall be full port valves.

B. All Other Valves, Unions, Stop Cocks, Etc.:
   1. Provide at each group of plumbing fixtures and at each individual fixture, at each piece of equipment, at all inlet and outlet connections for hot and cold water and gas.
   2. Provide Di-Electric Unions at connection of dissimilar pipe materials to prevent electrolysis.

C. Type:
   1. Suitable for 125 lbs. working pressure.

2.6 PIPE SUPPORTS

A. Hangers:
   1. 2" and Smaller Piping:
      a. May be split cast ring type with fastening device in walls and chases.
   2. Copper Piping:
      a. Copper plated ferrous hangers.
   3. All Other Above Ceiling Locations:
      a. Adjustable clevis type. Hangers to accommodate circumference of pipe and saddles.

B. Hanger Rods:
   1. Type:
      a. Minimum 3/8 inch diameter with machine threads.

C. 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" to 5" diameter pipe:
      a. 5/8"
   4. 6" diameter pipe or larger:
      a. 3/4"

D. Hanger Manufacturers:
   1. Anvil
   2. Elcen
   3. ERICO
   4. F&S Manufacturing
   5. Fee & Mason
   6. PHD

E. In wall pipe supports:
   1. Metal strut, manufactured pipe clamps

F. In wall pipe support manufacturer:
   1. Holdrite or Equivalent

PART 3 EXECUTION

3.1 PIPE INSTALLATION

A. Install piping in a neat and workmanlike manner.

B. Install each of the piping systems to provide for expansion and contraction.

C. Solder all joints when the system is not under strain.

D. Expansion Offsets:
   1. Copper Piping:
      a. Use developed length Copper Tube Handbook 411-R as published by Copper Development Association, Inc.
   2. Steel Piping:
      a. Use developed per Carrier System Design Manual, Part 3 Piping Design.

E. Furnish necessary spring pieces and offsets as required.

F. Conceal all of the piping systems in chases, above ceilings, in walls and in finished areas.

G. Run Exposed piping only in machinery spaces and unfinished areas as specified or as shown on the plans.

H. Install all necessary fittings and offsets to hold the piping close to walls and ceilings.

I. Where these lines run exposed, obtain a clearance from the Engineer in writing before making the installation.

J. Install piping in the most advantageous manner possible with respect to headroom, valve access, openings, equipment clearances, and clearances for other work.

K. Give particular attention to piping in the vicinity of equipment.

L. Preserve the maximum access to various equipment parts for maintenance.

M. Do not cut or weaken any structural member.

N. Cut all pipes accurately to measurement determined at the site.

O. After cutting pipe, ream it to remove burrs.

P. Install piping neatly, free from unnecessary traps and pockets. Work into place without springing or forcing.

Q. Use fittings to make all changes in direction.

R. Field bending and mitering are prohibited.

S. Make all connections to equipment using flanged joints or unions.

T. Make reducing connections with reducing fittings only.

U. Do not allow piping to pass through or over designated electrical rooms.

V. Compression fittings are not allowed.

3.2 VALVES, UNIONS, STOP COCKS, ETC.

A. Locate all valves so that their bonnets may be easily removed.

B. Move all flange valves shown in horizontal positions so that valve stem is inclined one bolt hole above the horizontal position.

C. Make-up all screwed pattern valves placed in horizontal lines so that their valve stem is inclined at an angle of 30 degrees above the horizontal position.

D. All valve stems must be true and straight at the time the system is tested for final acceptance.

E. Pack all valves and leave perfectly tight at the completion of the work.

F. Provide access doors as required for these valves.

G. Furnish locations of all access doors to the Engineer.

3.3 PIPING JOINTS

A. Screwed Pipe Joints:
   1. Provide full cut pipe threads.
   2. Assemble joints with an approved compound applied to only the male threads.
   3. Leave a maximum of three pipe threads exposed where the joint is assembled.

B. Welded Pipe Joints:
   1. Fuse weld by using a metallic arc welding process.
   2. Conform to the current recommendations of the American Welding Society for all welding operations.

C. Mechanical Coupling Joints for Copper Systems:
   1. Grooved-End-Tube Couplings: Ductile iron conforming to ASTM A-536, Grade 65-45-12, coated with copper colored alkyd enamel. Housings cast with offsetting, angle-pattern bolt pads to provide rigidity. Coupling Gaskets: Grade “P” Fluoroelastomer compound with red and blue color code designed for operating temperatures from 0 deg F to +180 deg F.
      a. Center-leg gasket with pipe stop to ensure proper groove engagement, alignment, and pipe insertion depth.
      b. Installation Ready direct-push-installation
      c. Reference shall always be made to the latest published Victaulic Selection Guide for Gaskets for proper gasket selection for the intended service.
      d. Basis of design Victaulic Style 607 or engineer approved equal
   2. Fittings: Fittings shall be manufactured to copper tubing sizes, with grooves designed to accept grooved end couplings of the same manufacturer. Fittings shall be wrought copper, conforming to ASTM B-75 alloy C12200 or ASTM B-152 alloy C11000 and ANSI B16.22, or bronze sand-casting ANSI B16.18 and UNS-C89836. Victaulic Copper Connection Fittings.

D. Solder Joints:
   1. Assemble with square cut pipe using a pipe cutter.
   2. Hacksaw-cut pipe ends will not be acceptable.
   3. Ream open pipe end to full size.
   4. Burnish both the pipe and fitting absolutely clean.
   5. Apply brazing flux to both the pipe and the fittings.
   6. The use of corrosive acid flux will not be permitted.
   7. Charge the pipe and fittings with nitrogen gas during the brazing.

E. Hubless Cast Iron Soil Pipe Joints:
   1. Make with an approved neoprene gasket and stainless steel retaining sleeve.
   2. Mark no-hub gaskets with the manufacturer's name, ASTM C 564, the word "No-Hub", nominal diameter and the CI symbol of the Cast Iron Soil Institute indicating it meets the standard.
   3. Mark stainless steel couplings for no-hub "All Stainless", name of manufacturer, words "No-Hub", nominal diameter and the CI symbol indicating it conforms to CISPI Standard 310.
   4. Install the hubless cast iron soil pipe systems in accordance with CISPI Pamphlet 100 - Installation Suggestions for CI No-Hub Pipe and Fittings.
   5. Provide identifying markers for stainless steel couplings and neoprene gaskets to indicate compliance with CISPI-310.

F. Positive-Seal One Piece Elastomeric Compression-Type Gasket:
   1. May be used for joining hub and spigot cast iron soil pipe as an alternate for lead or oakum joints or for drainage and waste system above and below ground.
   2. Form the joint by inserting an approved gasket in the hub.
   3. Lubricate the inside of the gasket and push the spigot end of the pipe into the gasket until seated, thus effecting a positive seal.
   4. Use neoprene compression gaskets for cast iron soil pipe, marked as such, with ASTM C564 and the CI symbol of Cast Iron Soil Pipe Institute to indicate the gasket meets the standard.

G. PVC Pipe Joints:
   1. May be solvent cemented using the proper cement recommended for the particular materials.
   2. Cut all pipe square and clean both pipe and fittings of all soil, dirt, oil and grease.
   3. Make solvent joints in accordance with the applicable ASTM Standards.
   4. Allow joints to dry before testing.
   5. If any leak occurs during the water test, then replace the defective joint.
   6. Comply with requirements of the NSF Standard 14 for all solvent cements and primers and label to identify the laboratory certifying compliance for the particular cement and primer being used.
   7. Plastic pipe and fittings for sewer and water pressure lines may also be joined by use of elastomeric (O-ring gasket) joints when the respective standards for the materials so specify. No-Hub fittings are not allowed on PVC sanitary sewer and storm drain piping under slab or underground.
   8. Do not use pipes with cracked bells.
   9. PVC pipe and pipe fittings are not allowed in any return air plenum serving mechanical systems. Use cast iron piping above slab for these installations.

3.4 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. Below Grade and/or Moist Locations:
1. Install suitable flange in the center of wall or floor to form a waterproof passage.
2. Fill the void space around the pipe with jute twine or Oakum caulk or an asphalt based compound to insure a waterproof penetration.

C. 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.

3.5 SECURING AND SUPPORTING OF PIPE

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. Hanger Spacing:
1. Schedule 40 PVC Piping:
    a. All Sizes:
        (1) 4'-0"
2. Ferrous (Schedule 40) Piping:
    a. 1/2" diameter pipe:
        (1) 6'-0" or less
    b. 3/4" diameter pipe:
        (1) 8'-0" or less
    c. 1-1/4" diameter pipe:
        (1) 10’-0” or less
    d. Vertical:
        (1) Every Floor Level Minimum
3. Copper (Water Tube) Piping:
    a. Smaller Than 1¼”:
        (1) 6'-0"
    b. 1 ½” and Larger:
        (1) 10'-0"
    c. Vertical:
        (1) 10'-0"

4. Cast Iron Piping:
    a. All pipe sizes:
        (1) One hanger per length of pipe and not exceeding 5'-0" O.C.
    b. Vertical:
        (1) Every Floor Level Minimum

G. Vertical Lines:
1. Adequately support at their bases, either by a suitable hanger placed in the horizontal line near the riser, or by a base fitting set on a pedestal or foundation.
2. Support from each floor slab by means of an approved clamp-type support which bears on the slab or beam.

H. 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.

3.6 EXCAVATION AND BACKFILLING

A. Excavation:
1. Call utility companies before digging.
2. Call Notifications Center before digging.
3. Excavate trenches for underground piping to the required depths with bell holes being provided as necessary to insure uniform bearing. Dig all bell holes after the trench has been graded.
4. Refill excavation below the required grade of piping with fine granular material to the pipe grade.
5. Where rock is encountered, excavate to a grade 3 inches below the lowermost part of the pipe and refill with fine granular materials to the pipe grade.
6. Sheath, brace, pump or bail the trenches as required to protect workmen and structures and to permit execution of the work. A trench greater than 5 feet deep will not be permitted unless the sides are cutback at 45 degrees to 5 feet or less. If this cannot be accomplished, hire a Registered Engineer to design shoring.
7. Install all underground piping below the frost line and in no case less than 18 inches below the surface.

B. Pea Gravel Embedment
1. Refer to Specification Sections 22 13 17 and 22 14 01 for Pea Gravel Embedment for schedule 40 PVC piping below slab.

3.7 EQUIPMENT PLUMBING CONNECTIONS

A. Make all final connections to all pieces of equipment which require natural gas, water, drain, waste or vent connections.

B. Provide all required shut-off cocks, valves, drain valves and traps.

3.8 TESTING AND INSPECTION

A. Perform all tests as specified in Division 22 or as required by the Engineer or by the Local, Federal, and State Bureaus having jurisdiction and under their supervision during the progress and upon completion of work.

B. Include costs of all required tests in your bid.

C. Provide all apparatus, temporary pipeline and all other requirements necessary for such tests.

D. Take all due precautions to prevent damage to the building or its contents incurred by such tests as the Contractor will be required to repay and make good any damage so caused at his own expense.

E. Immediately repair any leaks, defects or deficiencies discovered as a result of the tests. Repeat until test requirements are in full compliance.

3.9 IDENTIFICATION OF PIPING AND EQUIPMENT

A. Mark all piping to show the service and direction of flow.

B. Place markers at each branch of tees, at equipment connections, and change of direction and at 20 foot intervals. Minimum of one (1) marker in each room.

C. Install valve tags on all valves.

D. Frame under glass cover and hang a type written list including the valve number, type of service, and location of each valve in the boiler mechanical room.

E. Mark all valve numbers corresponding to this system of identification on the as-built drawings which will be delivered to the Owner upon completion of the work.

END OF SECTION

SECTION 22 05 54

PLUMBING IDENTIFICATION

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions, Division 01 Specifications and Section 22 00 10, apply to this Section.

1.2 SECTION INCLUDES

A. Identification required for plumbing systems.

B. Code required identification not shown on plans nor specified herein shall be provided.

1.3 RELATED SECTIONS

A. Section 22 00 10 - Basic Plumbing Requirements

B. Section 22 05 30 - Pipe and Pipe Fittings - General

1.4 SUBMITTALS

A. Provide submittal data on all items specified in this section in accordance with Specification Section 22 00 10, General Conditions, and Division 01.

B. Submit wording of nameplates with submittals.

C. Submit 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

E. API

1.6 DESCRIPTION OF WORK

A. Provide signs for the following equipment identification:
   1. Water Heaters
   2. Piping
   3. Pumps
   4. Starters
   5. Valves

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Seton

B. Brady

C. Marking Services, Inc.

2.2 EQUIPMENT LABELS

A. Type:
   1. Engraving-Stock, melamine plastic laminate, 3 layer.
      a. Thickness:
         (1) Less than 25 square inches: 1/16 inch
         (2) 25 square inches or more: 1/8 inch

B. Color:
   1. Black

C. Conform to FS L-P-287

2.3 LETTERING

A. Style:
   1. Engraved standard print, unless otherwise indicated.

B. Size:
   1. 3/16 inch to 1/4 inch

C. Color:
   1. White letters, black background

2.4 SIGN INFORMATION

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

2.5 NAMEPLATE FASTENERS

A. Securely attach nameplates to equipment with non-corroding stainless steel screws.

B. Non-corroding pop rivets are acceptable.

C. Stick-ons or adhesives will not be allowed.

2.6 PIPING AND CONTROL DIAGRAM SIGNS

A. Material:
   1. 1/4 inch acrylic cover and backing screwed together with brass screw/bolts.
   2. Size:
      a. Minimum:
         (1) 12" x 17"
      b. Maximum:
         (1) 24" x 36"

B. Provide a diagram in each mechanical room similar to the diagrams shown on the plans, and/or as required for the area served.

C. Provide pipe markers with the following features.
   1. Letters from 1/2" to 3-1/2":
      a. Size letters to afford readability from the appropriate viewing position.
   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.

D. Letters on Field:
   1. Identify the specific material conveyed, e.g., "Domestic Cold Water", "Domestic Hot Water", etc.

E. Model:
   1. Less than 3/4":
      a. Tags, same as Paragraph. Piping System Devices, color codes for hazard.
   2. 3/4" up to 6":
      a. Seton Setmark SNA snap-on.
   3. Over 6":
      a. Seton Setmark STR strap-on, with stainless steel spring straps.
   4. Use Seton Ultra-Mark for outdoor use.

F. 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.

G. Attachment:
   1. Stainless steel or solid brass jack chain; Seton JA16, or stainless steel or brass "S" hooks

H. Underground Warning Tapes:
   1. Provide materials that meet the codes or have the approvals listed below:
      a. Office of Pipeline Safety Regulation, USAS Code B31.8.
      b. GSA Public Building Service Guide Specification.
      c. National Transportation Safety Board Report NTSB-PSS-73-1.
      d. AGA Report 72-D-56.
      e. API Report API RP 1109.
   2. Material:
      a. Plastic, continuous tape, color-coded, marked for hazard.
      b. For Non-metallic Piping System:
         (1) Aluminum foil core encased in plastic.
      c. Metallic Piping:
         (1) Plastic tape.
   3. Color:
      a. Colored (not printed color) plastic, coded for material conveyed by piping.
   4. Width:
      a. As scheduled for piping system burial depth.
   5. Legend:
      a. "Caution [System Name] Line Buried Below".

6. Tape Colors:

Utility	**Color**
Natural Gas, Oil, Dangerous Materials	Hi Visibility Safety Yellow
Communications	Safety Alert Orange
Water Systems	Safety Precaution Blue
Sewer Systems	Safety Green

7. Model:
   a. Metallic Piping System: Seton Polyethylene Tape.
   b. Non-Metallic Piping System: Seton Metallic Detection Tape.

I. Underground Gas Piping:
   1. Attach No. 18 gauge copper tracer wire to the piping and terminate above grade at each end.

J. Pipeline Markers for Pipe Beneath Pavement and Slabs:
   1. Minimum 2" round, square, or octagonal, same as specified in Subparagraph: Piping System Devices.
   2. Attachment:
      a. 1-1/2" screw, bolted to tag as anchor.
      b. Anchor Setting Compound: 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 valve and pump.

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, Engineer and Owner to secure construction room numbers.

D. Provide all additional signage required by local authority at no cost to the Owner.

E. 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.

F. Equipment Labeling:
   1. Install on scheduled items of equipment, including the following:
      a. Water heaters
      b. Pumps
      c. Control panels and major control components
      d. Other items of equipment
      e. Include Mark Number and descriptive name from Drawing and Specification schedules
      f. Attach with corrosion resistant, stainless steel screws or pop rivets

g. Install 1/2" diameter adhesive marker (color to be approved by Engineer), and apply to T-bar below any mechanical equipment, valves, and fire dampers above lay-in ceilings.

2. Spacing:
   a. Where pipe passes through walls, floors, and other barriers.
   b. In Tunnel Vaults and Equipment Rooms:
      (1) Maximum spacing, 10 feet; closer where piping is congested, and where piping continuity is obscured from view.
   c. Piping in Tunnels:
      (1) Maximum spacing 100 feet
   d. Other Places:
      (1) Maximum spacing 50 feet

G. 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.

H. Surfaces to be Painted:
1. Bare piping
2. Insulation covering of insulated piping

I. Paint according to the following schedule:

System	**Pastel Color**
Exposed Domestic Cold Water	Blue
Waste and Vent	None
Exposed Gas Piping	Black

J. Piping System Devices (Valves, Thermometers, Pressure Gages, etc.):
1. Identify with the following information:
   a. System
   b. Device number
   c. Device Function
2. Device Chart:
   a. Key devices to device chart
   b. Give complete description of device function and system.

K. Key devices to drawings as follows:
1. Floor plans
2. Schematic drawings of piping systems

L. Underground Warning Tapes:
1. Tape Widths:

Piping Burial Depth	**Tape Width**
10"	2"
20"	3"
27"	6"
30"	9"
40"	12"
50" or more	18"

M. Recommended Tape Bury Depth:
  1. Minimum Depth:
    a. 6".
  2. Distance Between Pipe and Tape:
    a. Minimum 12".
  3. Maximum Depth:
    a. 12".

N. Tie tape to pipe where pipe leaves the ground.

O. Pipeline Markers for Pipe Beneath Pavement and Slabs.
  1. Location:
    a. Accuracy:
      (1) Plus or minus 6" from piping centerline.
    b. Flat Edge Pavement and Slabs:
      (1) Set within 6" of pavement or slab edge.
    c. Concrete Curbs:
      (1) Set in top of curb.
    d. Spacing:
      (1) Each change in direction, each edge of pavement or slab, maximum spacing of 100'.

P. Legend:
  1. Same as tags plus an engraved or stamped line; set marker with line parallel to buried line.

Q. Attachment:
  1. Drill hole for anchor bolt, full depth of bolt plus 1/2"; set full tag and bolt in epoxy, flush with pavement or slab.

END OF SECTION

SECTION 22 07 20

PIPING 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 22 00 10, apply to this Section.

1.2 SECTION INCLUDES

A. Fiberglass insulation
   1. Applications:
      a. Above ground domestic cold water
      b. Roof drains
      c. Horizontal portions of waste lines above grade which receive condensate from air handling units
      d. Condensate drain lines
      e. Domestic hot water piping

B. Closed Cell Insulation
   1. Closed cell insulation for piping in concrete masonry unit walls only.

1.3 RELATED SECTIONS

A. Section 22 00 10 - Basic Plumbing Requirements

1.4 SUBMITTALS

A. Product Data:
   1. Provide submittal data on all equipment specified in this section in accordance with Section 22 00 10, 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 and method of application.

1.5 REFERENCES

A. Refer to Section 22 00 10 for complete names of references identified in this section.

ASTM E 84	Fire and Smoke Ratings
ASTM C 547	Standard Specifications for Mineral Fiber Pipe Insulation
ASTM C 585	Standard Practice for Inner and Outer Diameters of Rigid Thermal Insulation for Nominal Sizes of Pipe and Tubing (NPS System)
ASTM C 795	Standard Specifications for Thermal Insulation for Use in Contact with Austenitic Stainless Steel
ASTM C 1136	Standard Specification for Flexible, Low Permeance Vapor Retarders for Thermal Insulation
NFPA 255	Surface Burning Characteristics of Building Materials
UL 723	Composite Surface Burning Characteristics

1.6 DEFINITIONS

A. Concealed:
1. Hidden from sight as in trenches, chases, furred spaces, walls, pipe shafts, or hung ceilings.

B. Exposed:
1. Not "concealed" as defined above. Normally open and visible to building occupants (such as gymnasiums).

1.7 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.
2. These ratings must be 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.

B. Quality Controls:
1. All insulation shall be the product of reputable manufacturers.
2. All insulation shall be applied by mechanics skilled in the use of various materials, and in the employ of a concern regularly engaged in the insulating business. Submit qualifications of insulator with insulation submittals.
3. The materials shall be applied in accordance with the special materials as required by these specifications and by the manufacturer standards.
4. Poor workmanship or appearance will be cause for rejection.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Fiberglass Products:
1. Johns Manville
2. Knauf
3. Owens/Corning

B. Closed Cell Products:
1. Armacell
2. Aeroflex
3. Armstrong

2.2 GENERAL

A. Molded pipe insulation shall be manufactured to meet ASTM C 585 and ASTM C 547 for sizes required for the particular system and shall be suitable for installation on piping systems defined.

2.3 ABOVE GROUND PIPE INSULATION

A. Density - 3 pounds per cubic foot.

B. Construction:
   1. Fiberglass pipe insulation complying with ASTM C 547
   2. Vapor retarding jacket with self–sealing longitudinal closure laps and butt strips complying with ASTM C 1136.

C. Construction for Fiberglass Insulation (for all installations other than concrete masonry walls):
   1. Fiberglass with factory-applied, all service reinforced vapor barrier jacket having integral laminated aluminum vapor barrier and double adhesive self-sealing lap. Roof drain not exposed to have FRK type foil reinforced Kraft vapor barrier jacket.
   2. Thickness:
      a. Domestic Cold Water Piping:
         (1) Interior walls and above ceilings: 1/2 inch
         (2) Exterior walls: 1 inch
      b. Condensate Lines: 1/2 inch
      c. Waste Lines Which Receive Condensate: 1/2 inch
      d. Roof Drain Piping:
         (1) Exposed: 2 inch
         (2) Not exposed: 2 inch
      e. Domestic Hot Water Piping (Up to 169° F):
         (1) 2" diameter and larger:
            - Interior walls and above ceilings: 1½ inch
            - Exterior walls: 1½ inch
         (2) 1½ inch diameter and smaller: 1½ inch
      f. Outdoor:
         (1) 2 inch

D. Construction for Closed Cell Insulation (for concrete masonry wall installations only):
   1. Type: Closed-cell polyethylene pipe insulation.
   2. Performance Criteria: Resistant to ultraviolet and biological degradation.
   3. Temperature Range: -90ºF to 212ºF
   4. Water Vapor Permeability (Dry Cup): Less than 0.03 per inch when measured by ASTM C355.
   5. Thermal Conductivity: 0.265 BTU-IN/HR-F2-ºF or less at 75ºF mean temperature

2.4 FLANGE, VALVE AND FITTING INSULATION

A. Exposed Piping:
   1. Provide molded or mitered covers with full thickness matching adjacent covering.
   2. Finish with white glass, reinforced white vapor barrier coating or white .020 inch thick PVC jacketing with self-seal lap.

B. 2½ Inch Diameter and Larger Concealed Piping:
   1. Insulate fittings and valves with molded or mitered fitting covers.
   2. Finish with white vapor barrier coating reinforced with white 10" x 10" reinforced mesh.

C. 2 Inch Diameter and Smaller Concealed Piping:
   1. Insulate fittings and valves with mineral wool and insulating cement to a thickness equal to or greater than adjoining straight pipe.
   2. Molded or mitered fittings finished with white vapor barrier coating reinforced with reinforced mesh may be provided.

D. Underground Piping (hot water only):
   1. Provide mitered covers with full thickness matching adjacent covering.
   2. Field fabricated miter joints are not acceptable.
   3. No insulation is required on underground domestic cold water piping.

E. Outdoor Piping:
   1. Metal jacketing shall be 0.016" minimum aluminum or stainless steel with moisture barrier, secured in accordance with jacket manufacturer's recommendations.
   2. Use preformed fitting covers matching jacket used on straight pipe, with all joints sealed with metal jacketing sealant.

2.5 SEALANT, ADHESIVE, AND FINISH

A. Sealant:
   1. Manufacturers:
      a. Foster 95-44
      b. Childers CP-76
   2. Usage:
      a. Valve Covers
      b. Anchors
      c. Hangers
      d. Metal Jacketing
      e. Flashing Penetrations

B. Adhesive:
   1. Manufacturers:
      a. Foster 85-20/85-60 and Childers CP-127
   2. Usage:
      a. Longitudinal laps of the vapor barrier jacket
      b. Butt joint covers.

C. Weather Barrier Mastic
   1. Manufacturers:
      a. Foster 46-50
      b. Childers CP-10
   2. Usage:
      a. Used on above ambient piping/duct to protect insulation from weather.
      b. Use in conjunction with reinforcing mesh.

D. Vapor Barrier Coating:
   1. Manufacturers:
      a. Foster 30-33 Vapor Out
      b. Childers CP-33 Chil Out
   2. Usage:
      a. Glass fabric reinforcement.

E. Reinforcing Mesh
   1. Manufacturers:
      a. Foster Mast Afab
      b. Childers Chil-glass #10

2.6 INSULATION SHIELD

A. Field-fabricated:
   1. Material:
      a. High-density fiberglass insulation
   2. Construction:
      a. Insulation to support the bearing area at hangers and supports with a shield of galvanized metal extending not less than 4 inches on either side of the support bearing area, covering at least half of the pipe circumference. When pipe is guided at top and bottom, metal shields should cover the whole pipe circumference. Adhere

metal shield to insulation so that metal will not slide with respect to insulation.

3. Schedule:
   a. 3" and smaller pipe diameter:
      (1) 12 inch insulated section, 18 gauge metal shield
   b. Greater than 3" pipe diameter:
      (1) 12 inch insulated section, 16 gauge metal shield

B. Factory-made:
1. Manufacturer:
   a. Pipe Shields, Inc. or equal.
2. Type:
   a. Proper shield for service and pipe span.
3. Construction:
   a. Extend insulation at least 1 inch beyond metal.

C. Insulation shall not compress at hanger.

PART 3 EXECUTION

3.1 SITE INSPECTION

A. Before starting work under this section, carefully inspect the site and installed work of other trades and verify that such work is complete to the point where installation of materials and accessories under this section can begin.

B. Verify that all materials and accessories can be installed in accordance with project drawings and specifications and material manufacturers' recommendations.

C. Verify, by inspecting product labeling, submittal data, and/or certifications which may accompany the shipments, that all materials and accessories to be installed on the project comply with applicable specifications and standards and meet specified thermal and physical properties.

3.2 PROPERTIES

A. Ensure that all pipe and fitting surfaces over which insulation is to be installed are clean and dry.

B. Ensure that insulation is clean, dry, and in good mechanical condition with all factory-applied vapor or weather barriers intact and undamaged. Wet, dirty, or damaged insulation shall not be acceptable for installation.

C. Ensure that pressure testing of piping and fittings has been completed prior to installing insulation.

3.3 INSTALLATION

A. General:
1. Install all insulation materials and accessories in accordance with manufacturer's published instruction and recognized industry practices to ensure that it will serve its intended purpose.
2. Install insulation on piping subsequent to installation of heat tracing, painting, and acceptance tests.

3. Install insulation materials with smooth and even surfaces. Insulate each continuous run of piping with full-length units of insulation, with single cut piece to complete run. Do not use cut pieces or scraps abutting each other. Butt insulation joints firmly to ensure complete, tight fit over all piping surfaces.
4. Maintain the integrity of factory-applied vapor barrier jacketing on all pipe insulation, protecting it against puncture, tears or other damage. All staples used on cold pipe insulation shall be coated with suitable vapor barrier coating to maintain vapor barrier integrity.
5. All cold water, hot water and condensate drains routed in concrete masonry units shall be insulated using closed cell insulation as noted in this specification.

3.4 PIPE

A. Insulation size shall match pipe size.

B. Insulation to be continuous through wall and ceiling penetrations.

C. Apply insulation to clean, dry pipes.

D. Butt insulation joints firmly together and apply butt strip. All pipe insulation ends shall be tapered and sealed.

E. Butt pipe insulation against hanger inserts. Seal jacketing according to type used.

F. Seal longitudinal laps and butt strips with sealant in addition to the self-sealing laps.

G. Seal joints with adhesive and staple at 2" O.C. with outwardly clenching staples.

H. Seal all joints with vapor barrier coating.

3.5 VALVES, FLANGES, AND FITTINGS

A. Insulate all valves, flanges, and fittings with covers secured with Velcro with equivalent thickness and composition installation on straight pipes.

B. Finish with 1/4 inch layer of Foster 30-33 or Childers CP-33 reinforced with reinforcing mesh.

C. Factory made covers equal to Schuller Zeston are acceptable.

3.6 CONTROL VALVE COVERS

A. Fabricate special covers, complete with troweled-on vapor seal, shaped to accommodate the valve stem. Insulation thickness shall be same thickness as adjoining pipe.

B. Seal covers to valve insulation properly with adhesive so that the seal may be broken with a knife blade without damage to either part. Arrange so that cover can be removed and replaced as necessary for operation of the valve.

C. Finish valve cover with glass cloth and two coats of vapor barrier coating.

D. Factory made covers are acceptable. Provide submittal.

3.7 ROOF DRAIN PIPING

A. Wrap insulation tightly on the pipe with all circumferential joints butted and longitudinal joints overlapped a minimum of 2 inches.

B. Adhere insulation to metal with 4 inch strips of insulation bonding adhesive at 8 inch on centers. On circumferential joints, the 2 inch flange of the facing shall be secured and taped with a minimum of 3 inch wide foil reinforced Kraft tape. On longitudinal joints, the overlap shall be secured using 9/16" flared door staples applied 6" on centers and taped with minimum 3" wide foil reinforced Kraft tape.

C. Seal vapor tight to prevent any moisture from leaking out from under the insulation.

D. Roof drains for canopies do not require insulation.

E. Roof drains that are exposed shall be insulated as described in the paragraph on exposed piping.

F. Roof drain laterals which serve primary roof drains shall be insulated.

G. No insulation is required on concealed secondary roof drain piping.

H. Insulate all roof drain bodies (primary and secondary), first 3-feet of vertical pipe on secondary laterals, and primary roof drain piping to a point seven feet downstream of the first elbow.

3.8 WASTE LINES WHICH RECEIVE CONDENSATE

A. Insulate from the drain receptor (i.e. floor sink, hub drain) all the way to where the drain line changes to a vertical stack.

3.9 REPAIRS AND REPLACEMENT

A. Replace any insulation that gets wet, whether now dry or not.

B. Repair any damage caused by condensation due to improper insulating.

3.10 ALL EXPOSED PIPING

A. All exposed piping insulation to be pre-formed pipe insulation with white PVC jacket and white PVC fittings (no exceptions). All exposed roof drain primary and secondary downspouts, water piping, condensate piping, and any other piping that requires insulation shall be insulated down to the floor level using the pre-formed pipe insulation and PVC jackets and fittings.

3.11 OUTDOOR PIPING

A. Metal jacket shall be applied per manufacturer's recommendations. Longitudinal joints shall be applied so they will shed water completely and be sealed completely with 1/8” bead of metal jacketing sealant under each lap. Circumferential joints shall be closed using preformed butt strips in accordance with manufacturer's recommendations.

3.12 SHIELDS

A. Metal jacketing shall be 0.016-inch minimum aluminum or stainless steel with moisture barrier, secured in accordance with jacket manufacturer's recommendations. Use bands and seals of the same material. Use preformed fitting covers matching jacket used on straight pipe, with all joints weather sealed with 1/8” bead of metal jacketing sealant under each lap.

3.13 SHIELDS AND HANGERS

A. Piping hangers or anchors are not to be in direct contact with pipe. Hangers are to on the outside of the insulation with pipe shields at each hanger.

B. At the location of hangers or supports for pipes run above ground and finished with a vapor seal insulation, provide rigid sections of cork, high density fiberglass, Foamglas, calcium silicate or high density polyurethane, the same thickness as adjacent insulating material to adequately support the pipe without compression of the insulating material and cover with a vapor seal that is bonded to the adjacent insulation as described for fittings in the lines. Wood inserts shall not be allowed. Hangers and supports for piping insulation to receive a vapor barrier shall be installed exterior to the insulation.

C. Material Changes:
   1. Wherever there is a change in materials on lines that are vapor sealed, apply a suitable adhesive that is compatible with both materials, tapes, etc., as required to maintain the vapor barrier.

D. Apply insulation around the hanger ring or anchor and pipe and carry vapor barrier upward and outward along the hanger rod or anchor members to a point not less than 12 inches from the adjacent pipe.

E. Take care to avoid puncturing the vapor seal.

F. Finish insulation as specified for flanges, and seal over adjacent vapor barrier jacket.

3.14 FIELD QUALITY ASSURANCE

A. Upon completion of all insulation work covered by this specification, visually inspect the work and verify that it has been correctly installed. This may be done while work is in progress, to assure compliance with requirements herein to cover and protect insulation materials during installation.

3.15 PROTECTION

A. Replace damaged insulation which cannot be satisfactorily repaired, including insulation with vapor barrier damage and moisture-saturated insulation.

B. The insulation contractor shall advise the general and/or the mechanical/plumbing contractor as to requirements for protection of the insulation work during the remainder of the construction period, to avoid damage and deterioration of the finished insulation work.

END OF SECTION

SECTION 22 13 18

CONDENSATE 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 22 00 10, apply to this Section.

1.2 SECTION INCLUDES

A. Condensate piping for cooling units.

1.3 RELATED SECTIONS

A. Section 22 00 10 - Basic Plumbing Requirements

B. Section 22 05 30 - Pipe and Pipe Fittings - General

C. Section 22 07 20 - Piping Insulation

1.4 REFERENCES

A. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials

B. ASTM D1784 - Standard Specification for Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC) Compounds

C. ASTM F441 - Standard Specification for Chlorinated Poly Vinyl Chloride (CPVC) Plastic Pipe, Schedules 40 and 80

D. ASTM D3311 - Standard Specification for Drain, Waste and Vent (DWV) Plastic Fitting Patterns

1.5 DEFINITIONS

A. Draw-through Unit:
   1. A unit in which the cooling coil operates under a negative static pressure.

B. Blow-through Unit:
   1. A unit in which the cooling coil operates under a positive static pressure.

1.6 SUBMITTALS

A. Product Data:
   1. Provide submittal data on all equipment specified in this section in accordance with Section 22 00 10, 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.

PART 2 PRODUCTS

2.1 GENERAL

A. Provide condensate lines for all cooling units even if not shown on the plans.

B. Provide a secondary condensate drain pan and secondary condensate piping for all horizontal air handlers above ceiling, even if not shown on plans.

C. Minimum size:
1. 1", but no smaller than the coil nipple.

2.2 PIPING

A. Type: PVC
1. Schedule 40 PVC pipe to be manufactured in accordance with ASTM D1784 sizes to conform to ASTM D1785, ASTM D2665 & NSF STD14.
2. Solvents cement to conform to ASTM D254
3. Primer to conform to ASTM F656
4. Other types as noted on plans.

B. Type: CPVC
1. Schedule 40 CPVC pipe to be manufactured in accordance with ASTM F441, ASTM D3311 and ASTM D1784.
2. Primerless solvents to conform to ASTM F493.

2.3 FITTINGS

A. Type: PVC
1. PVC Fittings conform to ASTM D1784, ASTM D1785, ASTM 2665.

B. Type: CPVC
1. CPVC fittings shall confirm to ATM D1784 and ASTM D3311.

2.4 INSULATION

A. All condensate lines shall be insulated per Section 22 07 20.

2.5 CONNECTIONS

A. Type:
1. Solid string hard solder
2. Wire hard solder
3. Cored solder will not be allowed.

B. Material:
1. Solder:
a. 95% tin and 5% antimony
2. Flux:
a. Non-corrosive paste type

C. Use a cast adapter when connecting soldered copper piping to screwed brass pipe.

2.6 ROOF PIPE SUPPORTS

A. Manufacturers:
1. MAPA MS-5
2. Miro Industries Model 3 RAH (3-inch or less)

3. Pipe Hangers and Devices (PHP) Model PP10
4. Portable Pipe Hangers (PHP) Model PP10
5. ERICO RPS 360407

B. All roof supports to be equal to MAPA Products Model MS-5, adjustable height, select size designed for size of pipe supported. MS-5 for 4" and smaller.
   1. Install ½" rubber walk pad under each pipe support.

C. MAPA MWP ½" thick rubber walk pad.
   1. Coordinate exact locations of supports with roofing contractor.

D. Roof supports to support all gas piping a minimum of 6" above roof.
   1. Coordinate exact locations of supports with roofing contractor.
   2. Install ½" rubber walk pad under each pipe support.

E. Spacing of Supports (Horizontal):

½"	6 feet or less
¾" or 1"	8 feet or less
1¼" or larger	10 feet or less

Install supports within 2 feet of every change of direction.

2.7 ACCESSORIES

A. Traps:
   1. Draw-through units:
      a. Required on all units, unless noted otherwise on plans.
   2. Blow-through units:
      a. As recommended by the unit manufacturer or as shown on the plans.

B. Clean-outs

C. Unions

D. Neutralization kits for all condensing furnaces and condensing water heaters. Equal to JJM Boiler Works, Inc.

PART 3 EXECUTION

3.1 INSTALLATION

A. Traps:
   1. Install in each line serving a draw-through unit. Coordinate size and configuration with air conditioning unit manufacturer.

B. Cleanouts:
   1. Install cleanouts as shown on plans.
   2. Install cleanouts at changes in direction (greater than 45º).
   3. Provide insulation caps on cleanouts for easy removal and reinstall.

C. Unions:
   1. Install unions on both sides of the trap.

D. Minimum Drain Line Slope:
   1. 1/8 inch per foot
   2. Insulate all condensate lines inside buildings.

E. PVC and CPVC pipe exposed to any sun light shall be painted with UV protective paint (Black).

F. Size and install Neutralization kits per manufacture's recommendations.

G. At all rooftop units on the roof, contractor to connect to the side outlet on the rooftop unit condensate drain pan and then route condensate drain down through roof in roof penetration per the roofing consultant's roof penetration detail. The bottom outlet on the rooftop unit condensate drain pan is unacceptable. The P-trap must be accessible on the roof.

H. TESTING:
   1. Pressure test all sections of the condensate drainage system at a 10 foot head pressure for a 24 hour period. Repeat test until no leaks exist.

END OF SECTION

HVAC RENOVATION TO RAINS HIGH SCHOOL
RAINS INDEPENDENT SCHOOL DISTRICT

HEATING, VENTILATING AND AIR-CONDITIONING (HVAC)

DIVISION 23

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 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 (EMCS) BACnet
23 23 00	Refrigerant Piping
23 31 13	Metal Ductwork
23 33 33	Access Doors
23 34 16	HVAC Fans
23 37 13	Diffusers, Registers, and Grilles
23 43 23	Bipolar Ionization Air Purification System
23 81 26	Split System HVAC 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 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 & REFERENCE STANDARDS

A. General:
   1. Perform all Division 23 work in strict accordance with the requirements and recommendations stated in the codes and standards except when requirements are modified by the contract documents.
   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:
   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 Part 1926 - Regulation of Excavation
    c. Texas Underground Facility Damage Prevention Act (H.B. 2295)
    d. All other applicable standards
9. National Fire Protection Association:
    a. NFPA No. 90A Installation of Air Conditioning and Ventilating Systems
10. Texas State Board of Insurance Standards
11. Clean Air Act and Clean Air Act Amendments
12. State Codes:
    a. Texas Department of Labor Boiler Rules and Regulations
    b. All other applicable codes
13. Local Municipal Codes and Ordinances

1.5 SCHEDULE OF ABBREVIATIONS

A. Reference Standards are listed in Section 23 using abbreviations listed below:

AABC	Associated Air Balance Council
AASHTO	American Association of State Highway and Transportation Officials
ADA	Americans with Disabilities Act
ADC	Air Diffusion Council
A/E	Architect/ Engineer
AGA	American Gas Association
AMCA	Air Moving and Conditioning Association
ANSI	American National Standards Institute
AHRI	Air-Conditioning and Refrigeration Institute
ASHRAE	American Society of Heating, Refrigerating and Air-Conditioning Engineers
ASME	American Society of Mechanical Engineers
ASPE	American Society of Plumbing Engineers
ASTM	American Society for Testing and Materials
AWE	American Welding Society
AWWA	American Water Works Association
CGA	Compressed Gas Association
CISPI	Cast Iron Soil Pipe Institute
CS	Commercial Standard
CSA	Canadian Standards Association
DIPRA	Ductile Iron Pipe Research Association
DOT	Department of Transportation
DOC	Department of Commerce
FCC	Federal Communications Commission
FM	Factory Mutual
FS	Federal Specification
GSHPA	Ground Source Heat Pump Association
IBC	International Building Code
ITL	Independent Testing Laboratories
NEC	National Electric Code
NFPA	National Fire Protection Association
NSF	National Sanitation Foundation
OSHA	Occupational Safety and Health Administration
PDI	Plumbing and Drainage Institute

SMACNA	Sheet Metal and Air Conditioning National Association
TCEQ	Texas Commission on Environmental Quality
TDH	Texas Department of Health
TWC	Texas Water Commission
UBC	Uniform Building Code
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. Erect barricades, protective fencing, and signs to prevent injury to personnel on site.
2. Make permanent connection to utilities or existing lines. Determine depth and location, and bid accordingly.
3. Relocate and repair any existing lines cut by general construction work.
4. Pay all costs in connection with metering devices.
5. Plans do not show exact location and elevations of lines, nor do they show all offsets required.
6. Deviate from plans as required to conform to the general construction and provide proper grading.
7. Maintain all utility services during construction to existing portions of job that remain.
8. Procure and pay for all necessary permits or licenses to carry out the work.
9. Obtain and pay for all the necessary certificates of approval which must be delivered to the A/E before final acceptance of the work.
10. Periodically remove rubbish, clean or repair all surfaces marred by the work required under this contract.
11. Protect work from damage by other trades.
12. Make all tests required by law; pay all costs in connection with the testing.
13. Where job conditions require changes in indicated locations and arrangement, make such changes without extra cost to Owner.
14. 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. See Section 26 00 00.

1.7 DEFINITIONS

A. Approval:
1. It is understood that approval must be obtained from the A/E in writing before proceeding with the proposed work.
2. Approval by the A/E 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.
   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.

1.8 WARRANTY

A. The Contractor shall warranty his work against defective materials and workmanship for a period of one year from 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 SUBMITTALS

A. Refer to Section 23 00 90 for submittal procedures.

1.11 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.

B. Upon submitting his request for final payment, he shall turn over to the A/E, 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 A/E 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.

1.12 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.

1.13 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 A/E.

E. The A/E 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.

1.14 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, A/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.

1.15 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 ten working days prior to the schedule date for opening of bids.

C. The Engineer will consider all such submittals and the A/E 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.
   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.

1.16 PROTECTION OF EQUIPMENT AND MATERIALS

A. The Contractor shall take such precautions as may be necessary to properly protect his apparatus from damage.

B. 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.

C. 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.

D. 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.

1.17 FINAL INSPECTION

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 A/E 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 A/E 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.

1.18 ASBESTOS

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

1.19 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 A/E.

D. No joists, beams, girders or columns shall be cut by any Contractor without first obtaining written permission of the A/E.

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.

1.20 IDENTIFICATION

A. Refer to Section 23 05 53.

1.21 MANUFACTURER'S INSTRUCTIONS

A. All equipment and devices shall be 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.

1.22 RELATED WORK

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

1.23 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.

1.24 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.

1.25 OPERATION PRIOR TO COMPLETION

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.

1.26 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.

1.27 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.

1.28 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) which 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.

1.29 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.

1.30 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.

1.31 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.

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

1.32 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

A. Not Applicable

PART 3 EXECUTION

3.1 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.

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 A/E 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. List of required Division 23 submittals to the engineer
   3. 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.

B. Manufacturers: Manufacturers submitted shall be as per the acceptable manufacturers listed in each specification section or referenced schedule. For additional manufacturers requiring approval, reference the Substitution of Products article in Section 23 00 00.

C. Required Submittals: Refer to the Submittals article of each individual Division 23 specification section for the required items to 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 web site, 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 catalog, 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. Scale and measurements: Make shop drawings accurately to a scale sufficiently large to show all pertinent aspects of the item.
   2. Electronic shop drawing submittals are required.

PART 2 PRODUCTS

A. Not applicable

PART 3 EXECUTION

3.1 SUBMITTALS

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 check list. 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.

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 in accordance with the requirements of Division 1.

23 05 29	**Hangers and Supports for HVAC Piping and Equipment**					
	Isolation Devices					
	Piping hangers and supports					
23 05 53	**Identification for HVAC Piping and Equipment**					
	Label material and attachment method (No adhesives)					
	Sample identification tag(s)					
23 05 93	**Testing, Adjusting, and Balancing for HVAC**					
	Test and Balance Company					
	Sample test and balance forms					
23 07 13	**Duct and Grille Insulation**					
	Insulation thickness and R-value					
23 07 21	**Refrigerant Piping Insulation**					
23 09 23	**Energy Management Control System**					
	Energy Management Controls company					
	Control Devices					
	System configuration drawings					
	Sequences of Operation					
23 23 00	**Refrigerant Piping**					
	Piping material					
23 31 13	**Metal Ductwork**					
	Ductwork material					
	Type of ductwork					
23 33 33	**Access Doors**					
	Access door material					
23 34 16	**HVAC Fans**					
	Fan manufacturer					
	Voltage/ phase					
	Fan CFM					
	Fan static pressure					
23 37 13	**Diffusers, Registers, and Grilles**					
	Grille manufacturer					
23 43 23	**Bipolar Ionization Air Purification System**					
	Bipolar ionization manufacturer					
	Bipolar ionization type					
23 81 26	**Split System HVAC Units**					
	Unit manufacturer					
	Voltage/ phase					
	Unit capacity					
	Unit options and specifics					

1 - Reviewed
2 - Furnish as corrected in comments, resubmit not required
3 - Revise and Resubmit based on comments
4 - Rejected based on comments

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. Refrigerant Piping supports

E. 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 34 16 - HVAC Fans

E. 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.

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 as shown on plans.

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. All Other Above Ceiling Locations:
      a. Adjustable clevis type. Hangers to accommodate circumference of pipe and saddles.

B. Hanger Rods:
   1. Type:
      a. Minimum 3/8 inch diameter with machine threads.

C. 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" to 5" diameter pipe:
      a. 5/8"
   4. 6" diameter pipe or larger:
      a. 3/4"

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.

B. Above Grade and/or dry locations:
   1. Material:
      a. 20 or 22 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. Galvanized or black steel pipe.
      b. Non-combustible.
      c. 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 2½" 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

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. Hanger Spacing:
   1. Schedule 40 Black Steel Piping (Chilled water/ Hot water piping):
      a. 1/2" diameter pipe → 6'-0" or less
      b. 3/4" diameter pipe → 8'-0" or less
      c. 1-1/4" diameter pipe → 10'-0" or less
      d. Vertical:
         (1) Every Floor Level Minimum
         (2) Adequately support at their bases, either by a suitable hanger placed in the horizontal line near the riser, or by a base fitting set on a pedestal or foundation.
         (3) Support from each floor slab by means of an approved clamp-type support which bears on the slab or beam.
   2. Copper Piping (Refrigerant Piping):
      a. Smaller Than 1¼" → 6'-0" or less
      b. 1 ½" and Larger → 10'-0" or less
      c. Vertical → 10'-0" or less

G. 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 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 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

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. Non-corroding pop rivets are acceptable.

C. Stick-ons or adhesives will not be allowed.

2.6 PIPING AND CONTROL DIAGRAM SIGNS

A. Material: 1/4 inch acrylic cover and backing screwed together with brass screw/bolts.
   1. Size:
      a. Minimum: 12" x 17"
      b. Maximum: 24" x 36"

B. Provide a diagram in each mechanical room similar to the diagrams shown on the plans, and/or as required for the area served. This diagram to reflect as built conditions.

2.7 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.
   2. Repeated and reversed words for viewing from 360^{o} 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. Attachment:
   1. Stainless steel or solid brass jack chain, or stainless steel or brass "S" hooks

E. Ductwork:
   1. Stenciled letters or self-adhesive labels, minimum 1" high characters.
   2. Red ribbon at each balancing damper.

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.

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. Provide all additional signage required by local authority at no cost to the Owner.

E. Provide filter sizes and quantity on all air handlers.

F. 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.

G. 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
      f. Install 1/2" diameter adhesive marker (color to be approved by A/E), and apply to T-bar below any mechanical equipment and fire dampers above lay-in ceiling.

H. 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.

I. Surfaces to be Painted:
   1. Bare piping
   2. Insulation covering of insulated piping

J. Paint according to the following schedule:

System	**Pastel Color**
Gas Piping on Roof	Black or as required by local authority having jurisdiction

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

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

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 37 13 - Diffusers, Registers, and Grilles

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

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 sepias 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.

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.

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.
   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

A. Not Applicable

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 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 revision 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 duct work 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. 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 why a traverse was not made must appear on the appropriate data sheet.

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 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, 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:
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. Water 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. Verification of valve positioning and static pressures across valves
   c. Entering and Leaving water temperatures across all coils.
   d. Static pressure drops across all coils.
   e. Static pressure drops across all equipment (chillers, pumps, boilers, cooling towers, etc.)
4. System Identification
   a. In each report, the zones, supply, return, and exhaust openings, and traverse points shall be numbered and/or lettered on mechanical drawings to correspond to the numbers and letters used on the report data sheets.
5. Controls
   a. Document verification of controls.
6. 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.
7. 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.

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.

ASTM E84	Standard test for surface burning characteristics of building materials.
NFPA 221	Fire walls and fire barrier walls.
NFPA 255	Surface burning characteristics of building materials.
NFPA 96	Ventilation control and fire protection of commercial cooking operations.
UL 723	Test for surface burning characteristics of building materials.
UL 1978	First Edition Standard for Grease Ducts
ASTM C553	Standard specification for mineral fiber blanket thermal insulation for commercial and industrial applications.
ASTM C1071	Fibrous glass duct lining insulation (thermal and sound).
IECC	International Energy Conservation Code
ASTM C355	Water Vapor Permeance

ASTM C916-85(2001)e1	Standard Specification for Adhesives for Duct Thermal Insulation
ASTM C1136-02	Standard Specification for Flexible, Low Permeance Vapor Retarders for Thermal Insulation
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 Requirements
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. All insulation must meet ASTM C553.
   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. Kitchen Exhaust Insulation Performance Requirements:
   1. Two-hour rated resistive enclosure assembly, ASTM E119: Large scale Wall Panel Test and Total Engulfment Test.
   2. Zero inch clearance to combustible, maximum allowable surface temperature on unexposed side, UL 1978.
   3. Class I interior finish materials, ASTM E84.
   4. Through-penetration protection systems for grease and air ducts, ASTM E814 and UL 1479.
   5. Non-combustibility, ASTM E136.
   6. ISO-6944-1985, Fire Resistance Tests - Ventilation Ducts.

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

G. Kitchen exhaust ducts

H. General exhaust ducts do not receive insulation

2.2 MANUFACTURERS

A. Owens Corning

B. Knauf

C. Johns Manville

2.3 EXTERNAL DUCT WRAP AND GRILLE INSULATION

A. Minimum Density:
   1. 3/4 pound per cubic foot

B. Material:
   1. Fiberglass blanket with type FRK foil reinforced Kraft vapor barrier jacket

C. Thickness:
   1. 2.0 inch, Minimum Value R-6.0

D. Comply with ASTM C553 standard

E. Comply with ASTM C1136-02

F. Comply with ASTM E84

G. Comply with IECC

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. 1½ inch thick, Minimum Value R-6.0

D. Fasteners:
   1. Pronged straps.

E. Comply With ASTM C916-85(2001)e1

F. Comply with ASTM C1071 standard

G. Comply with ASTM C553 standard

H. Comply with ASTM C1136-02

I. Comply with ASTM E84

J. Comply with IECC

2.5 FIREPROOFING KITCHEN HOOD EXHAUST DUCTS

A. Manufacturers:
   1. Thermal Ceramics - Firemaster Duct Wrap
   2. 3M Fire Barrier Duct Wrap
   3. John Manville Firetemp Wrap

B. Materials:
   1. Fire Resistive duct wrap: Duct Wrap, 1.5" thick or 2” thick, 24" or 48" wide x 300" long rolls, foil encapsulated with logo identification. Duct Wrap Collar, 8" wide for air duct butt alternate wrap method (see Part 3).
   2. Tapes:
      a. High performance filament: Tape No. 898, 1" wide, manufactured by 3M Company, St. Paul, MN, or equal and approved.
      b. Aluminum foil tape: Minimum 3" wide to seal cut blanket edges.
   3. Banding Material:
      a. 304 Stainless Steel banding: 3/4" wide x 0.015" thick minimum.
   4. Insulation Pins/Washers:
      a. Pins: 10 gage, 5 inches long, copper coated steel; washers: 1.5" x 1.5" square or 1.5” diameter galvanized steel speed clip.
   5. Through-Penetration Fire Stop Materials:
      a. Packing Material: Scrap pieces, Duct wrap, 1.5" thick or 3 pcf mineral wool as packing material.
      b. 3M FB-2000+Silicone or FireMaster Putty, ceramic fiber based sealant.
   6. Grease Duct Access Door:
      a. Steel angle opening frame
      b. Access over, minimum 16 gage
      c. Insulation Pins
      d. Speed Clips, minimum 1.5" x 1.5" or 1.5" diameter galvanized steel
   7. Hardware:
      a. Threaded rods: 4" to 5" long, 1/4" diameter galvanized steel with 1/4" wing nuts and 1/4" metal washers.
      b. Four inch long steel hollow tubing to fit threaded rods.
      c. 1/4" wing nuts.

PART 3 EXECUTION

3.1 DUCT WRAP INSTALLATION

A. Wrap insulation tightly on the ductwork with all circumferential joints butted and longitudinal joints overlapped a minimum of 3 inches.

B. Adhere insulation to metal with 4 inch strips of insulation bonding, using adhesive at 8 inch centers.

C. On circumferential joints, secure the 2-inch flange of the facing and tape with a minimum of 3 inch wide foil reinforced Kraft tape.

D. On longitudinal joints, secure the overlap using 9/16 inch flared door staples applied 6 inches on centers and taped with minimum 3 inch wide foil reinforced Kraft tape.

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. Fasten insulation installed on diffusers, grilles, and registers using 3-inch minimum wide foil reinforced Kraft tape.

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. 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 completely coating the clean sheet metal.

D. Do not use duct liner in kitchen or other areas that may have excess moisture present.

E. Secure fasteners to the ducts with adhesive.

F. Conform to SMACNA Standards for all duct construction standards.

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.

I. Install duct liner in accordance with SMACNA standards.

3.3 KITCHEN HOOD EXHAUST DUCTS

A. Install Duct wrap system in accordance with manufacturer's instructions and referenced standards.

B. Install Duct wrap in direct contact with the duct it enclosed. Protect every portion of duct with manufacturer specified layers for grease duct applications. Overlap both perimeter and longitudinal joints minimum 3" per layer of material.

C. Air Duct Enclosure Alternate Wrap:
   1. Follow same traditional wrap method with exception of utilizing a 3" perimeter overlap in conjunction with longitudinal butt joint wrap plus Duct wrap Collar over exterior layer joints. Filament tape is used as temporary hold on both layers until banding hardware is in place. Band exterior layer spaced minimum 10½" on center. For duct widths greater than 24", weld insulation pins to bottom horizontal and outer vertical duct runs. Impale Duct wrap over pins and secure with galvanized steel speed clips until banding is applied.

D. Locate grease duct access doors at horizontal cleanouts as required by local codes. Protect with minimum of 2 layers of Duct wrap, each layer overlapping previous by 1" on all sides and in accordance with manufacturer's instructions.

E. Sections of grease ducts that are inaccessible from the hood or discharge openings shall be provided with cleanout openings spaced not more than 20 feet apart and not more than 10 feet from changes in direction greater than 45 degrees.

F. Cleanouts and openings shall be equipped with tight-fitting doors constructed of steel having a thickness not less than that required for the duct.

G. Cleanout doors shall be installed liquid tight.

H. Door assemblies including any frames and gaskets shall be approved for the application and shall not have fasteners that penetrate the duct.

I. Gasket and sealing materials shall be rated for not less than 1500ºF (816ºC).

J. Protect floor and wall penetrations with an approved through-penetration system having an F and T hourly rating not less than that of assembly penetrated and installed in accordance with manufacturer's instructions and as follows:

1. Grease Ducts - 2 hour Enclosure: Alternate A: 2 layers Duct wrap per manufacturer's installation instructions, maintaining 3" transverse and longitudinal overlaps continuous through the penetration. Alternate B: Tightly butt Duct wrap to the floor or wall on both sides of the assembly. Fill remaining annular space (3" maximum) between the wrapped duct (Alternate A) or bare steel duct (Alternate B) and periphery of the opening with 4¼" thickness of scrap Duct wrap, or 4¼" 3 pcf mineral wool batt, firmly packed into opening. Apply 1/4" minimum 2000+ Silicone over packing material, within the annulus, flush with top surface of floor or both surfaces of wall.

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 - Refrigerant suction lines serving cooling 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 E 84-03 - Standard Test Method for Surface Burning Characteristics of Building Materials

C. ASTM C 355 - Water Vapor Permeability

1.7 QUALITY ASSURANCE

A. Fire Endurance Rating: 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.

B. Components such as adhesives, mastics and cement must meet the same requirement.

PART 2 PRODUCTS

2.1 PIPE INSULATION

A. Type: Closed-cell polyethylene pipe insulation.

B. Performance Criteria: Resistant to ultra-violet and biological degradation.

C. Temperature Range: -90°F to 200°F

D. Water Vapor Permeability (Dry Cup): Less than 0.03 per inch when measured by ASTM C355.

E. Thermal Conductivity: 0.25 - 0.29 BTU-IN/HR-FT^2-°F.

F. Refrigerant Suction Lines Insulation thickness - 1½-inches

G. Manufacturer/Model:
   1. Armacell
   2. Aeroflex

2.2 SEALANT & ADHESIVE

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

2.3 FINISHES

A. Manufacturers:
   1. WB Armstrong Finish - White
   2. Aeroflex
   3. VentureClad

PART 3 EXECUTION

3.1 PIPE

A. Where straps or hangers are used, provide insulation shield.

B. Apply insulation to clean, dry pipes.

C. Butt insulation joints firmly together.

D. Seal butt seams with sealant. Duct tape or electrical tape will not be permitted.

E. Install in accordance with manufacturer's instructions.

F. Accomplish in a good workmanship manner and be neat in appearance.

G. Insulation not neat in appearance will be rejected by the Engineer.

H. Do not stretch insulation around elbows.

I. Install insulation on piping prior to final connection.

J. Longitudinal joints installed after pipe is assembled are not acceptable.

K. Refer to plans for installation of shields around pipe hangers.

L. 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 insulation to be painted with WB Armstrong Finish, or equivalent. Apply as recommended by the manufacturer, to protect the insulation on exterior of building. Apply above 50°F. Apply to dry insulation only.

3.3 VALVES, FLANGES & FITTINGS

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

3.4 REPAIRS & 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. LonWorks or proprietary protocol software is not allowed.

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.

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 or 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 UL916 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 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. The EMCS shall be a totally Native BACnet-based system, based on a distributed control system in accordance with this specification. The operator's 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.

B. 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.

C. 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.

D. 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.

E. 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.

F. 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.

G. 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.

H. Prepare individual hardware layouts, interconnection drawings, and software configuration from project design data.

I. 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.

J. Design, provide, and install all equipment cabinets, panels, data communication network cables needed, and all associated hardware.

K. Provide and install all interconnecting cables between supplied cabinets, application controllers, and input/output devices.

L. Provide and install all interconnecting cables between all operator's terminals and peripheral devices (such as printers, etc.) supplied under this section.

M. Provide complete manufacturer's specifications for all items that are supplied. Include vendor name of every item supplied.

N. Provide supervisory specialists and technicians at the job site to assist in all phases of system installation, startup, and commissioning.

O. Provide a comprehensive operator and technician training program as described herein.

P. 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.

Q. 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.

R. Unless otherwise specified, all products shall be of single manufacturer where possible with substitutions approved by Engineer/Owner.

S. 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.

T. Provide protective devices to prevent damage to the EMCS as a result of lightning.

U. 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.

V. All applications programs shall be pre-engineered and pretested. Program entries shall utilize graphical templates.

W. 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

B. Section 23 05 93 - Testing, Adjusting, and Balancing for HVAC

C. Section 23 81 26 - Split System HVAC Units

D. Section 26 00 00 - Basic Electrical Requirements

1.5 DEFINITIONS

A. Energy Management Control System, Facility Management System, 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
   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 web site, 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.

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 - Climatec

B. 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. 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.

B. 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.

C. Software shall include the following, but not be limited to:
   1. DDC Programming tool
   2. All points binding and interoperability software to make the system truly open
   3. Graphic editing tools
   4. Energy management tools
   5. Trending tools

D. Graphics:
   1. Graphics pages shall consist of the following graphics at a minimum:
   2. District Map
   3. Floor plans (typical of every school for both space temperature and humidity)
   4. Animated Unit Summary Pages (one per piece of HVAC equipment)
   5. Text Summary Pages (one per piece HVAC equipment)
   6. Time Schedule Pages
   7. Run times Page
   8. Graphics Editing Mode
   9. Trendlog Page

E. General structure of workstation interaction shall be a standard client/server relationship. Server shall be used to archive data and store system database. Clients shall access server for all archived data. Each client shall include flexibility to access graphics from server or local drive. Server shall support a minimum of 50 clients simultaneously. Provide software licenses for server and 20 clients.

F. BACnet Conformance:
   1. Operator's workstation shall as a minimum support Point-to-Point (PTP) and Ethernet BACnet LAN types. It shall communicate directly via these BACnet LANs as a Native BACnet device. Operator's terminal shall comply with the requirements of a BACnet

conformance class 3 device and support all BACnet services necessary to provide the following BACnet functional groups:
a. Clock Functional Group
b. Event Response Functional Group
c. Time Master Functional Group
d. Device Communications

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 accessed by the workstation shall include as a minimum: Analog Value, Analog Input, Analog Output, Binary Value, Binary Input, Binary Output, Calendar, Device, Event Enrollment, File, 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.
4. The Operator Workstation 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). Workstation shall support Foreign Device Registration to allow temporary workstation connection to IP network.

G. Displays:
1. Operator's workstation shall display all data associated with project as called out on drawings and/or object type list supplied. Graphic files shall be created using digital, full color photographs of system installation, AutoCAD or Visio drawing files of field installation drawings and wiring diagrams from as-built drawings. Operator's workstation shall display all data using three-dimensional graphic representations of all mechanical equipment. System shall be capable of displaying graphic file, text, and dynamic object data together on each display and shall include animation. Information shall be labeled with descriptors and shall be shown with the appropriate engineering units. All information on any display shall be dynamically updated without any action by the user. Workstation shall allow user to change all field-resident EMCS functions associated with the project, such as setpoints, weekly schedules, exception schedules, etc. from any screen no matter if that screen shows all text or a complete graphic display. This shall be done without any reference to object addresses or other numeric/mnemonic indications.
2. All displays and programming shall be generated and customized by the local EMCS supplier and installer. Systems requiring factory programming for graphics or DDC logic are specifically prohibited.
3. Binary objects shall be displayed as ACTIVE/INACTIVE/NULL or with customized text. Text shall be justified left, right or center as selected by the user. Also, allow binary objects to be displayed as individual change-of-state graphic objects on the display screen such that they overlay the system graphic. Each binary object displayed in this manner shall be assigned up to three graphic files for display when the point is ON, OFF or in alarm. For binary outputs, toggle the object's commanded status when the graphic item is selected with the system mouse. Similarly, allow the workstation operator to toggle the binary object's status by selecting with the mouse a graphic of a switch or light, for example, which then displays a different graphic (such as an "ON" switch or lighted lamp). Additionally, allow binary objects to be displayed as an animated graphic. Animated graphic objects shall be displayed as a sequence of multiple graphics to simulate motion. For example, when a pump is in the OFF condition, display a stationary graphic of the pump. When the operator selects the pump graphic with the mouse, the represented object's status is toggled and the graphic of the pump's impeller rotates in a time-based animation. The operator shall be able to click on an animated graphical object or switch

it from the OFF position to ON, or ON to OFF. Allow operator to change graphic file assignment and also create new and original graphics online. System shall be supplied with a library of standard graphics, which may be used unaltered or modified by the operator. Systems that do not allow customization or creation of new graphic objects by the operator (or with third-party software) shall not be allowed.

4. Analog objects shall be displayed with operator modifiable units. Analog input objects may also be displayed as individual graphic items on the display screen as an overlay to the system graphic. Each analog input object may be assigned to a minimum of five graphic files, each with high/low limits for automatic selection and display of these graphics. As an example, a graphic representation of a thermometer would rise and fall in response to either the room temperature or its deviation from the controlling setpoint. Analog output objects, when selected with the mouse, shall be displayed as a prompted dialog (text only) box. Selection for display type shall be individual for each object. Analog object values may be changed by selecting either the “increase” or “decrease” arrow in the analog object spinner box without using the keypad. Pressing the button on the right side of the analog object spinner box allows direct entry of an analog value and accesses various menus where the analog value may be used, such as trendlogs.
5. Analog objects may also be assigned to an area of a system graphic, where the color of the defined area changes based on the analog object’s value. For example, an area of a floor-plan graphic served by a single control zone would change color with respect to the temperature of the zone or its deviation from setpoint. All editing and area assignment shall be created or modified online using simple icon tools.
6. A customized menu label (push-button) shall be used for display selection. Menu items on a display shall allow penetration to lower level displays or additional menus. Dynamic point information and menu label push buttons may be mixed on the same display to allow sub-displays to exist for each item. Each display may be protected from viewing unless operator has appropriate security level. A security level may be assigned to each display and system object. The menu label shall not appear on the graphic if the operator does not have the appropriate security level.
7. A mouse shall be used to move the pointer arrow to the desired item for selection of new display or to allow the operator to make changes to object data.

H. Password Protection:
   1. Provide security system that prevents unauthorized use unless operator is logged on. Access shall be limited to operator’s assigned functions when user is logged on. This includes displays as outlined above.
   2. Each operator’s terminal shall provide security for 200 users minimum. Each user shall have an individual User ID, User Name and Password. Entries are alphanumeric characters only and are case sensitive (except for User ID). User ID shall be 0-8 characters, User Name shall be 0-29 characters, and Password shall be 4-8 characters long. Each system user shall be allowed individual assignment of only those control functions and menu items to which that user requires access. All passwords, user names, and access assignments shall be adjustable online at the operator’s terminal. Each user shall also have a set security level, which defines access to displays and individual objects the user may control. System shall include 10 separate and distinct security levels for assignment to users.

I. Operator Activity Log:
   1. Operator Activity Log shall be included with system that tracks all operator changes and activities. System shall track what is changed in the system, who performed this change, date and time of system activity and value of the change before and after operator activity. Operator shall be able to display all activity, sort the changes by user and also by operation.
   2. Log shall be gathered and archived to hard drive on operator workstation as needed. Operator shall be able to export data for display and sorting in a spreadsheet.

3. Any displayed data, that is changeable by the operator, may be selected using the right mouse button and the operator activity log shall then be selectable on the screen. Selection of the operator activity log using this method shall show all operator changes of just that displayed data.

J. Scheduling:
   1. Operator's workstation shall show all information in easy-to-read daily format including calendar of this month and next. All schedules shall show actual ON/OFF times for day based on scheduling priority. Priority for scheduling shall be events, holidays and daily with events being the highest.
   2. Scheduling tool shall allow scheduling of events up to 2 calendar years in advance.
   3. Holiday and special event schedules shall display data in calendar format. Operator shall be able to schedule holidays and special events directly from these calendars.
   4. Operator shall be able to change all information for a given weekly or exception schedule if logged on with the appropriate security access.
   5. System shall include a Schedule Wizard for set up of schedules. Wizard shall walk user through all steps necessary for schedule generation. Wizard shall have its own pull-down selection for startup or may be started by right clicking on value displayed on graphic and then selecting Schedule.

K. Alarm Indication and Handling:
   1. Operator's workstation shall provide audible, visual, and printed means of alarm indication. The alarm dialog box shall always become the top dialog box regardless of the application(s), currently running. Printout of alarms shall be sent to the assigned terminal and port.
   2. System shall provide log of alarm messages. Alarm log shall be archived to the hard disk of the system operator's terminal. Each entry shall include a description of the event-initiating object generating the alarm. Description shall be an alarm message of at least 256 characters in length. Entry shall include time and date of alarm occurrence, time and date of object state return to normal, time and date of alarm acknowledgment and identification of operator acknowledging alarm.
   3. Alarm messages shall be in user-definable text (English or other specified language) and shall be entered either at the operator's terminal or via remote communication.
   4. System shall include an Alarm Wizard for set up of alarms. Wizard shall walk user through all steps necessary for alarm generation. Wizard shall have its own pull-down selection for startup or may be started by right clicking on value displayed on graphic and then selecting alarm setup.

L. Trendlog Information:
   1. System server shall periodically gather historically recorded data stored in the building controllers and field controllers and archive the information Archived files shall be appended with new sample data, allowing samples to be accumulated. Systems that write over archived data shall not be allowed, unless limited file size is specified. Samples may be viewed at the operator's workstation. Operator shall be able to scroll through all trended data. All trendlog information shall be displayed in standard engineering units.
   2. Software shall be included that is capable of graphing the trend logged object data. Software shall be capable of creating two-axis (x, y) graphs that display up to ten object types at the same time in different colors. Graphs shall show object values relative to time.
   3. Operator shall be able to change trend log setup information. This includes the information to be logged as well as the interval at which it is to be logged. All input, output, and value object types in the system may be logged. All operations shall be password protected. Setup and viewing may be accessed directly from any and all graphics on which object is displayed.

4. System shall include a trend Wizard for setup of logs. Wizard shall walk user through all necessary steps. Wizard shall have its own pull-down selection for startup, or may be started by right clicking on value displayed on graphic, and then selecting Trendlogs from the displayed menu.

M. Energy Log Information:
   1. System server shall be capable of periodically gathering energy log data stored in the field equipment and archive the information. Archive files shall be appended with new data, allowing data to be accumulated. Systems that write over archived data shall not be allowed unless limited file size is specified. Display all energy log information in standard engineering units.
   2. All data shall be stored in data base file format for direct use by third-party programs. Operation of system shall stay completely online during all graphing operations.
   3. Operator shall be able to change the energy log setup information as well. This includes the meters to be logged, meter pulse value, and the type of energy units to be logged. All meters monitored by the system may be logged. System shall support using flow and temperature sensors for BTU monitoring.
   4. System shall display archived data in tabular format form for both consumption and peak values. Data shall be shown in hourly, daily, weekly, monthly and yearly formats. In each format the user shall be able to select a specific period of data to view.

N. Configuration/Setup:
   1. Provide means for operator to display and change system configuration. This shall include, but not be limited to, system time, day of the week, date of daylight savings set forward/set back, printer termination, port addresses, modem port and speed, etc. Items shall be modified using understandable terminology with simple mouse/cursor key movements.

O. Field Engineering Tools:
   1. Operator's workstation software shall include field-engineering tools for programming all controllers supplied. All controllers shall be programmed using graphical tools that allow the user to connect function blocks on screen that provide sequencing of all control logic. Function blocks shall be represented by graphical displays that are easily identified and distinct from other types of blocks. Graphical programming that uses simple rectangles and squares is not acceptable.
   2. User shall be able to pick graphical function block from menu and place on screen. Provide zoom in and zoom out capabilities. Function blocks shall be downloaded to controller without any reentry of data.
   3. Programming tools shall include a real time operation mode. Function blocks shall display real time data and be animated to show status of data inputs and outputs when in real time operation. Animation shall show change of status on logic devices and countdown of timer devices in graphical format.
   4. Field engineering tools shall also include a database manager of applications that include logic files for controllers and associated graphics. Operator shall be able to select unit type, input/output configuration and other items that define unit to be controlled. Supply minimum of 250 applications as part of workstation software.
   5. Field engineering tool shall include Device Manager for automatic detection of devices connected anywhere on the BACnet network by scanning of the entire network. This function shall display device instance, network identification, model number and description of connected devices. It shall record and display software file loaded into each controller. A copy of each file shall be stored on the computer's hard drive. If needed, this file shall be downloaded to the appropriate controller by selection using the mouse.

P. Software:
1. At the conclusion of project, contractor shall leave with owner a CD ROM or flash drive that includes the complete software operation system and project graphics, setpoints, system parameters, etc. This backup shall allow the owner to completely restore the system in the case of a computer malfunction.

2.4 BUILDING CONTROLLER

A. 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 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).

B. Schedules:
1. Each building controller shall support a minimum of 250 BACnet Schedule Objects and 250 BACnet Calendar Objects.

C. 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 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.
      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.
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 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.

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.)

2.8 DAMPERS AND VALVES

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.

2.9 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.

2.10 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. Intelligent Room Sensor with LCD Readout:
1. Sensor shall contain a backlit LCD digital display and user function keys along with temperature sensor. Controller shall function as room control unit, and shall allow occupant to raise and lower setpoint, and activate terminal unit for override use—all within limits as programmed by building operator. Sensor shall also allow service technician access to hidden functions as described in sequence of operation.
2. The Intelligent Room Sensor shall simultaneously display room setpoint, room temperature, outside temperature, and fan status (if applicable) at each controller. This unit shall be programmable, allowing site developers the flexibility to configure the display

to match their application. The site developer should be able to program the unit to display time-of-day, room humidity and outdoor humidity. Unit must have the capability to show temperatures in Fahrenheit or Centigrade.

3. Override time may be set and viewed in half-hour increments. Override time count down shall be automatic, but may be reset to zero by occupant from the sensor. Time remaining shall be displayed. Display shall show the word “OFF” in unoccupied mode unless a function button is pressed.
4. See sequence of operation for specific operation of LCD displays and function keys in field service mode and in normal occupant mode. Provide intelligent room sensors as specified in point list.
5. Field service mode shall be customizable to fit different applications. If intelligent room sensor is connected to VAV controller, VAV box shall be balanced and all airflow parameters shall be viewed and set from the intelligent room sensor with no computer or other field service tool needed.

C. 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 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.

D. 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 for this project.

E. 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. Proved 1 Network Connection Tool for this project.

F. 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.

G. 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.

H. Mixed Air Low Limit Controllers (Freezestats):
   1. Mixed air low limit controllers shall be manual reset, adjustable setpoint with 20-foot element serpentined across the entering air face of center cooling coil. Control shall be responsive only to the lowest temperature along the element.

I. 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.

J. 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.

K. 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 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.

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 ±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. 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.

Q. Pushbutton Switches:
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.

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 back-up database for all stand-alone application controllers on disk.

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 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.
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 persons.
3. Provide on-site training above as required, up to 8 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 and 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.

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.
CO_2	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, 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.

G. MONITORING
1. Electric Meter Monitoring:
    a. The EMCS shall monitor the electrical energy consumption at the buildings main electric feed. Pulse generator shall be furnished by the utility company and paid for by the owner. The temperature control contractor shall be responsible for coordinating requirements with existing conditions. The EMCS shall monitor pulse counts and broadcast signal to HMI operator workstation. Pulse meters may be located on the MSB, coordinate with electrical contractor and existing conditions.
2. Cooler/Freezer Monitoring:
    a. The walk-in cooler and the walk-in freezer shall each be monitored for space temperature. The EMCS shall generate an alarm should the space temperature exceed or drop below its assigned alarm limits (adj.).
3. Kitchen Hood Exhaust Fan/ Makeup Unit
    a. The kitchen hood exhaust fan(s) and makeup air unit(s) shall be monitored for operation. The EMCS shall generate an alarm should the internal hood controls generate an alarm signaling an exhaust fan or makeup air unit is not working.

4.2 CONTROL

A. BUILDING ELECTRICAL
1. General:
    a. Provide digital monitoring of building existing MSB. The EMCS shall monitor the electrical energy consumption at the buildings main electric feed. Coordinate with existing switchgear manufacturer and/or electrical contractor.
    b. Provide dashboard with daily, weekly, monthly, and yearly usage totals
2. Control Points:

Description	Type
KVA	AI
KWH	AI
Demand	AI
Power Factor	AI
Voltage	AI

B. AMBIENT CONDITIONS
1. General:
    a. The EMCS shall monitor the ambient outside conditions at the building. Sensors shall be located outside the building for northern exposure.

2. Control Points:

Description	Type
Outside Temperature	AI
Outside Humidity	AI
Outside CO2	AI

C. EXISTING EXTERIOR LIGHTING
1. General:
   a. Provide (5) auxiliary contactor(s) to control existing lighting. Include all hardware and software required and connect to nearest EMCS controller. Coordinate with existing conditions and electrical contractor.
2. Control Points:

Description	Type
Photocell	AI/DI
Lighting Contactor	DO

4.3 HEAT PUMP SPLIT SYSTEM – DX AND HEAT AND IONIZER

A. GENERAL:
1. The heat pump unit shall be provided with a filter, supply fan, cooling/heating coil, auxiliary 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. Upon a call for cooling or heating, 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 set point shall be user adjustable within ±2°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. 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).
         - Second stage cooling – High speed supply CFM and second stage of compressor(s).
         - 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.
   e. When space temperature drops below occupied heating setpoint, the DDC controller shall energize the first stage of heat. When space temperature continues to drop 2°F (adj.) below occupied heat setpoint, the DDC controller shall energize the second stage of heat.
      (1) First stage heating – Low speed supply CFM and first stage of heat.
      (2) Second stage heating – High speed supply CFM and second stage of heating.
         - 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. 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
Compressor Command (Each Stage)	DO
Reversing Valve	DO
Auxiliary Heat (Each Stage)	DO
Fan Start/Stop Command	DO

Description	Type
Outside Air Damper	AO

4.4 NATUREAL GAS 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. Upon a call for heating or cooling, 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 set point shall be user adjustable within ±2°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. 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).

- 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.

e. When space temperature drops below occupied heating setpoint, the DDC controller shall energize the first stage of heat. When space temperature continues to drop 2°F (adj.) below occupied heat setpoint, the DDC controller shall energize the second stage of heat.
   (1) First stage heating – Low speed supply CFM and first stage of heat.
   (2) Second stage heating – High speed supply CFM and second stage of heating.
      - 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. 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

4.5 OUTSIDE AIR SUPPLY FAN

A. GENERAL:
1. The control system contractor shall provide a dedicated stand-alone DDC controller for each supply fan unit.

B. UNIT ENABLING/DISABLING:
1. The occupied/unoccupied mode of operation shall be defined by the EMCS time schedule. **Unit shall not operate during optimum start/stop times or when associated units are in warm-up or cool-down mode.**

C. FAN CONTROL:
1. The outside air fan shall operate on occupancy schedule. After an initial time of 1 minute after occupied schedule, the supply fan shall run.

2. 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.

D. SAFETIES:
1. Static Pressure Switch
a. A high static pressure switch shall be provided to disable the fan when pressure switch is activated.

E. CONTROL POINTS:

Description	Type
Fan Amps/Status	AI
Static Pressure Sensor	AI
Static Alarm	DI
Fan Start/Stop Command	DO
Fan Speed	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 is allowed in concealed locations, such as behind walls. Above ceiling is not considered a concealed location.

2.2 FITTINGS

A. Wrought copper fittings

B. Use silver solder at connections

2.3 VALVES

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

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.

E. All suction lines 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 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 653 - Sheet Metal, Zinc Coated (Galvanized) or Zinc-Iron Alloy Coated (Galvanized) by the Hot-Dipped Process

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

E. ASTM A463 - 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 92A - Smoke-Control Systems

H. SMACNA - Sheet Metal and Air Conditioning Contractors Association

I. SMACNA HVAC Duct Construction Standards, Latest Edition, for Metal and Flexible Ducts

J. U.L. - 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.

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. The drawings shall be coordinated with structural and electrical. 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 in accordance with SMACNA standards.

D. Where the standards and requirements of this specification exceed those of SMACNA, the requirements herein shall govern.

E. Except where specified otherwise, all sheet metal used shall be constructed from prime galvanized steel sheets or coils up to 60 inches in width. Each sheet shall be stenciled with manufacturer's name and gauge. Coils of sheet steel shall be stenciled throughout on 10 foot centers with manufacturer's name and gauge tolerances in inches.

F. Spiral pipe:
   1. All pipe and fittings must be from a single manufacturer.

G. Flexible:
1. The composite assembly including insulation, vapor barrier, and glass scrim shall meet the Class 1 requirements of the latest NFPA Bulletin #90A and be labeled for a spread rating of 25 or less and a smoke development rating of 50 or under.

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

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 SMACNA Duct Construction Standards Tables 1-3 to 1-9 and Appendix- page 2.

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 A 653.

F. Identification:
1. Sheet steel:
a. Stencil each sheet with manufacturer's name and gauge.

G. Coil steel:
1. Stencil coils on 10 foot centers with manufacturer's name and gauge.

H. Construction:
1. Manufacture in accordance with SMACNA Round Duct Standards, Tables 3-2A, 3-2B, and 3-3, Figures 3-1, 3-2, 3-3, 3-4, and 3-5.
2. Pre-manufactured round duct may be used if approved by the Architect/Engineer.

2.2 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.

2.3 FLEXIBLE DUCTS

A. Material: In accordance with SMACNA Metal and Flexible Duct Standards, Latest Edition.

B. Construction:
   1. Factory insulate with high density fiberglass to a minimum R value of 5.79.
   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 U.L. 181, NFPA 90A

C. Manufacturer/Model:
   1. ATCO 30 Series

2.4 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 SMACNA Duct Standards (Metal & Flexible), Figures 2-12 & 2-13.

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.

2.5 TURNING VANES

A. Provide in all rectangular supply elbows. Turning vanes in return air ductwork is not necessary.

B. Conform to SMACNA Duct Standards, Figures 2-3 and 2-4.

2.6 DUCT SEALANT

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

2.7 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. 212ºF fusible link fire damper.
   2. Fire protection rating: 1.5 hours
   3. Conform to UL Standard 555 and be UL labeled
   4. Tested in accordance with AMCA 500.

C. Application:
   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. Interface with fire alarm
   4. Radiation blanket
   5. Blades 16 gauge galvanized, maximum 6-inch width.
   6. 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

2.8 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 A 653/A 653M, G90 Galvanized sheet steel, 0.034 inch thick.

C. Inner Casing and Baffles:
   1. ASTM A 653/ A 653M, 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.

2.9 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.

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 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 form 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 insure 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) 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.

2.10 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.

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 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 in accordance with Table 1-2 Class B.

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.

H. Before installing grilles, operate air conditioning unit fans and remove all debris or foreign matter.

I. Rectangular ductwork:
   1. Construct in accordance with SMACNA, Duct Construction Standards for the specific duct pressure classification involved (see pressure classification). 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 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. Reinforcement:
   1. Reinforce all ducts to prevent buckling, breathing, vibration, or unnecessary noise.
   2. Reinforcing shall be in accordance with SMACNA Duct Construction Standards (Metal and Flexible), Tables 1-3, 1-4, 1-5, 1-6, 1-7, 1-8, and 1-9 plus any additional reinforcing to meet job conditions.
   3. All ducts shall be supported in accordance with SMACNA Duct Construction Standards (Metal and Flexible), Tables 4-1, 4-2, 4-3.

M. 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.

N. 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.

O. 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.

P. 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.

Q. 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.

R. Duct Leakage:
1. Seal ductwork in accordance with Table 1-2 of the 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.

S. Fire and Smoke Dampers:
1. Install fire and smoke dampers at locations shown on plans, and where required by local and state ordinances.
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 suing 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 U. L. 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 Standard 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 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. Section 23 00 00 - Basic Mechanical Requirements

B. Section 23 05 93 - Testing, Adjusting, and Balancing for HVAC

C. Section 23 09 23 - Energy Management Control System

D. 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

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” for equipment above hard ceilings.
   3. Conform to architectural panel pattern for acoustical ceilings.
   4. Confirm size with Building Inspector and Engineer.

D. Construction:
   1. Hinges: Concealed continuous type.
   2. Locking Device: Flush cam type, screw driver 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 34 16

HVAC FANS

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. Centrifugal fans

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 REFERENCES

A. AMCA - Air Moving and Conditioning Association, Inc.

B. UL - Underwriter's Laboratory

1.5 QUALITY ASSURANCE

A. UL Listed and Bear Label

B. Tested in accordance with AMCA standards

1.6 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 fans, information, accessories, etc.

D. Indicate mechanical and electrical service locations and requirements.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Acme

B. Cook

C. Greenheck

D. CaptiveAire

E. PennBarry

F. Twin City Fans

2.2 GENERAL

A. Provide fan type, arrangement, capacity, size, motor horsepower, and motor voltage as shown on the drawings.

B. Rate fans according to appropriate Air Moving and Conditioning Association, Inc. (AMCA) approved test codes and procedures. Seal to be attached.

C. Supply fans with sound ratings below the maximums permitted by AMCA standards.

D. All fans provided must bear the UL Label.

E. Sound levels shall be as listed or quieter. Fans with excessive noise will be replaced at Contractor's expense.

F. Fans are to be supplied with engraved aluminum nameplates indicating CFM, static pressure, manufacturer, serial number, and model number.

2.3 ROOF MOUNTED EXHAUST FANS

A. Type:
   1. Roof mounted, direct driven centrifugal exhaust ventilator. Fan shall be spun aluminum and mounted on vibration isolators.

B. Motors:
   1. NEMA design B with a minimum of Class B insulation rated for continuous duty and furnished at the scheduled voltage.
   2. Motor shall be electronically commutated motor rated for continuous duty and furnished either with internally mounted potentiometer speed controller, or with leads for connection to 0-10 VDC external controller.
   3. Exhaust fan motor to be located outside of the exhaust airstream and enclosed in a weather-tight compartment.

C. Mounting:
   1. Resilient mounts outside the air stream.

D. Cooling:
   1. Forced air cooling.

E. Bearing Rating:
   1. Heavy duty regreasable ball type in a cast iron pillowblock housing selected for a minimum L50 life in excess of 200,000 hours at maximum catalogued operating speed.

F. Construction:
   1. Fan shall be bolted and welded construction utilizing corrosion resistant fasteners.
   2. Spun aluminum structural components shall be constructed of minimum 18 gauge marine alloy aluminum, and bolted to a rigid aluminum support structure.
   3. Aluminum base shall have continuously welded curb cap corners for maximum leak protection.
   4. Fan wheel shall be backward inclined, constructed of 100% aluminum, and provided with an aerodynamic aluminum inlet cone.
   5. Integral conduit chase shall be provided through the curb cap and into the motor compartment to facilitate wiring connections.
   6. Provide 1/2 inch galvanized mesh bird screen over openings

G. Features:
   1. Disconnect switch: Factory wire the switch and motor to the junction box
   2. Automatic dampers with curb flanges
   3. Insulated, prefabricated curb with cant strips and with resilient gasket on top flange.
   4. Minimum 18 gauge galvanized steel or aluminum.
   5. Factory installed variable speed controller.
   6. Minimum 18 inch curb height.
   7. Lifting lugs.

H. Verify roof slope so that fans are installed in a level condition.

I. Coordinate and furnish curbs that are compatible with roof being installed.

2.4 INLINE MOUNTED EXHAUST FANS

A. Type:
   1. Centrifugal, direct driven exhaust fans

B. Motors:
   1. Motor shall be totally enclosed type with permanently lubricated bearings and built-in thermal overload protection.

C. Construction:
   1. Fan housing shall be minimum 20 gauge galvanized steel and acoustically insulated.
   2. Blower and motor assembly shall be mounted to a minimum 14 gauge reinforcing channel.

D. Features:
   1. Disconnect switch: Internal wiring box with switch.
   2. Blower assembly to be easily removed without disconnecting the ductwork.
   3. Factory tested prior to shipment.
   4. EC Motor.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install fans according to the manufacturer's instructions and in the locations shown on the drawings.

B. All roof mounted fans shall have electrical wiring and conduit internal to roof curb and fan housing. No external wiring or conduit will be allowed on roof.

C. Verify compliance of “in Situ” vibration readings with AMCA Standard 204-05.

D. All fans shall be air balanced in accordance with Section 23 05 93.

E. Top of level curb to have minimum 11” from finished roof to top of curb.

F. Screw fans to curbs with gasketed screws.

3.2 START-UP

A. Start fans to verify rotation and operation sequence prior to test and balance.

3.3 IDENTIFICATION

A. Provide identification per Section 23 05 53.

END OF SECTION

SECTION 23 37 13

DIFFUSERS, REGISTERS, AND GRILLES

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. Grilles

B. Diffusers

C. Registers

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 34 16 - HVAC Fans

1.4 REFERENCES

A. ARI Standard 890-94 Rating of Air Diffusers and Air Assembles.

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 01.

B. Product data for review prior to placement of purchase order:
1. Outlets
2. Grilles
3. Registers
4. Control devices
5. Diffusers
6. Similar equipment

C. Product data shall be submitted for each device specified. Data shall be arranged to match grille schedule.

D. If a manufacturer other than the one scheduled on the plan is used, the sizes shown on the plans shall be checked for performance, noise level, face velocity, throw, pressure drop, etc., before the submittal is made.

E. Selections shall meet the manufacturer's own published data for the above performance criteria.

F. If grilles other than those scheduled by name are furnished, manufacturer shall be prepared to demonstrate compliance with noise criteria at Engineer's request and to Engineer's satisfaction.

1.6 COORDINATION

A. Coordinate this work with work under Division 26 to insure that intended functions of lighting and air systems are achieved.

B. Locations of outlets on plans are approximate and shall be coordinated with other trades to make symmetrical patterns.

C. Locations shall be governed by the established pattern of the lighting fixtures or architectural reflected ceiling plan.

D. The Contractor shall move any grille, register, or outlet up to four feet in any direction as directed by the Engineer at no additional cost.

PART 2 PRODUCTS

2.1 GENERAL

A. Provide grilles, registers and diffusers as shown or scheduled on the plans. Conform to ARI 890-94.

B. All air distribution devices in kitchen and any wet areas such as locker rooms, showers and restrooms shall be 100% aluminum construction.

C. All air distribution devices for 1-hour structures (walls or ceilings) shall be steel construction conforming to all codes and standards.

2.2 MANUFACTURERS

A. Metalaire

B. Krueger

C. Titus

D. Nailor

E. Price

F. Greenheck

2.3 PERFORMANCE CRITERIA

A. Throw: Velocity at the end of the throw, in the 5’-0” occupancy zone, will be between 25 to 50 FPM.

B. Noise levels (NC Curve):
   1. Not to exceed those scheduled below.
      a. Classrooms, Libraries, and Offices - 25 N.C.

b. Cafeterias - 30 N.C.
c. Gymnasiums - 40 N.C.

C. All devices shall be tested per Air Diffusion Council and labeled as such.

2.4 FINISHES

A. Paint exposed devices with factory standard prime coat or factory finish coat. Architect/ Engineer to determine final color of grille.

PART 3 EXECUTION

3.1 INSTALLATION

A. Where called for on the schedules, the grilles, registers and ceiling outlets shall be provided with deflecting devices and manual dampers. These shall be the standard product of the manufacturer, subject to review by the Engineer.

B. All ceiling devices shall be furnished to be compatible with the ceilings in which they are installed.

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. Ionization units shall be supplied to provide between 500 and 1500 negative ions per cubic centimeter in the areas served.

B. Where the air purification system is intended to reduce outside ventilation air in accordance with the International Mechanical Code and ASHRAE 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. A qualified representative from the manufacturer shall be available to inspect the installation of the air purification system to ensure installation in accordance with manufacturer's recommendation.

C. 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.

D. The operation of bi-polar ionization units shall conform to UL 867 with respect to ozone generation.

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

1.6 RELATED WORK PERTAINING TO OTHER SPECIFICATIONS

A. Electrical wiring

B. Ductwork

1.7 REFERENCE CODES AND STANDARDS

A. UL Standard 2998 and Standard 2043

B. National Electric Code NFPA 70

C. ASHRAE Standard 62.1

PART 2 PRODUCTS

2.1 APPROVED MANUFACTURERS

A. Plasma Air International

B. Bioclimatic

C. Phenomenal Air

D. Air Oasis

E. Other qualified manufacturer's meeting the requirements of this specification may be 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 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. Exposed needles protruding into the air steam will not be accepted.

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 12V. 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 insure 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.

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. Light emitting diode shall be visible from the ground for each unit and shall be on any time power is on to the unit and ions are being generated. Light signaling unit power only shall not be acceptable.

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 COMMISSIONING AND TRAINING

A. A manufacturer's authorized representative shall provide start-up supervision and training of owner's personnel in the proper operation and maintenance of all equipment.

B. Provide 5 copies of Operating and Maintenance Manuals.

C. OPTIONAL ADD FOR HANDHELD ION COUNTER: Provide to the owner a portable hand held ion counter with a calibrated range of 0 to 20,000 ions/cm3 and an accuracy of +/- 25% within the specified range. Ion counter shall have automatic zeroing capability on 10 minute intervals.

3.4 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 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.

AGA	American Gas Association
AHRI 210/240	Unitary Air-Conditioning and Air Source Heat Pump Equipment
AHRI 270	Sound Rating of Outdoor Unitary Equipment
ANSI/ASHRAE 15	Safety Code of Mechanical Refrigeration
ASHRAE90.01-2001	Energy Standard for Buildings Except Low Rise Residential Buildings
ASHRAE 62-2001	Ventilation for Acceptable Indoor Air Quality
D.O.E.	Department of Energy
IECC	International Energy Conservation Code
NFPA 70 N.E.C.	National Electrical Code
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

3. Sound rating in accordance with AHRI 270
4. Cooling efficiency in accordance with AHRI Standard 210
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, and 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 air flow, 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 Standard 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 catalogues 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.

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. Additional 4 year warranty provided for the compressors and heat exchangers.

C. Additional 9-year warranty provided for galvanized heat exchangers.

D. Additional 14-year warranty provided for stainless steel heat exchangers.

E. 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.

F. 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: HEAT PUMP

A. 1½ to 2 ½ tons - 13.0 SEER:
   1. Lennox
   2. Trane

B. 3 to 5 tons - 17.0 SEER:
   1. Lennox
   2. Trane
   3. Units to have two stage compressor and a minimum two speed fan.

C. 6 tons and up - High Efficiency EER:
   1. Lennox
   2. Trane
   3. All units 7½ ton and larger are to have two compressors with dual refrigeration circuits.
   4. Greater than 65,000 BTU/hr and less than 135,000 BTU/hr - Minimum 11.0 EER
   5. Greater than 135,000 BTU/hr - Minimum 10.6 EER

2.2 MANUFACTURERS: GAS FURNACE

A. 1½ to 2 ½ tons - 13.0 SEER:
   1. Lennox
   2. Trane

B. 3 to 5 tons - 17.0 SEER:
   1. Lennox
   2. Trane
   3. Units to have two stage compressor and a minimum two speed fan.

C. 6 tons and up - High Efficiency EER:
1. Lennox
2. Trane
3. All units 7½ ton and larger are to have two compressors with dual refrigeration circuits.
4. Greater than 65,000 BTU/hr and less than 135,000 BTU/hr - Minimum 11.0 EER
5. Greater than 135,000 BTU/hr - Minimum 10.6 EER

2.3 MANUFACTURERS: ELECTRIC FURNACE

A. 1½ to 2 ½ tons - 13.0 SEER:
1. Lennox
2. Trane

B. 3 to 5 tons - 17.0 SEER:
1. Lennox
2. Trane
3. Units to have two stage compressor and a minimum two speed fan.

C. 6 tons and up - High Efficiency EER:
1. Lennox
2. Trane
3. All units 7½ ton and larger are to have two compressors with dual refrigeration circuits.
4. Greater than 65,000 BTU/hr and less than 135,000 BTU/hr - Minimum 11.0 EER
5. Greater than 135,000 BTU/hr - Minimum 10.6 EER

2.4 SPLIT SYSTEM HEATING/ COOLING UNITS

A. Minimum Cooling Efficiencies:
1. EER ratings by AHRI Standard 210/ 240 and AHRI Standard 340/360:
a. All units to comply with ASHRAE 90.1.
b. All units to comply with International Energy Conservation Code 2015.

B. Natural Gas Furnaces:
1. Heating capacities:
a. Equal to or greater than those scheduled on plans.
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. Aluminized steel
b. Bear AGA label.

C. Electric Furnaces/Air Handlers:
1. Heating capacities:
a. As scheduled on plans at rated voltage.
2. Three-phase electrical power:
a. Impose an equal electrical load on all phases of heater.
b. Electrical resistance elements which are not balanced over all three phases are not acceptable.

D. Heat Pump 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 on the roof
h. Factory installed defrost control to operate on demand
i. Provide any reference specialties that manufacturer requires
j. Refrigerant R-410A

E. 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

F. 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 ≥ 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.

G. Accessories:
1. 2-Stage Compressor Unit:
a. All split system units with two stage compressors are to have a minimum of 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. Set differential temperature between first stage cooling and second stage cooling at 2°F (adj.).

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 thermostat wire from air handler to condensing units.

C. Contractor to provide and install flexible watertight conduit for wiring.

D. Coordinate with plumbing contractor on all condensate piping.

E. Install roll type filter media over all 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

ELECTRICAL

DIVISION 26

26 00 00	Electrical
26 00 30	Warranty Period
26 00 90	Electrical Submittal Procedures
26 05 11	Electrical Demolition
26 05 19	Low-Voltage Electrical Power Conductors and Cables
26 05 26	Grounding and Bonding for Electrical Systems
26 05 33.11	Raceways and Conduits for Electrical Systems
26 05 33.13	Boxes and Fittings for Electrical Systems
26 05 53	Identification for Electrical Systems
26 08 11	Testing of Electrical System
26 24 16	Panelboards for Distribution Switchgear
26 27 26	Wiring Devices
26 43 00	Surge Protective Devices (SPD)
26 28 13	Fuses
26 28 16	Enclosed Safety Switches and Circuit Breakers

SECTION 26 00 00

ELECTRICAL

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. Bidding requirements, contract forms, conditions of the contract, Division 1 - General Requirements apply to work of this division.

1.2 SECTION INCLUDES

A. Furnishing of all materials, equipment, tools, scaffolding, labor and transportation required for the complete installation of the electrical systems as shown on the drawings 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.

C. It is the intent of these specifications to provide complete installations even though each and every item necessary is not specifically mentioned or shown. In general, the work specified in this section shall consist of, but is not limited to, the following:
   1. Electrical demolition.
   2. Systems of raceways, conductors, cables, boxes, receptacles, wiring devices, and cover plates.
   3. Relays, wiring, devices, contactors, conduit and other required equipment for all systems and details shown on the electrical drawings.
   4. Electrical identification.
   5. Surge Protective Devices (SPDs)
   6. Utility services, utility requirements, including conduit and coordination.
   7. Switchgear including switchboards and panelboards.
   8. Secondary electrical service and distribution system including wiring.
   9. Luminaires, LED modules and drivers.
   10. Coordination (including voltage, phase, ampacity, etc.) and final connection to all line voltage systems or equipment provided under other divisions or by owner.
   11. Testing of wire and cable installation.
   12. Submittals and shop drawings.

1.3 RELATED WORK SPECIFIED ELSEWHERE

A. Control wiring of HVAC and related equipment as specified in other sections.

B. Motor starters required on HVAC and related equipment as specified in other divisions and sections.

1.4 REFERENCES

A. On projects where the engineer is the prime consultant and no architect is involved, any references to the architect or to architectural drawings in the Division 26 specifications shall be interpreted as referring to the engineer or to the engineering drawings.

1.5 CODES, STANDARDS AND THEIR ABBREVIATIONS

A. Perform all Division 26 work in strict accordance with the requirements and recommendations stated in the codes and standards except when requirements are modified by the contract documents.

B. In addition to the requirements outlined in other sections of the specifications the following standards are imposed as applicable to the work in each instance:
   1. NECA standards for installation.
   2. NFPA No. 70, National Electric Code.
   3. Local Codes and Ordinances.
   4. COG Standard Specifications for Public Works Construction.
   5. Title 25, Health Services, Part 2, Texas Department of Health, Chapter 145, Long Term Care Subchapter Q.
   6. OSHA Standard 2207 - Construction Industry Standard
   7. OSHA 29 CFR 1926 - Regulation of Excavation
   8. Texas Underground Facility Damage Prevention Act (H.B. 2295)

C. Where local codes or practices exceed or conflict with the NEC, it shall be the Contractor's responsibility to perform the work in accordance with the local code prevailing and local interpretations thereof. Any such additional work shall be performed at no additional cost to the Owner.

D. Materials and components shall be UL listed and approved for the purpose intended.

E. The Contractor shall obtain all permits required to commence work and, upon completion of the Work, obtain and deliver to the Owner's Representative a Certificate of Inspection and Approval from the State Board of Fire Underwriters, the City of Rains, Texas and other authority having jurisdiction. The Contractor shall pay required permit fees.

1.6 LIST OF ASSOCIATIONS AND STANDARDS

A. The following abbreviations are applicable for this entire division.
   1. ANSI - American National Standards Institute, 1430 Broadway; New York, NY 10018.
   2. ASTM - American Society for Testing and Materials, 1916 Race Street; Philadelphia, PA 19103.
   3. IEEE - Institute of Electrical and Electronics Engineers, 345 East 47th Street; New York, NY 10017.
   4. ICEA - Insulated Cable Engineers Association, P.O. Box P; South Yarmouth, MA 02664.
   5. NEC - National Electrical Code; NFPA No. 70.
   6. NECA - National Electrical Contractors Association, Inc., 7315 Wisconsin Ave.; Washington, DC 20014.
   7. NEMA - National Electrical Manufacturers Association, 155 East 44th Street; New York, NY 10017.
   8. NESC - National Electrical Safety Code, ANSI 2.
   9. NFPA - National Fire Protection Association, 60 Batterymarch Street; Boston, MA 02110.
   10. OSHA - Occupational Safety and Health Administration, US Department of Labor; Washington, DC 20402.
   11. UL - Underwriters Laboratories, Inc., 333 Pfigsten Road; Northbrook, IL 60062.

B. Nothing in the Contract Documents shall be construed to permit work not conforming to these codes. When two or more codes or standards are applicable to the same work, then the stricter code or standard shall govern.

C. The date of the code or standard is that in effect on the date of issue of the contract documents except when a particular publication date is specified.

D. This Contractor shall comply with all State, Federal, NFPA, local codes and ordinances that may alter any part of the plans or specifications. This Contractor shall bear all costs for correcting any deficiencies due to non-compliance.

E. 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 resulting cost.

1.7 DEFINITIONS

A. Approval: It is understood that approval must be obtained from the Architect in writing before proceeding with the proposed work. Approval by the Architect of any changes, submitted by the Contractor, will be considered as general only to aid the Contractor in expediting his work.

B. Directed: Terms such as directed, requested, authorized, selected, approved, required, and permitted mean directed by the Architect, requested by the Architect, and similar phrases.

C. Furnish: The term furnish means to equip with what is needed, supply and deliver to the Project site, ready for unloading, unpacking, assembly, installation, and similar operations.

D. Install: The term install describes operations at the Project site including setting in position, connecting on adjusting for use, the actual unloading, unpacking, assembly, erection, placing, anchoring, applying, working to dimension, finishing, curing, protecting, cleaning, and similar operations.

E. Provide: Defined as requiring the furnishing, supplying, to make available, and installation of the item or facility indicated, complete in all respects and ready for operation unless otherwise specifically noted.

F. Indicated: The term indicated refers to graphic representations, notes, or schedules on the Drawings, or other Paragraphs or Schedules in the Specifications, and similar requirements in the Contract Documents. Terms such as shown, noted, scheduled, and specified are used to help the reader locate the reference. There is no limitation on location.

1.8 ABBREVIATIONS FOR ELECTRICAL DRAWINGS

A	Amperes
ALT	Alternate
AFF	Above finish floor
AFG	Above finished grade
AWG	American wire gauge
ATS	Automatic transfer switch
CLG	Ceiling
CKT	Circuit
CCTV	Closed circuit television
DFA	Down from above
DISC	Disconnect
EWC	Electric water cooler
EXIST	Existing
FAP	Fire alarm plan

FACP	Fire alarm control panel
FAGA	Fire alarm graphic annunciator
FARA	Fire alarm remote annunciator
FPC	Fire protection contractor
GRN	Ground
GFCI	Ground-fault circuit interrupters
GFP	Ground-fault protection
HP	Horsepower
HPS	High pressure sodium
KW	Kilowatts
KES	Kitchen equipment supplier
MTS	Manual transfer switch
MH	Metal Halide
MCC	Motor control center
NC	Normally closed
NO	Normally open
NTS	Not to scale
NIC	Not in contract
PNL	Panel
SFD	Smoke/Fire Damper
SU	Stub up above finish floor
SWBD	Switchboard
TV	Television
TX	Transformer
TYP	Typical

1.9 NEMA CLASSIFICATIONS

A. For complete definitions and listing see NEMA Standards.

Type 1	General Purpose, Indoor.
Type 2	Drip-proof, Non corrosive, Indoor.
Type 3R	Rain proof, Outdoor.
Type 4	Watertight and dust tight, Non corrosive. Indoor and outdoor.
Type 4X	Watertight and dust tight, Corrosion resistant. Indoor and outdoor.
Type 12	Dust tight, Drip-tight, Non corrosive, Indoor. See NEC 2008 110.22 FPN.

1.10 PROJECT/SITE CONDITIONS

A. Before submitting a 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, including all required utilities.

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.

1.11 SUBMITTALS

A. Refer to Section 26 00 90, Electrical Submittal Procedures.

1.12 QUALITY ASSURANCE

A. Provide complete installations of and verify that all systems, comply with NFPA 70, latest edition. The more stringent of the N.E.C. or specifications shall apply to this project.

B. 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.

C. Submit a bid on the basis of a complete installation including all labor, material, delivery, insurance, permits, inspection fees and tests required even though each and every item necessary is not specifically mentioned or shown.

D. In case of any conflict between the specifications, plans and ordinances, the ordinances shall govern. In case of any conflict between the specifications and plans, the Engineer shall make the final decision. Refer to Division 1 - General Requirements.

1.13 CONTRACTOR'S RESPONSIBILITY

A. Erect barricades, protective fencing, and signs as required to prevent injury to personnel on site.

B. Coordinate all utility services and/or revisions with utility companies for base bid.

C. Make permanent connection to new utilities or existing lines. Determine depth and location, and bid accordingly. Relocate and repair any existing lines cut by general construction work.

D. Plans do not show exact location and elevations of lines. Deviate from plans as required to conform to the general construction, provide proper grading and installation.

E. Maintain all utility services during construction to existing portions of job that remain.

F. Procure and pay for all necessary permits or licenses to carry out the work. Pay all costs in connection with metering.

G. Obtain and pay for all the necessary certificates of approval which must be delivered to the Architect before final acceptance of the work.

H. Periodically remove rubbish, clean or repair all surfaces marred by the work required under this contract.

I. Where job conditions require changes in indicated locations and arrangement, make such changes without extra cost to Owner.

J. Exposed piping and/or other materials will not be permitted in the finished job except where noted on the drawings.

K. Provide required hook-up to line voltage at all electromagnetic door holder/release, fire/smoke dampers, and smoke dampers. Provide required relays and wiring to fire alarm panels and coordinate with other specified work.

L. Accomplish all demolition and remodeling work involving this trade in a manner and completeness to provide the appearance of new construction work.

M. Replace any usable equipment and/or structure damaged during demolition and remodel work.

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 ten working days prior to the schedule date for opening of bids.

C. The Engineer will consider all such submittals and the Architect 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. Items noted as "No Substitutes" shall be as specified only.

G. Samples shall be provided by the manufacturer of the proposed substitute unit for evaluation when required at no charge and non-returnable.

H. Requests for substitution are understood to mean that the Contractor:
   1. Has personally investigated the proposed substitution and determined that it is equivalent 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.

I. After Award of the Contract, substitutions will be considered only under one or more of the following circumstances.
   1. The substitution is required for compliance with subsequent interpretations of code or insurance requirements.
   2. The specified product is unavailable through no fault of the Contractor.
   3. The manufacturer refuses to warranty the specified products as required.
   4. Subsequent information that the specified product is unable to perform properly or to fit in the designated space.
   5. In the Engineer's sole judgment, the substitution would be in the Owner's best interest.

J. Revisions to the electrical system caused by substitutions 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 PROJECT RECORD DOCUMENTS

A. 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, fixtures, equipment and new or existing site utilities and lights.

B. Upon submitting his request for final payment, he shall turn over to the Architect, record document submittals as outlined in Division 1 - General Requirements of the Specifications.

C. In addition to the above, the Contractor shall accumulate during the job's progress the following data, in duplication. Two (2) each prepared in a three inch (3"), 3-ring binder, neat in appearance of sufficient size and turned over to the Architect for checking and subsequent delivery to the Owner:
   1. All warranties, guarantees and manufacturer's directions on equipment and material covered by the Contract.
   2. All shop drawings.
   3. Set of operating instructions. Operating instructions shall also include recommended maintenance and seasonal changeover procedures.
   4. Any and all other data and/or plans required during construction.
   5. 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.

   3. Submit megger reading log copies in accordance with Section 26 08 11.
   4. Submit ground tests methods and results in accordance with Section 26 08 11 & 26 05 26.
   5. Submit testing of electrical system results in accordance with Section 26 08 11.
   6. Submit conductor insulation test results in accordance with Section 26 05 19.
   7. Submit SPD warranty in accordance with Section 26 43 00.

1.16 PLANS AND SPECIFICATIONS

A. The intent of the drawings is to establish the types of systems and functions, but not to set forth each item essential to the functioning of the system.

B. Electrical drawings are generally diagrammatic and show approximate location and extent of work.

C. Install the work complete including minor details necessary to perform the function indicated. Provide an electrical system (including all hook ups) complete in every respect and ready to operate.

D. If clarification is needed, consult the Engineer.

E. Review pertinent drawings and adjust the work to conditions shown. Where discrepancies occur between drawings, specifications, and actual field conditions, immediately notify the Engineer for his interpretation.

F. The Architect reserves the right to make any reasonable change in the location of any part of this work without additional cost to the Owner.

G. Contractor, subcontractor, vendors and suppliers are required to waive subrogation against Owner and Engineer.

1.17 ELECTRICAL WIRING AND EQUIPMENT FOR MECHANICAL SYSTEMS

A. Electrical Contractor to Provide
   1. Line Voltage and hook-up to all plumbing equipment (Division 22), HVAC equipment (Division 23), and building automation equipment (Division 25), including required manual safety switches with fuses/heaters of required size.
   2. All conduit into accessible attic space for thermostats and sensors.
   3. All lighting contactors, mechanically held with control relay, required coil voltage coordinated with controls contractor.
   4. Junction Boxes (Standard One or Two Gang) required for controls contractor, and coordination with controls contractor.

B. Mechanical Contractor to Provide
   1. All motor starters (with heaters as required).
   2. All thermostats.
   3. All HVAC Equipment.
   4. All relays, contactors, and switches required to start/stop Mechanical Equipment other than switches shown on and required by Division 26.

C. Controls Contractor to Provide
   1. All required relays associated with Controls in specifications.
   2. All sensors.
   3. All conduit required above ceiling.
   4. All control wiring.

D. The Electrical plans are based on the equipment and devices scheduled shown on the drawings or as called for in the specifications. Should any mechanical equipment or device associated devices be changed or accepted 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.

E. 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.

F. 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.

1.18 UTILITIES, LOCATIONS, AND EXISTING CONDITIONS

A. Location of power company electrical service poles, transformers, telephone service pedestal, cable television service, and any existing underground services, where shown, have been obtained from substantially reliable sources, are shown as a general guide only, without guarantees as to accuracy.

B. 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.

C. 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.

1.19 FINAL COMPLETION REQUIREMENTS

A. The following will be required at time of final completion.
   1. Refer to general conditions.
   2. Final clean up completed.
   3. All systems are fully operational, all material and devices installed and tested.
   4. Ground tests (megger readings) performed, two copies of method used, and results attached.
   5. Project Record Documents submitted to the Architect.
   6. Spare material delivered to the Owner and documented.
   7. Owner instructions completed.

1.20 MANUFACTURER'S INSTRUCTIONS

A. All equipment and devices shall be installed in accordance with the drawings 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. 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.

1.21 INSTALLATION

A. Cooperation with trades of adjacent, related or affected materials or operations, and or trades performing continuations of this work under subsequent contracts is considered a part of this work in order to effect timely and accurate placing of work and to bring together, in proper and correct sequence, the work of such trades, including under the general contractor Division 1, and Division 23.

B. The Electrical Contractor shall coordinate installation of the electrical system with the General Contractor, Mechanical, Plumbing, and Communications Contractors to insure a complete working system for the Owner.

C. Where required, all conduit and boxes for all systems, except mechanical controls specified otherwise, shall be provided by the Electrical Contractor. Any and all allowances shall be included.

D. All wiring shall be enclosed in conduit or raceway in all exposed areas such as gymnasium, shops, stages, or field houses.

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

F. The Contractor shall construct foundations for floor mounted equipment where indicated on the Drawings. Foundations generally shall be built up from structural floor slabs and shall be made of 3000 psi concrete four (4) inches thick unless otherwise indicated or specified. Top edges shall be beveled. All exposed surfaces shall be finished with cement mortar troweled smooth. Reinforcing shall be 6 x 6-10/10 welded wire mesh.

G. Equipment shall be secured to foundations by this Contractor with anchor bolts embedded in the concrete of ample size and proper arrangements to suit equipment furnished.

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

I. Coordinate the actual locations of electrical outlets and equipment with building features and mechanical equipment as indicated on architectural, structural and mechanical drawings. Review with the Architect any proposed changes in outlet or equipment location. Relocation of outlets before installation, of up to 3 feet from the position indicated, may be directed without additional cost. Remove and relocate outlets placed in an unsuitable location when so requested by the Architect.

1.22 TEMPORARY SERVICE AND LIGHTING

A. Electrical service to all portions of existing buildings at the construction site not involved with the project shall remain in operation throughout construction. Provide all required temporary electrical service in the base bid to all required areas so as to satisfy OSHA requirements.

B. All metering and temporary electrical service charges and/or costs of utilities shall be paid by The Contractor/Managing Construction Contractor.

1.23 ADDITIONAL MATERIALS

A. Additional materials to be a dollar cost in the base bid. At the end of the project the contractor shall generate a dollar amount credited back to the owner for any unused items. All attic stock shall be provided to the owner at substantial completion. The base bid shall include all additional materials and attic stock.

B. Additional Materials -Include the following cost on a dollar basis in the base bid:
   1. All costs to provide 5 additional electrical circuits, all required three pole circuit breakers, wiring, conduit, labor and devices as specified and directed by Architect. Each circuit to be priced with a rating of 30 amps and at a distance of 200 feet. Each circuit to include one 30A NEMA 3R fused disconnect and three 30A fuses.

PART 2 PRODUCTS

A. Not Used

PART 3 EXECUTION

3.1 INSTALLATION

A. All electrical connections shall be made per NEC 110.14. Additionally, where torque values are listed in manufacturer instructions, a calibrated torque tool shall be used to achieve indicated torque values.

END OF SECTION

SECTION 26 00 30

WARRANTY PERIOD

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Procedures during the warranty period.

1.2 RELATED SECTIONS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions, Division 1 Specifications and Division 26, Section 26 00 00, apply to this Section.
   1. Section 26 00 00 - Electrical

1.3 WARRANTY

A. 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.

B. Neither the final payment nor any provisions in Contract Documents shall relieve this Contractor, or the Contractor, of the responsibility for faulty materials or workmanship.

C. The contractor shall remedy any defects due thereto, and pay for any damage to other work resulting there from, which shall appear.

D. This Warranty shall not be construed to include the normal maintenance of the various components of the system covered by these specifications.

1.4 MAINTENANCE SERVICE

A. Provide normal maintenance services recommended by the manufacturer at no additional cost to the Owner during the warranty period.

PART 2 PRODUCTS

A. Not Used.

PART 3 EXECUTION

A. Not Used.

END OF SECTION

SECTION 26 00 90

ELECTRICAL SUBMITTAL PROCEDURES

PART 1 GENERAL

1.1 SUMMARY

A. This section contains requirements applicable to Division 26 submittals.

1.2 SECTION INCLUDES

A. This section includes, but is not limited to:
   1. Electrical submittal procedures
   2. List of required Division 26 submittals to the engineer

B. This section applies only to the Division 26 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 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.

B. Manufacturers: Manufacturers submitted shall be as per the acceptable manufacturers listed in each specification section or referenced schedule. For additional manufacturers requiring approval, reference the Substitution of Products article in section 26 00 00.

C. Required submittals: Refer to the Submittals article of each individual Division 26 specification section for the required items to be submitted.

D. Color selection: Some products require that a color selection be coordinated with the architect. Information regarding such products shall be submitted to the architect.

E. 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.

F. Electronic Submittals: Provide submittals in pdf format. Paper submittals will be rejected.

G. Coordination correspondence: The contractor may desire to verify the acceptability of a particular item prior to assembling the submittal package. The contractor may send material directly to the engineer for comments and feedback. This communication, whether by mail, fax, or e-mail, 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 submittal package along with a copy of the correspondence.

H. Unapproved products: If materials or equipment are installed before being reviewed and approved 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 unapproved 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.

1.4 PRODUCT DATA

A. 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 catalog, pamphlets, etc., of items submitted shall be clearly made in a contrasting color or highlighting. Data of a general nature shall not be acceptable.

1.5 SHOP DRAWINGS

A. Scale and measurements: Make shop drawings accurately to a scale sufficiently large to show all pertinent aspects of the item.

B. Types of prints required: Submit in pdf format.

1.6 SEQUENCING

A. Submit product information within 30 calendar days after the contractor has received the owner's notice to proceed.

B. After the engineer has reviewed the submittals, make necessary revisions as directed by the engineer and resubmit.

C. After the submittal has been reviewed and approved by the engineer, proceed to purchase materials and perform the work.

1.7 SCHEDULING

A. Failure to submit items that meet the requirements of the contract documents in ample time for review shall not entitle the contractor to an extension of contract time, and no claim for extension by reason of such default shall be allowed. The contractor may be held liable for delays so occasioned.

PART 2 PRODUCTS

A. Not applicable.

PART 3 EXECUTION

3.1 GENERAL

A. Submit 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 1, and additional requirements of each individual Division 26 specification section.

3.2 SUBMITTAL ORGANIZATION

A. Provide a submittal cover page that lists at least the following:
   1. Project name
   2. Date
   3. Name and address of architect
   4. Name and address of engineer
   5. Name, address and telephone number of electrical distributor
   6. Name, address and telephone number of prime contractor
   7. Name, address and telephone number of electrical contractor

B. Provide an index page listing all items submitted.

C. The contractor shall call to the attention of the engineer by letter, included in the submittal after the index page, any instance in which the submittals are known to differ from the requirements of the contract documents.

D. Organize all required items by specification section. All material for each specification section shall be in one single pdf file. Material for multiple specification sections may be combined into one file.

E. The material for each specification section shall be organized as follows:
   1. The first page shall indicate the specification number and title and the name, address and telephone number of the vendor or vendor's representative, if applicable.
   2. Refer to the individual Division 26 specification sections for any required organization of the submittal material within each submittal section.

F. Send pdf submittals to the engineer's office via email or other electronic means.

G. Submittals not organized as described here may be rejected, without being reviewed, as not complying with the provisions of the contract.

3.3 CLOSEOUT SUBMITTALS

A. Provide close-out submittals in accordance with the requirements of Division 1.

3.4 SCHEDULES

A. Division 26 Submittal Schedule: The Division 26 submittal shall include the following items for each Division 26 specification section that is in the contract documents. Coordinate this list with the submittal requirements listed in each specification section. If an item has been omitted from either list but is included in the other, then provide that item in the submittal. In case of conflicting or unclear requirements, contact the engineer.

Section	Submit on the following	1	2	3	4	Arch Sub #
26 05 19	**Low-Voltage Electrical Power Conductors and Cables**					
	Line voltage conductors					
26 05 26	**Grounding and Bonding for Electrical Systems**					
	Grounding materials and devices					
26 05 33.11	**Raceways and Conduits for Electrical Systems**					
	Raceways and conduit					
	Fittings					
	Wireways					
	Supports for rooftop conduits					
	Labeling					
26 05 33.13	**Boxes and Fittings for Electrical Systems**					
	Fittings					
	Cover plates					
	Junction boxes					
	Outlet boxes					
	Pull boxes					
	Floor boxes					
	Extension rings					
26 05 53	**Identification for Electrical Systems**					
	Label material					
	Sample identification tag					
26 28 13	**Fuses**					
	Fuses					
26 28 16	**Enclosed Switches and Circuit Breakers**					
	Safety switches					

1 - Reviewed
2 - Furnish as corrected in comments, resubmit not required
3 - Revise and Resubmit based on comments
4 - Rejected based on comments

END OF SECTION

SECTION 26 05 11

ELECTRICAL DEMOLITION

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Electrical demolition.

B. Off-site removal of materials not reused.

1.2 RELATED SECTIONS

A. Section 26 00 00 - Electrical

B. Section 26 05 53 - Identification for Electrical Systems

PART 2 PRODUCTS

A. Not used.

PART 3 EXECUTION

3.1 EXAMINATION

A. 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.

B. Verify abandoned wiring and equipment serving only abandoned facilities.

C. Drawings are based on casual field observation and existing record documents. Report discrepancies to the Engineer before disturbing existing installation.

D. The Contractor accepts the existing conditions when beginning demolition.

3.2 PREPARATION

A. Disconnect electrical systems in walls, floors and ceilings as shown or required.

B. Coordinate utility service outage with the respective utility company and the Owner.

C. Provide temporary wiring and connections to maintain required existing systems in service during construction.

D. 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.

3.3 DEMOLITION AND EXTENSION OF EXISTING ELECTRICAL WORK

A. Demolish and extend existing electrical work under provision of Division 1 and this section.

B. Remove, relocate and extend existing installations to accommodate new construction as required.

C. Remove abandoned wiring to the source of the supply.

D. Remove exposed abandoned conduit, including abandoned conduit above accessible ceiling finishes. Cut conduit flush with walls, floors and patch surfaces.

E. Disconnect abandoned outlets and remove devices. Remove abandoned outlets if conduit servicing them is abandoned and removed. Provide blank cover for abandoned outlets which are not removed in masonry construction.

F. Disconnect and remove electrical devices and equipment serving equipment that has been removed.

G. Disconnect and remove abandoned lighting fixtures. Remove brackets, stems, hangers and other accessories.

H. Repair adjacent construction and finishes damaged during demolition and extension work.

I. Maintain access to existing electrical installations which remain active. Modify installation or provide access panel as appropriate.

J. Extend existing installations using materials and methods compatible with existing electrical installations or as specified.

K. Confirm with Owner or Architect regarding the handling and disposal/reuse of removed material, equipment, devices, lights, etc.

3.4 REPAIR/RESTORATION

A. Clean and repair existing materials and equipment, in areas of revision, which remain or which are to be reused.

B. Panelboards:
   1. Clean exposed surfaces and check tightness of electrical connections.
   2. Replace damaged circuit breakers and provide closure plates for vacant positions.
   3. Provide typed circuit directory showing revised circuiting arrangement as specified, on all existing switchgear.
   4. Provide new identification nameplates per Section 26 05 53.

3.5 RE-INSTALLATION

A. Install all relocated materials and equipment under the provisions of Divisions 1 and 26.

END OF SECTION

SECTION 26 05 19

LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. This section includes conductors for power circuits, including terminations and connectors.

1.2 RELATED SECTIONS

A. Section 26 00 00 - Electrical

B. Section 26 00 90 - Electrical Submittal Procedures

C. Section 26 05 26 - Grounding and Bonding for Electrical Systems

D. Section 26 08 11 - Testing of Electrical System

1.3 REFERENCES

A. ANSI/UL 83 - Thermoplastic-Insulated Wires

B. ICEA S-61-402 - Thermoplastic-Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy

C. UL 44 - Rubber Insulated Wires and Cables

D. National Electric Code

E. UL 493 - Thermoplastic Insulated Underground Feeder and Branch Circuit Cables

1.4 SUBMITTALS

A. Submittals required in this section shall conform to and be submitted in accordance with the General Conditions, Division 1, and Division 26, Section 26 00 90 - Electrical Submittal Procedures.

B. Product Data: Submit product data for the following:
   1. Conductors for power circuits
   2. Conductor terminations
   3. Connectors

C. Closeout Submittals: Closeout submittals shall include the following.
   1. Submit letter certifying acceptable testing of all branch circuits.
   2. Submit insulation test results for all new feeders installed in this project.

1.5 QUALITY ASSURANCE

A. General work practices for electrical construction shall be in accordance with NECA 1, Standard Practices for Good Workmanship in Electrical Construction.

B. Regulatory Requirements: All products provided under this section shall be UL listed for the intended use.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Storage and Protection: Material shall be stored in a clean and dry location until installation.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Conductors shall be manufactured in the United States. Acceptable manufacturers are:
   1. Encore Wire
   2. Southwire
   3. Cerro Wire
   4. Alan Wire
   5. General Cable

B. All other manufacturers shall require pre-approval in accordance with specification section 26 00 00.

2.2 MATERIALS

A. All feeders to be annealed copper.

B. All branch circuit conductors shall be soft-drawn annealed copper.

2.3 MANUFACTURED UNITS

A. Manufactured conductors for power circuits:
   1. All conductors for power circuits shall be rated for at least 600 volts.
   2. The insulation for power conductors shall be type THWN-2 or THHN/THWN.
   3. Conductors for power circuits shall be #12 AWG or larger.
   4. Conductors for power circuits that are #12 AWG or #10 AWG shall be solid. Conductors for power circuits that are #8 AWG and larger shall be stranded.
   5. Conductors sized #6 AWG and smaller shall have factory colored insulation.

B. MC Cable: MC cable is not approved for use on this project.

C. Manufactured conductor terminations and connectors:
   1. All accessory materials such as connectors, splice and tap fittings, and terminations shall be of a type designed or intended and suitable for the use. They shall be compatible with the conductor material.
   2. Conductors shall be connected and terminated using suitable listed clamps, listed pressure connectors, listed compression terminals or listed lugs and hardware of the proper size for the application.
   3. Only connection devices that require the complete removal of the conductor jacket or insulation and result in a connection to the complete conductor surface area are suitable for use. Insulation piercing type connectors shall not be used.
   4. Splices and taps shall have a mechanical strength and insulation rating at least as that of the conductors.
   5. Compression systems shall include crimped die index and company logo for purposes of inspection. Aluminum shall not be used for connection purposes.

PART 3 EXECUTION

3.1 SITE VERIFICATION OF CONDITIONS

A. Do not install the conductors until raceway system is complete.

B. Before installing the conductors for any power circuit or feeder, verify that the conductor ampacity is at least as large as the rating of the overcurrent device protecting it. In the event that the conductors would not be adequately protected, notify the engineer before installation.

3.2 INSTALLATION

A. Wire Sizing: Provide conductors sized as indicated on drawings unless modified as described below. Where conductor sizes have been omitted from drawings, base bid shall include conductors with ampacity as least as large as the overcurrent protection device protecting the conductors, or at least as large as the amp rating of the load being served, whichever is greater. In such cases, notify the engineer before installation for size verification. When pulling 120v branch circuits, #12 wire shall not be run more than 90', #10 wire shall not be run more than 120', #8 wire shall not be run more than 150', etc.

B. Neutral Conductors: 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.

C. Equipment grounding conductors: Provide equipment grounding conductors in accordance with specification section 26 05 26 - Grounding and Bonding for Electrical Systems.

D. Number of Conductors per Conduit: When #12 AWG conductors are used on 20-amp circuits, install no more than six conductors in a single conduit run. When #10 AWG conductors are used on 20-amp circuits, install no more than nine conductors in a single conduit run. Otherwise, there shall be no more than three conductors in each conduit run. The equipment grounding conductor shall not be counted for the preceding statements.

E. Installation in Raceways:
   1. Install all conductors for power circuits in raceways.
   2. All conductors to be installed in a raceway shall be pulled together. Use an approved wire pulling compound when pulling large conductors.
   3. Do not bend any conductor either permanently or temporarily during installation to radii less than four times the outer diameter of conductors.
   4. Do not exceed manufacturer's recommended values for maximum pulling tension.
   5. When installing conductors in existing conduit, the interior of the existing conduit shall be cleaned prior to the installation of the new conductors to insure that there is nothing that will damage the insulation.
   6. The pulling device shall be of a type that will not damage the raceway.

F. Terminations:
   1. Use pressure type lugs or connectors for terminations or splices of all stranded conductors. Use ring tongue type terminators on all control wiring. More than one conductor shall not be installed in any termination unless the termination is marked as suitable for more than one conductor. With the written approval of the engineer's office, an exception to this may be allowed for the installation of the surge protective devices required in specification section 26 43 00 Surge Protective Devices.
   2. Conductors shall not be supported solely by their terminations.
   3. Terminations shall be made such that the stripped length of the conductor is no longer than required for the terminal, lug, or connector.

4. Conductive antioxidant shall be applied on all outdoor connections and connections in damp or wet locations.

G. Splices:
1. Conductor splices shall be kept to a minimum.
2. Where splices are necessary, they shall be in a box or enclosure. Splices within a conduit run are not acceptable.

H. Color Coding:
1. Provide factory colored insulated conductors for #6 AWG and smaller.
2. Color code larger insulated conductors with an approved field-applied tape 2" wide on each end of conductors.
3. If existing wiring in renovation or addition work has a consistent color coding, then match the existing and note in record documents. Otherwise, colors shall be as follows:

Line	**208/120V**	**240/120V**	**480/277V**
A	Black	Black	Brown
B	Red	Orange	Orange
C	Blue	Blue	Yellow
Neutral	White	White	Gray
Ground	Green	Green	Green
Isolated Ground	Green +Yellow	Green + Yellow	Green + Yellow

4. Switch leg shall be the same color as the un-switched phase wiring. Travelers, and special systems as selected by the Contractor. Note in record drawings.

I. Identification: All conductors in a panelboard shall be identified by means of tags or tape.

3.3 SITE TESTS

A. Perform in accordance with manufacturer's printed testing procedures, applicable industry standards, ANSI standards, IEEE standards, and NEMA standards. Provide testing equipment in good working order and which complies with the applicable industry standards and manufacturer's requirements. Submit a list of testing equipment used and date of last calibration.

B. Insulation Test: The insulation of each feeder run and each branch circuit shall be tested. The test shall be performed after the conductors have been pulled into the conduit and after terminations have been added, but before final connections are made.

C. Test the following:
1. Phase to phase resistance
2. Phase to neutral resistance
3. Phase to ground resistance
4. Neutral to ground resistance

D. Branch Circuits: The insulation of branch circuits may be tested with a standard ohm meter. Readings must indicate an open circuit to be acceptable. Submit letter documenting that all circuits have been tested and are acceptable.

E. Feeders:
1. Perform megger tests on all new feeder runs.
2. Tests shall be performed in accordance with the Publication "Instruction Manual For Megger Insulation Testers" by the Biddle Company.
3. Written documentation of the test results shall be submitted in accordance with specification section 26 08 11 - Testing of Electrical System.

END OF SECTION

SECTION 26 05 26

GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions, Division 1 Specifications and Section 26 00 00, apply to this Section.

1.2 SECTION INCLUDES

A. This Section includes solid grounding of electrical systems and equipment. It includes basic requirements for grounding for protection of life, equipment, circuits, and systems. Grounding requirements specified in this Section may be supplemented in other sections of these Specifications.

1.3 RELATED SECTIONS

A. Section 26 00 00 - Electrical

B. Section 26 08 11 - Testing of Electrical System

1.4 REFERENCES

A. National Electrical Code

B. ANSI/IEEE 142 - Recommended Practice for Grounding of Industrial and Commercial Power Systems.

C. ANSI/UL 467 - Safety Standard for Grounding and Bonding Equipment.

1.5 SUBMITTALS

A. Submittals required in this section shall conform to and be submitted in accordance with the General Conditions, Division 1, and Division 26, Section 26 00 90 requirements.

B. Submit grounding materials and devices to be used.

C. Submit test results of megger reading to Engineer after installation of grounds with records for Owner.

D. Revisions to grounding will be to satisfaction of the Engineer at no cost by the Contractor.

PART 2 PRODUCTS

2.1 GROUND RODS

A. Copper cladding permanently bonded to a high-strength steel core, molten welded to core.

B. 3/4 inch by 10 feet (19mm by 30m) Straight, Conform to UL 467.

2.2 CONNECTIONS

2.2.1 GENERAL CONNECTION REQUIREMENTS

A. Listed and labeled as grounding connectors for the materials used.

2.2.2 OUTDOOR & BELOW GRADE GROUNDING CONNECTIONS

A. Welded.

B. Provide starting material in kit form.

C. Aluminum, copper and iron oxide.

D. No phosphorous or any other caustic, toxic or explosive substance may be used.

E. Manufacturer/Model
   1. Erico Products "Cadweld Exothermic"
   2. Thermoweld

2.2.3 OUTDOOR & ABOVE GRADE GROUNDING CONNECTIONS

A. Bonds and clamps.

B. Non-ferrous material which will not cause electrolytic action between the conductor and connector.

C. Provide exothermal welding where clamping is not accessible.

2.2.4 INDOOR GROUNDING & POWER CONNECTIONS

A. Provide clamps as listed for outdoor applications.

B. Use low smoke/low emission welding where not accessible.

C. Manufacturer/Model: Erico Products "Cadweld Exolon".

D. Service Entrance Grounding Connections: U-bolt with pressure plate.

2.3 WIRING

A. Copper 600 volt insulated conductors with a green-colored insulation for bonding.

B. Grounding conductors to be in accordance with NEC Table 250-95.

C. Bonding jumpers to be minimum cross-sectional area greater than or equal to that of the equivalent grounding conductor as determined from NEC Table 250-95.

D. Use to ground electrode and equipment grounding conductors.

2.4 MISCELLANEOUS CONDUCTORS

A. Ground Bus: Bare annealed copper bars of rectangular cross section. 98% IAGS conductivity, not less than 25% of feeders cross section area.

B. Braided Bonding Jumpers: Copper tape, braided No. 3/0 AWG bare copper wire, terminated with copper ferrules.

C. Bonding Strap Conductor/Connectors: Soft copper, 0.05 inch (1mm) thick and 2 inches (50mm) wide, except as indicated.

2.5 LIGHTNING ARRESTORS

A. Manufacturers: Products of the following manufacturers which meet the requirements of these specifications are acceptable.
   1. Anixter Brothers, Inc.
   2. Blackhawk Industries
   3. Burndy
   4. Copperweld Corporation
   5. Erico Products, Inc.
   6. Ideal Industries, Inc.
   7. Ilsco
   8. ITT Blackburn
   9. Joslyn
   10. OZ/Gedney Co.
   11. Raco, Inc.
   12. Thomas & Betts Corp

PART 3 EXECUTION

3.1 APPLICATION

3.1.1 EQUIPMENT GROUNDING CONDUCTOR APPLICATION

A. Comply with NEC Article 250 for sizes and quantities of equipment grounding conductors, except where larger sizes or more conductors are indicated.

B. All power circuits shall be provided with a separate copper insulated equipment grounding conductor (EGC) run in the raceway with the power conductors. The conduit is not to be used as the sole means of grounding. The insulation of the EGC shall be green.

C. Bonding to the EGC shall be provided at each end of metallic conduit runs and at all boxes and enclosures.

3.2 INSTALLATION

3.2.1 GENERAL

A. Ground electrical systems and equipment in accordance with NEC requirements except where the Drawings or Specifications exceed NEC requirements.

3.2.2 GROUND RODS

A. Locate a minimum of one-rod length from each other and at least the same distance from any other grounding electrode. Interconnect ground rods with bare conductors buried at least 24 inches (600 mm) below grade. Connect bare-cable ground conductors to ground rods by means of exothermic welds except as otherwise indicated. Make these connections without damaging the copper coating or exposing the steel. Use 3/4 inch by 10-ft. (19mm by 30 m) ground rods except as otherwise indicated. Drive rods until tops are 6 inches (150mm) below finished floor or final grade except as otherwise indicated. Provide "Powerfill" "Gem" or equal conducting material in quantity recommended by manufacturer at all ground rods.

3.2.3 METALLIC WATER SERVICE PIPE

A. Provide insulated copper ground conductors, sized as indicated, in conduit from the building main service equipment, or the ground bus, to main metallic water service entrances to the building. Connect ground conductors to the main metallic water service pipes by means of ground clamps. Where a dielectric main water fitting is installed, connect the ground conductor to the street side of the fittings. Do not install a grounding jumper around dielectric fittings. Bond the ground conductor conduit to the conductor at each end.

B. Route bond interior metal piping systems and metal air ducts to equipment ground conductors of pumps, fans, electric heaters, and air cleaners serving individual systems.

3.3 CONNECTIONS

3.3.1 GENERAL

A. Make connections in such a manner as to minimize possibility of galvanic action or electrolysis. Select connectors, connection hardware, conductors, and connection methods so metals in direct contact will be galvanically compatible.

B. Use electroplated or hot-tin-coated materials to assure high conductivity and make contact points closer in order of galvanic series. Make connections with clean bare metal at points of contact.

C. Aluminum to steel connections shall be with stainless steel separators and mechanical clamps. Aluminum to galvanized steel connections will be with tin-plated copper jumpers and mechanical clamps.

D. Coat and seal connections involving dissimilar metals with inert material such as red lead paint to prevent future penetration of moisture to contact surfaces.

3.3.2 EXOTHERMIC WELDED CONNECTIONS

A. Use for connections to structural steel and for underground connections except those at test wells. Install at connections to ground rods and plate electrodes. Comply with manufacturer's written recommendations. Welds that are puffed up or that show convex surfaces indicating improper cleaning are not acceptable.

B. Terminate insulated equipment grounding conductors for feeders and branch circuits with pressure-type grounding lugs. Where metallic raceways terminate at metallic housings without mechanical and electrical connection to the housing, terminate each conduit with a grounding bushing. Connect grounding bushings with a bare grounding conductor to the ground bus in the housing. Bond electrically noncontinuous conduits at both entrances and exits with grounding bushing and bare grounding conductors.

C. Tighten grounding and bonding connectors and terminals, including screws and bolts, in accordance with manufacturer's published torque tightening values for connectors and bolts. Where manufacturer's torquing requirements are not indicated, tighten connections to comply with torque tightening valves specified in UL 486A and UL 486B.

3.3.3 COMPRESSION-TYPE CONNECTIONS

A. Use hydraulic compression tools to provide the correct circumferential pressure for compression connectors. Use tools and dies recommended by the manufacturer of the connectors. Provide embossing die code or other standard method to make a visible indication that a connector has been adequately compressed on the ground conductor.

3.3.4 MOISTURE PROTECTION

A. Where insulated ground conductors are connected to ground rods or ground buses, insulate the entire area of the connection and seal against moisture penetration of the insulation and cable.

3.4 TESTS

A. Subject the completed grounding system to megger test at each location where a maximum ground resistance level is specified, at service disconnect enclosure ground terminal, and at ground test wells. Measure ground resistance without the soil being moistened by any means other than natural precipitation or natural drainage or seepage and without chemical treatment or other artificial means of reducing natural ground resistance. Perform tests by the 2-point method in accordance with Section 9.03 of IEEE 81, "Guide for Measuring Earth Resistivity, Ground Impedance and Earth Surface Potentials of a Grounding System". Submit test results in accordance with Section 26 08 11 - Testing of Electrical System.

B. Ground/resistance maximum values shall be as follows:
   1. Equipment rated 500 kVA and less: 10 Ohms
   2. Equipment rated 500 kVA to 1000 kVA: 5 Ohms
   3. Equipment Grounds: 25 Ohms

3.5 CLEANING AND ADJUSTING

A. Restore surface features at areas disturbed by excavation and reestablish original grades except as otherwise indicated. Where sod has been removed, replace it as soon as possible after backfilling is completed. Restore areas disturbed by trenching, storing of dirt, cable laying and other work to their original condition. Include necessary topsoiling, fertilizing, liming, seeding, sodding, sprigging, or mulching. Perform such work in accordance with Division 2 Section. Maintain disturbed surfaces, restore vegetation and restore disturbed paving as indicated.

END OF SECTION

SECTION 26 05 33.11

RACEWAYS AND CONDUITS FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions, Division 1 Specifications and Section 26 00 00, apply to this Section.

1.2 SECTION INCLUDES

A. Electrical raceway and conduit systems.

1.3 RELATED SECTIONS

A. Section 26 00 00 - Electrical

B. Section 26 05 19 - Low-Voltage Electrical Power Conductors and Cables

C. Section 26 05 26 - Grounding and Bonding for Electrical Systems

1.4 REFERENCES

A. ANSI/ANSI C80.1 - Zinc-Coated Rigid Steel Conduit

B. ANSI/ANSI C80.4 - Zinc Coated Electrical Metallic Tubing

C. ANSI/ANSI C80.4 - Fittings for Rigid Metal Conduit and Electrical Metallic Tubing

D. ANSI/UL 1 - Flexible Metal Conduit

E. ANSI/UL 5 - Surface Metal Raceways and Fittings

F. ANSI/UL 651 - Rigid Nonmetallic Conduit

G. ANSI/UL 797 - Electrical Metallic Tubing

H. ANSI/UL 870 - Safety Standard for Wireways, Auxiliary Gutters and Associated Fittings

I. ETL PVC-001 - PVC-Coated Rigid Steel Conduit

J. NEMA TC2 - Electrical Plastic Tubing (EPT) and Conduit (EPC-40 and EPC-80) and Fittings

K. NEMA TC3 - PVC Fittings for Use with Rigid PVC Conduit and Tubing

L. UL 6 - Rigid Metal Electrical Conduit

M. UL 360 - Liquid tight Flexible Steel Conduit

N. UL 467 - Electrical Grounding and Bonding Equipment

1.5 SUBMITTALS

A. Submittals required in this section shall conform to and be submitted in accordance with the General Conditions, Division 1, and Division 26, Section 26 00 90 requirements. Included in this section are all raceways and conduit, fittings, wireways, supports for conduit on roof, and labeling used. Provide samples upon specific request. U.L. labels affixed to each item of material.

1.6 DESCRIPTION OF WORK

A. The use of the various raceway systems is restricted to the types and other restrictions of the NEC and the local codes. Use of all such systems shall be verified with the local code authority before use. In the case of questionable or denied use, the contractor shall be required to use a raceway system permitted by the local code at no additional cost.

B. Where conduits pass through beams, outside walls, fire rated walls, or structural members, galvanized steel pipe sleeves shall be provided. The size of these sleeves shall be such as to permit readily the subsequent insertion of conduit of the proper size with adequate clearance for movement due to expansion and contraction. Where conduits pass through outside walls, the inside diameter of the galvanized iron pipe sleeves shall be at least 1/2" greater than the outside diameter of the service pipe. After the conduits are installed, fill the annular space between the conduit and its sleeve with a mastic or caulk. Use packing as required to accomplish this. At fire rated wall penetrations, use fire barrier.

C. Grounding: The installation shall comply with all NEC grounding requirements. See specification section 26 05 26 Grounding and Bonding for Electrical Systems for additional grounding requirements.

D. Exposed surface raceways are specifically not permitted, in new construction. Where a raceway is required, in existing construction, it shall be solid, without knockouts, with hinged cover, placed so that cover is gravity closed.

E. Install complete, separate conduit systems for all electrical systems on this project to include, but not limited to include the following.
   1. Electrical power and lighting feeders
   2. Electrical power and lighting circuits
   3. Control wiring furnished by this contractor

F. Branch circuits shall not be installed in or under the ground floor slab and will not be accepted. The only exceptions being circuits and locations specifically required on the drawings to be in or under the floor slab.

G. Aluminum conduit shall not be installed in direct contact with concrete or masonry construction.

PART 2 PRODUCTS

2.1 CONDUITS AND FITTINGS

2.1.1 MINIMUM SIZES

A. Do not use conduit sized less than 1/2 inch steel, 3/4 inch for PVC conduit, 3/8 inch flexible metal conduit, for lengths not to exceed 72 inches supplying light fixtures.

2.1.2 RIGID METAL CONDUIT. (RSC) (RAC) (IMC)

A. Hot-dipped galvanized rigid steel (RSC), Intermediate Metallic (IMC) with zinc-coated threads and an outer coating of zinc chromate, Rigid Aluminum (RAC) accepted.

B. Fittings:
   1. Malleable iron, either cadmium plated or hot-dipped galvanized. Die cast zinc. Aluminum for aluminum conduit. To be insulated throat at terminations.
   2. Use of set screw or bolt-on connectors and couplings is not accepted.
   3. Use deflection and expansion couplings with bonding jumpers at all expansion joints where required. Steel Clamps.

C. Usage: Where exposed on interior and exterior of buildings including roof. All elbows of PVC conduit. Within or penetrating concrete slabs (RSC only).

2.1.3 PVC COATED RIGID METAL CONDUIT

A. NFPA 70, Type RMC galvanized steel rigid metal conduit with external polyvinyl chloride (PVC) coating complying with NEMA RN 1 and listed and labeled as complying with UL 6 and ETL PVC-001. The PVC coated galvanized rigid conduit must be ETL Verified to the Intertek ETL SEMKO High Temperature H2O PVC Coating Adhesion Test Procedure for 200 hours.

B. Fittings
   1. Malleable iron. Steel.
   2. Use fittings listed and labeled as complying with UL514B.
   3. Exterior Coating: Polyvinyl Chloride (PVC), minimum thickness of 40 mils.
   4. Interior Coating: Urethane, minimum thickness of 2 mils.

C. Usage: Damp or wet locations. The stub-up from below grade to above grade

2.1.4 ELECTRICAL METALLIC TUBING (EMT)

A. Galvanized Electrical Steel, Galvanized Thin Wall, or Aluminum Tubing

B. Fittings: Set screw or compression type. Indenter type is not accepted. Die cast zinc. Pressure cast. Malleable iron. Steel. Steel Clamps. To be insulated throat at terminations.

C. Usage: Concealed in interior walls and ceiling spaces. Exposed only in interior mechanical, electrical rooms, and equipment rooms. Gyms, activity spaces, stages as directed, above 10'-0" A.F.F. where exposed. Installation in or under the floor slab will not be accepted.

2.1.5 RIGID NONMETALLIC CONDUIT (RNC)

A. Schedule 40 heavy wall polyvinylchloride, high impact resistant.

B. Fittings: Solvent weld socket type

C. Usage: Underground, under slabs, all bends to be rigid steel. Do not penetrate slab with PVC. Do not use above slabs, above grade, or exposed. Use long sweep rigid steel 90's and rigid steel from 90's to and above grade.

2.1.6 FLEXIBLE METAL CONDUIT (FMC)

A. Spiral-wound, square-locked aluminum. Spiral-wound, square locked, hot-dipped galvanized steel.

B. Fittings: Cadmium plated two-screw, double-clamp malleable iron. Hot-dipped galvanized two-screw, double-clamp malleable iron. Malleable. Pressure cast. Steel cast. Steel/Malleable for 90°. Zinc coated, aluminum. To be insulated throat at terminations.

C. Usage:
1. May be used for light fixture whips.
2. May be used for final equipment connections, such as transformers, motors and HVAC equipment.
3. Total length not to exceed 72” above ceiling, 48” exposed below ceiling.
4. Exposed only in interior mechanical or electrical rooms.
5. For renovation work, may be used in existing walls only under the following conditions:
   a. The use of EMT or rigid conduit is not feasible.
   b. Written permission has been obtained from the engineer.
   c. Surface mounted conduit is not desired.
6. Installation in or under the floor slab will not be accepted.

2.1.7 LIQUID-TIGHT FLEXIBLE METAL CONDUIT (LFC)

A. Spiral-wound, square-locked, hot-dipped galvanized steel strip plus a bonded outer jacket of PVC.

B. Fittings:
1. Cadmium plated, compression type, malleable iron. Hot-dipped galvanized, compression type, malleable iron. To be insulated throat at terminations.
2. Aluminum - Copper free (1% or less)

C. Usage:
1. Exterior equipment - 5' 0" Maximum length
2. Kitchen equipment - 4' 0" Maximum length

2.1.8 ACCEPTABLE MANUFACTURERS

A. Metallic Conduits: American Conduit, Pittsburgh, Alflex, AFC, Wheatland, Allied, Omega, Spang, and Nepco.

B. Nonmetallic Conduits: Carlon, Sedco, and Cantex.

C. PVC Coated Metallic Conduits: Plasti-Bond, Perma-Cote, and KorKap.

D. Fittings: Madison, Hubbell, Raco, Regal, Appleton, Thomas & Betts, Eaton, Steel City, and ECN Korns.

E. Others: As listed with products.

2.2 WIREWAYS

A. Not less than 16 gauge sheet steel. Cross section dimensions not less than 4 inches by 4 inches, or as noted. ANSI gray epoxy paint over rust-inhibiting prime coat. NEMA rated. Large enclosed surface metal raceway used where conduit is not accessible, or use of conduit is not feasible.

B. Manufacturers: Square D., Hoffman

PART 3 EXECUTION

3.1 PREPARATION

A. Place sleeves in the cavities of walls and floor slabs for the free passage of conduits.

B. Set sleeves in place a sufficient time ahead of concrete placement so as not to delay the work.

C. Apply caulking for sleeves through floors and through exterior walls.

D. Be sure that plugs or caps are installed before concrete placement begins.

3.2 INSTALLATION

3.2.1 CONDUITS

A. Metallic conduits must be continuous between enclosures such as outlet, junction and pull boxes, panels, cabinets, motor control centers, etc. The conduit must enter and be secured to enclosures so that each system is electrically continuous throughout. Where knockouts are used, provide double locknuts, one on each side. At conduit terminations, provide insulated throat fittings. Where conduits terminate in equipment having a ground bus, such as in switchgear, and panelboards, provide conduit with an insulated grounding bushing.

B. It is intended to reuse the existing conduits in existing construction, if they prove to be adequate in size and integrity.

C. Install conduit and tubing products as indicated, in accordance with applicable requirements of NEC and the NECA "Standard of Installation", and in accordance with recognized industry practices to ensure that products serve the intended function.

D. Cap open ends of raceways until conductors are installed.

E. 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.

F. In mechanical rooms install conduit to equipment not adjacent to walls, by dropping conduits exposed from overhead.

G. Install conduits parallel and supported on Unistrut or equal trapezes and anchored with split ring hangers, conduit straps or other devices specifically designed for the purpose. Wire ties are not permitted. Do not support conduit from ceiling system supports.

H. Installation of the PVC Coated Conduit System shall be performed in accordance with the Manufacturer's Installation Manual. All clamping, cutting, threading, bending, and assembly instructions listed in the manufacturer's installation guide should be followed To assure correct installation, the installer shall be certified by Manufacturer to install coated conduit.

I. Liquid-tight flexible metal conduit on the roof shall be securely fastened in place by an approved means within 12 inches of each box, cabinet, conduit body, or other conduit termination, and shall be supported and secured at intervals not to exceed 4.5 feet. Flexible conduit cannot lay on roof.

J. Have rigid nonmetallic conduit adequately solvent welded at joints to form a tight, waterproof connection. Run green ground wire in all PVC conduit and extend to ground bus.

K. Run concealed conduit as directly and with the largest radius bends as possible. Run exposed conduit parallel or at right angles to building or other construction lines in a neat and orderly manner. Conceal conduit in finished areas. Branch circuits installed in or under slabs on grade will not be accepted unless noted on drawings. Branch circuits shall be installed below floor slabs above first floor.

L. Install each entire conduit system complete before pulling in any conductors. Clean the interior of every run of conduit before pulling in conductors. See Section 26 05 19 Conductors for additional requirements for installation of conductors in raceways.

M. Conduit and raceways shall be suspended from building structure, not from ceiling suspension system.

N. Make bends with standard ells or conduit bent in accordance with the NEC. Make field bends using equipment designed for the particular conduit material and size involved. Bends must be free from dents or flattening. Use no more than the equivalent of four 90-degree bends in any run between terminals and cabinets, or between outlets and junction boxes or pull boxes.

O. Securely fasten and support all conduit runs. Provide required clamps, straps, clips, hangers and brackets. Raceways run in joists shall be secured to joists with clamps at 20'0" maximum spacing. Raceways run parallel to joists shall be supported by caddy clips (1 inch or smaller) or in unistrut/threaded rods/beam clamps trapeze at 15'-0" centers. Raceways run perpendicular to bottom of joists shall be secured with individual conduit hangers at 10'-0" maximum spacing or unistrut/threaded rods/beam clamps at 15'-0" maximum centers. Raceways supported by straps at walls shall be supported per NEC. Support all raceways within one foot of each box, cabinet, disconnect, bend or other raceway termination.

P. Run flexible conduit to all recessed fluorescent fixtures in accessible ceilings. Do not use more than 4 flexible metal conduits per junction box to supply light fixtures in a location. Do not supply a fixture from another with any Raceway or FMC. Suspend junction boxes and conduits from high roofs with hangers and trapeze.

Q. Provide two spare 1 inch conduits stubbed into attic space at flush mounted electrical cabinets.

R. Provide a Greenlee #431 or equal (240 lbs.) nylon pulling line in conduits in which wiring is not installed under this work, such as telephone, signal, and similar systems. Identify both ends of the line by means of labels or tags reading "Pulling Line".

S. Use expansion-deflection fittings on conduits 2 inches and larger crossing structural expansion joints and on exposed conduit runs where necessary. Provide bonding jumpers across fittings in metal raceway systems.

T. Openings around electrical penetrations of fire resistance rated walls, partitions, floors or ceilings shall be made using approved methods so as to maintain the original fire resistance rating. See NEC 300-21.

3.2.2 WIREWAYS

A. Install wireways, where noted or required. Field apply a 90 percent grey zinc paint coating over cuts or scratches before any other finish is applied.

3.2.3 COMMUNICATION SYSTEMS

A. This contractor shall provide all raceways and conduits for all communication systems shown and/or required on the drawings. Communication Systems may include but are not limited to fire alarms, intercoms, telephones, television, security, computer data, antenna and media management.

B. This contractor shall provide a conduit pathway above ceiling for fire alarm, data, av systems, etc. between all spaces and the corridor, where walls go to deck. Coordinate exact conduit size (1" to 2") and quantity with low voltage contractors and installers.

C. Raceways and conduit requirements shall be coordinated by this contractor with each Communication Systems Contractor and the general contractor.

3.3 COLOR CODING

A. Provide color bands approximately two inches wide, applied at 10 foot centers and at pull box locations.

B. Color Codes:

1.	Fire Alarm System	Red
2.	Voice/Data	Blue
3.	Security System	Green
4.	Media Management	Yellow
5.	CATV/MATV	Black

END OF SECTION

SECTION 26 05 33.13

BOXES AND FITTINGS FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions, Division 1 Specifications and Section 26 00 00, apply to this Section.

1.2 SECTION INCLUDES

A. Junction boxes

B. Pull and splice boxes

1.3 RELATED SECTION

A. Section 26 00 00 - Electrical

1.4 REFERENCES

A. ANSI/NEMA Publication No. OS 1 - Sheet-steel Outlet Boxes, Device Boxes, Covers and Box Supports, and Cast Aluminum Covers.

B. ANSI/UL 514 - Electrical Outlet Boxes and Fittings.

C. NEC 370-23(d)

1.5 DESCRIPTION OF WORK

A. The extent of electrical box and electrical fitting work is indicated by drawings and the requirements of this section.

B. The types of electrical boxes and fittings required for the project include the following:
   1. Junction boxes
   2. Pull boxes
   3. Conduit bodies

1.6 SUBMITTALS

A. Submittals required in this section shall conform to and be submitted in accordance with the General Conditions, Division 1, and Division 26, Section 26 00 90 requirements.

B. Include cut sheets of fittings, cover plates, junction boxes, outlet boxes, pull boxes, floor boxes and extension rings. Provide samples upon specific request.

PART 2 PRODUCTS

2.1 OUTLET BOXES

A. Flush Device Boxes
   1. Galvanized steel boxes, with extension rings as required. Use 1½ inch deep by 4 inches long, square or rectangular, unless otherwise noted on drawings.
   2. Provide galvanized steel interior outlet wiring boxes of the type, shape and size, including depth of box, to suit each respective location and installation; constructed with stamped knockouts in back and sides, and with threaded holes with screws for securing box covers or wiring devices.
   3. In boxes with multiple switches, where the voltage between adjacent switches exceeds 300 volts, provide an enclosure equipped with identified, securely installed barriers between adjacent devices.

B. Exterior or Exposed Device Boxes: Use FS or FD cast boxes with threaded hubs.

C. Interior Lighting Fixture Boxes: Galvanized steel with fixture stud supports and attachments to properly support ceiling and bracket-type lighting fixtures. Provide galvanized steel interior outlet wiring boxes of the type, shape and size, including depth of box, to suit each respective location and installation; constructed with stamped knockouts in back and sides and with threaded holes with screws for securing box covers or wiring devices. 1½ inch deep by 4 inches wide octagonal box, unless otherwise noted.

D. Masonry Boxes: Galvanized steel with gang capacity and extension ring covers to match the number of devices installed.

2.2 JUNCTION, PULL AND SPLICE BOXES

A. Galvanized steel boxes conforming to NEC Article 370.

B. Use NEMA 1 type boxes at least 4 inches deep, interior spaces.

C. Use NEMA 3R type boxes at least 4 inches deep, exterior spaces.

D. Use NEMA 4 cast iron type with external recessed flanged cover when cast in concrete.

2.3 MANUFACTURERS

A. Appleton

B. Eaton

C. Hoffman

D. Hubbell

E. Keystone

F. Lew

G. Orbit Industries

H. Raceway Components

I. RACO

J. Stahlin

K. Steel City

L. Thomas & Betts

M. Walker

PART 3 EXECUTION

3.1 OUTLET BOXES

3.1.1 GENERAL

A. The definition of an outlet, as it is used in this section, is to be per article 100 of NEC.

B. Provide all standard boxes, pull junction, wiring device and/or splice boxes for all systems in walls and slabs.

C. All low voltage systems in attic or crawl spaces specified in Division 23 are not included.

D. At all ceiling-mounted receptacle and luminaire (exit light, pendants, linear direct/indirect, etc.) locations, provide a heavy duty dual bar hanger with ceiling ties to support the back box. Provide Cooper Industries BA50F or approved equal with appropriate back box for the application.

E. All outlet boxes shall be mounted between joists and supported by both adjacent joists/studs, not just one. All outlet boxes shall be supported by a rigid box support or mounting bracket that stretches the entire length between the joists/studs and is mechanically fastened to joists/studs at each end. Outlet boxes shall not be supported from only one side or by only one joist/stud regardless of stud material. Provide a caddy H23, SGB, TSGB, RBS or similar product.

3.1.2 FLUSH BOXES

A. Mount all outlet boxes flush within 1/4 inch of the finished wall or ceiling line unless otherwise indicated. Provide knockout closures to cap unused knock out holes where knock out holes have been removed. Install outlets flush with finish walls or ceiling surfaces for concealed wiring.

B. Provide galvanized steel extension rings where required to extend the box forward in conformance to NEC requirements. Attach ring with at least two machine screws. Install electrical boxes and fittings in compliance with NEC requirements and in accordance with the manufacturer's written instructions and with recognized industry practices to ensure that the boxes and fittings serve the intended purposes.

C. Locate boxes and conduit bodies so as to ensure accessibility of electrical wiring. Install blank cover plates, painted to match surrounding, at pull boxes, junction boxes and all others to which no fixture or device is to be attached.

D. Securely fasten outlet boxes in position using clips or other suitable means. Secure boxes rigidly to the substrate upon which they are being mounted. Solidly embed boxes in concrete or masonry. Boxes shall not be permitted to move laterally, or to be supported only by EMT or conduit.

E. Provide plaster rings for all boxes in plastered walls and ceilings.

F. Where more than one switch occurs at the same location, use multiple gang outlet boxes covered by a single plate. Separate switches ganged in one box by a grounded metal barrier where system voltage exceeds 150 volts to ground. Fittings shall be approved for grounding purposes or shall be jumpered with a copper grounding conductor of appropriate ampacity. Leave terminations of such jumpers exposed. Use masonry type boxes with square corners in unplastered tile walls to allow tile to be sawed out neatly around box. Plates shall cover any cracks between box and tile. Use oversize plates where necessary.

3.1.3 LIGHTING FIXTURE BOXES

A. Do not install boxes for suspended lighting fixtures which are attached to and supported from suspended ceilings. Coordinate all lighting fixture outlets with mechanical and architectural equipment and elements to eliminate conflicts and provide a workable neat installation. Install approved 3/8" fixture studs in outlets from which lights are suspended, fastened through from back of box. Anchor outlet boxes and particularly those supporting fixtures, securely in place in an approved manner. Support outlet boxes and fixtures from building structures, not from ceiling material. Provide yokes, channels, studs or other supporting materials as required.

B. At all exit luminaires installed in grid ceilings (T-grid), provide a Cooper Industries BA50F or approved equal.

3.1.4 WALL MOUNTING HEIGHT

A. Mounting height of a wall-mounted outlet box means the height from finished floor to bottom of box.

B. Where outlets are indicated adjacent to each other, mount these outlets in a symmetrical pattern with all tops at the same elevation.

C. Remove and relocate any outlet box placed in an unsuitable location.

3.1.5 BOX OPENINGS

A. Provide only the openings necessary to accommodate the conduits at each individual location.

3.2 JUNCTION, PULL AND SPLICE BOXES

3.2.1 INSTALLATION

A. Install boxes as required to facilitate cable installation in raceway systems.

B. Provide boxes in conduit runs of more than 100 feet or as required in Division 26.

C. Locate boxes strategically and make them of such shape to permit easy pulling of wire or cables.

D. Locate exposed pull or junction boxes subject to the owner's representative's approval. Protect boxes in such a manner as to prevent foreign material, such as plaster, from entering boxes. Boxes shall be thoroughly cleaned of foreign materials before pulling conductors.

E. Install and support boxes per NEC 314-23 as required and as directed.

3.2.2 COVERS

A. Provide boxes so that covers are readily accessible and easily removable after completion of the installation.

B. Include suitable access doors for boxes above suspended ceilings.

C. Select a practical size for each box and cover.

D. Label covers with permanent "black" felt-tip marker. Circuit numbers shall be provided on power covers.

E. Fire alarm covers to be red in color, Steel City part number 52-C-1RD or equivalent.

3.3 LOCATION OF BOXES

A. The approximate location of boxes for switches, light outlets, power outlets, etc. is indicated on the plans. These drawings, however, may not give complete and accurate information in regard to locations of such items. The exact locations shall be determined by reference to the general building plans and by actual measurements during construction of the building, subject to the Architect's approval.

B. The Owner's representative reserves the right to make reasonable changes, up to six feet, in the indicated locations before work is roughed in, without additional charge.

C. Unless otherwise shown or specified, install boxes for switches 44" and receptacles 18" above finished floor. Verify all door swings with the drawings and schedules and locate switches and pull stations, unless specifically noted otherwise, on the strike side of the door. If switch is indicated on hinged side of door, verify location with the Owners Representative.

D. Where shown near doors, install wall switches shall be ganged in multiples as required covered by a single multigang cover plate. Where convenience outlets, telephone outlets, or data processing equipment outlets are near each other, outlet boxes shall be joined or otherwise placed so that they are all the same level. Device plates shall match for all outlets.

END OF SECTION

SECTION 26 05 53

IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.1 SUMMARY

1.1.1 SECTION INCLUDES

A. Identification required for electrical systems.

B. Code required identification not shown on plans nor specified herein shall be provided.

1.1.2 RELATED SECTIONS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions, Division 1 Specifications and Division 26, Section 26 00 00, apply to this Section.

B. See the following sections for related work.
1. Section 26 00 00 - Electrical
2. Section 26 00 90 - Electrical Submittal Procedures
3. Section 26 24 16 - Panelboards for Distribution Switchgear
4. Section 26 28 16 - Enclosed Switches and Circuit Breakers

1.2 SUBMITTALS

1.2.1 PRODUCT DATA

A. Submittals required in this section shall conform to and be submitted in accordance with the General Conditions, Division 1 and Division 26, Section 26 00 90 requirements.

B. Submit product data for sign materials. Refer to Electrical Identification detail on drawings for additional information.

1.2.2 QUALITY ASSURANCE/CONTROL SUBMITTALS

A. After the owner's room number list is finalized, submit a list of all electrical identification tags. The list shall include the actual text that will appear on each tag. Include the owner's and architects room numbers on all tags. This list shall be submitted for the review of the owner and architect.

PART 2 PRODUCTS

2.1 MATERIALS

A. Sign Materials:
1. Type:
   a. Engraving-Stock
   b. Melamine plastic laminate
2. Thickness:
   a. Less than 25 square inches:
      (1) 1/16 inch

b. 25 square inches or more:
(1) 1/8 inch
3. Color: Black Conform to FS L-P-287

B. Lettering:
1. Style: Engraved standard print, unless otherwise indicated.
2. Size: 3/16 inch to 1/4 inch
3. Color: White

2.2 SIGN INFORMATION

A. Panelboard (New):
1. Data:
a. Panelboard designation
b. Voltage, phase and wires
c. Source of service
2. Example:
a. CHAC
b. 277/480V., 3-phase, 4-wire
c. Fed from MDP

B. Switchboard:
1. Data:
a. Switchboard designation
b. Source of service
c. Panel type
d. Style
e. Amperage
f. Neutral amperage
g. Voltage of each branch circuit designation.
h. Phase and wires.
2. Example:
a. DPC - 277/480V.
b. 3 phase
c. 4 wire
d. Fed from MDP

C. Safety Switches:
1. Data:
a. Switch or load served designation.
b. Voltage and phase.
2. Example: In the following example, the text in parenthesis does not go on the actual tag. It is for clarification only.
a. #112 (Owner's Room Number)
b. A/C #C206 (Architect's Room Number)
c. Circ. CHAC-15
d. 480V.
e. 3 phase

D. Time Clocks:
1. Data:
a. Time clock load(s) served
b. Voltage and phase
c. Source of service

2. Examples:
    a. Parking Lot Lights
    b. 480V.
    c. Single Phase
    d. Fed from CH-15

E. Soffit Lights
1. 277V.
2. Fed from CH-21

F. Water Heater:
1. 208V.
2. Single phase
3. Fed from AL2-25

G. Electrical Riser Diagram Signs:
1. Material:
    a. Provide laminated copy of electrical riser diagram and screw to wall in each electrical room.
2. Size:
    a. Minimum: 12" x 17"
    b. Maximum: 30” x 42”
3. Provide a riser diagram in each electrical room similar to the riser diagram shown on the plans, and/or as required for the area served.

H. Device Engraving:
1. Any switch for load that is not in sight of the equipment served: custom engrave on outside of switch cover plate.
2. Custom engrave switch function when called for on the plans.

I. Panelboard Directory:
1. For each panelboard, provide a directory-frame mounted inside the door with heat-resistant transparent face and a directory card for identifying the load served.
2. Identify circuits by equipment served on by room numbers where room numbers exist. Room numbers shall be as directed by Owner.
3. Verify nomenclature at job site.
4. Directory shall be typed, shall coordinate with panel breaker and be neat.
5. Indicate spares and spaces with erasable pencil.

J. Refer to Section 26 24 16 (Panelboards for Distribution Switchgear)

K. Nameplate Fasteners:
1. Securely attach nameplates to equipment with non-corroding stainless steel screws.
2. Non-corroding pop rivets are acceptable.
3. Stick-ons or adhesives will not be allowed.

PART 3 EXECUTION

3.1 PREPARATION

A. Coordinate with the architect to obtain a list of the finalized owner’s room number list.

B. Prepare the quality control submittal of tag data as described in the Submittals article of this specification.

C. After the submittal has been reviewed without comment by the architect and the owner, proceed to order the identification tags.

D. Tags with incorrect data that have not been reviewed without comment by the architect and owner do not comply with these specifications.

3.2 INSTALLATION

A. Provide signs for equipment requiring identification as shown on drawings and for equipment as required by National Electric Code.

B. Provide for each main disconnect not grouped together.

C. Refer to Section 26 28 16 for Enclosed Switches and Circuit Breakers.

D. Install signs on outside of cover for safety switches and time clocks.

E. Install signs on outside top, not on door, and at each circuit for panelboards, switchboards and motor control centers.

F. Label spares and blank spares in light, erasable pencil.

G. Mount in an easily visible location.

H. All labeling identification shall contain both the owner's and architect's room names and numbers. Coordinate with General Contractor to secure construction room numbers.

I. Provide all additional signage required by local authority at no cost to the Owner.

END OF SECTION

SECTION 26 08 11

TESTING OF ELECTRICAL SYSTEM

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions, Division 1 Specifications and Section 26 00 00, apply to this Section.

1.2 SECTION INCLUDES

A. Complete testing and evaluations to assure that the electrical system is installed for proper operation.

1.3 RELATED SECTIONS

A. Section 26 00 00 - Electrical

B. Section 26 05 19 - Low-Voltage Electrical Power Conductors and Cables

C. Section 26 05 26 - Grounding and Bonding for Electrical Systems

D. Section 26 27 26 - Wiring Devices

1.4 REFERENCES

A. Biddle Instruments #21-P8a - Electrical Insulation Testing

B. Biddle Instruments #25Ta - Earth Resistance Testing

1.5 COORDINATION

A. Coordinate special tests and/or equipment start-up as specified or implied in related sections.

1.6 SUBMITTALS

A. Submittals required in this section shall conform to and be submitted in accordance with the General Conditions, Division 1, and Division 26, Section 26 00 90 requirements. Included in this section are megger tests of all main feeders to all switchboards and/or panelboards. Submit tests of insulation resistance, conductor resistance, and ground resistance.

PART 2 PRODUCTS

A. Not used.

PART 3 EXECUTION

3.1 TESTING

A. Perform in accordance with 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.

B. Test the following:
   1. Feeder conductors from switchboard to panelboards.
   2. Grounding means for all switchgear.
   3. Grounding of the Electrical system neutral: Ground resistance shall not exceed 10 ohms.
   4. Equipment grounds for each feeder: Ground resistance shall not exceed 25 ohms.
   5. Insulation resistance: Ground resistance shall not be less than one (1) megohm.

C. Perform all tests in the presence of the Engineer, Architect or the Owner in accordance with the forms included in this section.

D. Submit each test form within ten (10) working days from the time the test is performed.

E. Document all test results and provide a signed report by the testing technician as witnessed. Reports shall include date, time, weather conditions, field conditions, test data, instruments used and brief description of the test. Include reports in operating manuals. Submit tests.

Job Name: _____

Person and Company Conducting Test: _____

Signature of Person Conducting Test: _____

Insulation Test Results (Megger)

Feeder Description	Test Date	Resistance (megohms)	Remarks

Notes:
1. Test shall be conducted after conductors are pulled.
2. Ground resistance on insulation shall be no less than one (1) megohm.
3. Make copies of this form if more blanks are needed.

Job Name: _____

Person and Company Conducting Test: _____

Signature of Person Conducting Test: _____

Transformer Test Results

Transformer	Test Date	Secondary Voltage	Tap Setting	Grounding of Transformer Neutral (ohms)	Remarks

Notes:
1. Test on transformer neutral and tap settings shall be performed at time of substantial completion.
2. Ground resistance of transformer neutral shall be no greater than ten (10) ohms.
3. Make copies of this form if more blanks are needed.

Job Name: _____

Person and Company Conducting Test: _____

Signature of Person Conducting Test: _____

Feeder Ground Test Results

Feeder	Test Date	Resistance (ohms)	Remarks

Notes:
1. Test shall be conducted at time of substantial completion.
2. Ground resistance shall not exceed 25 ohms.
3. Make copies of this form if more blanks are needed.

Job Name: _____

Person and Company Conducting Test: _____

Signature of Person Conducting Test: _____

System Neutral Ground Test Results

Feeder	Test Date	Unbonded resistance (megohms) see note 1	Bonded resistance (ohms) see note 2	Remarks

Notes:
1. Neutral is not bonded to equipment and/or ground at any location. Resistance shall not be less than one (1) megohm.
2. Neutral is connected to ground at transformer only. Resistance shall not exceed 25 ohms.
3. Test shall be performed at time of substantial completion.
4. Make copies of this form if more blanks are needed.

END OF SECTION

SECTION 26 24 16

PANELBOARDS FOR DISTRIBUTION SWITCHGEAR

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions, Division 1 Specifications and Section 26 00 00, apply to this Section.

1.2 SECTION INCLUDES

A. Switchboards

B. Branch circuit panelboards

C. Switchgear

1.3 RELATED SECTIONS

A. Section 26 00 00 - Electrical

B. Section 26 05 19 - Low-Voltage Electrical Power Conductors and Cables

C. Section 26 05 26 - Grounding and Bonding for Electrical Systems

D. Section 26 05 33.11 - Raceways and Conduits for Electrical Systems

E. Section 26 22 13 - Low-Voltage Distribution Transformers

F. Section 26 28 13 - Fuses

G. Section 26 43 00 - Surge Protective Devices (SPD)

1.4 REFERENCES

A. UL 50 - Cabinets and Boxes.

B. UL 67 - Electric Panelboards.

C. NEMA AB1 - Molded Case Circuit Breakers.

D. NEMA AB2 - Procedures for Verifying the Performance of Molded Case Circuit Breakers.

E. NEMA PB1 - Panelboards.

F. NEC - NFPA 70 National Electrical Code 2017

1.5 OVERCURRENT PROTECTIVE DEVICE COORDINATION STUDY

A. For any project where service entrance equipment is added or changed, provide a short circuit/coordination study for the entire system.

B. For any project where electrical panels are added or changed but the service entrance equipment is not changed, provide a short circuit/coordination study for the service entrance equipment and all affected panels.

C. For any project involving mechanical equipment changes including chillers, cooling towers, air handlers, condensers, pumps, or rooftop units, provide a short circuit/coordination study for the affected portion of the system including affected panels and branch circuit overcurrent protective devices to the HVAC equipment.

D. For any project where service entrance equipment and electrical panels are added, provide a short circuit/coordination study for all service entrance equipment and panels.

E. Submit the short circuit/coordination to the city. The level of detail and format shall conform to city requirements.

F. Coordinate the short circuit current ratings of mechanical equipment with the available short circuit current. The short circuit current ratings of all electrical and mechanical equipment shall exceed the available short circuit current.

G. Adjust settings of adjustable circuit breakers to achieve selective coordination of the system. Notify the engineer if selective coordination cannot be achieved.

1.6 ARC FLASH HAZARD STUDY

A. For any project where service entrance equipment is added or changed, provide an arc flash/fault study and all required labels for the new service entrance equipment per NEC 110.16 and 110.21(B).

B. For any project where electrical panels are added or changed but the service entrance equipment is not changed, provide an arc flash/fault study and all required labels for all affected panels per NEC 110.16 and 110.21(B).

C. Install all required labels on all service entrance equipment and electrical panels per the above NEC references.

1.7 DESCRIPTION OF WORK

A. All panelboards with 400 amp main circuit breakers, 400 amp main lugs or 400 amp fused and larger shall be factory assembled.

B. The Contractor shall furnish and install approved panelboards of the types indicated and specified herein at locations as shown on the drawings.

C. Interiors shall be completely factory assembled.

D. Where this specification conflicts with panelboard schedules, contact the Engineer for clarification.

1.8 SUBMITTALS

A. Submittals required in this section shall conform to and be submitted in accordance with the General Conditions, Division 1, and Division 26, Section 26 00 90 requirements.

B. Provide shop drawings for each electrical equipment room showing the placement of all panelboards, transformers, and other equipment such as mechanical equipment, drawn to scale and dimensioned. Such shop drawings will be reviewed for compliance with the intent of the contract drawings and the spaces available for the electrical apparatus.

C. Clearly indicate on the submittals whether equipment is fully rated or series rated.

D. Arrangement: Arrange panelboard submittals in the order the panelboard schedules appear on the panelboard sheets of the drawings as read from top to bottom, then left to right.

PART 2 PRODUCTS

2.1 ENCLOSURE

A. Minimum 16 gauge cold-rolled sheet steel. Gutter wiring space shall be a minimum of 4 inches on each side/industry standard. Provide standard conduit knockouts in ends and sides of cabinet. Provide flush type combination catch and key door locks on all panelboards and load centers. Key all locks alike, provide two keys with each panelboard.

B. Flush mounted panelboards trims shall fasten to permit both horizontal and vertical adjustment.

C. Surface mounted panelboards trims shall fasten to insure no overhang.

D. Bus Material shall be:
   1. Phase Bus: 98% IACS conductivity copper with rounded edges, tin electro-plated.
   2. Ground Bus: 25% phase rated, additional isolated bus in computer and communication panels.
   3. Neutral Bus:
      a. 200% of phase rated copper, tin electro-plated - computer panels
      b. 100% of phase rated copper, tin electro-plated - lighting and power panels
   4. Current density to be the industry standard.

E. Install in allotted spaces so that devices can be added without additional machining, drilling or tapping.

F. Brace to withstand symmetrical short circuit current as indicated on drawings.

G. Provide NEMA 3R panelboards where exposed to weather, with weatherproof threaded hubs for top/bottom/side conduit entries into panel.

2.2 CIRCUIT BREAKERS

A. Quick-make, quick-break. Manual and automatic operation. Trip free and trip indicating.

B. All switchgear bolt-on only. Number of poles and ampere ratings indicated for the specified service.

C. Interrupting Ratings: As indicated on panel schedules. Panels may be noted on the drawings as fully rated due to excessive motor loads. Otherwise, panels can be fully rated or series rated for construction of new buildings. For addition and renovation work, panels with main breakers can be fully rated or series rated unless noted on the drawings as fully rated. Main lug only panels for addition and renovation work shall be fully rated.

D. Bimetallic overload elements. Magnetic trip. Common trip type so that an overload or fault on one pole will trip all poles simultaneously. Handle ties are not acceptable.

E. Connect to the main bus by means of a solid connection. Use breakers which are capable of being operated in any position within the panel.

F. Independently mount so that a single unit can be removed from the front of the panel without disturbing or removing main bus, other units or other branch circuit connections.

G. Provide ground fault circuit breakers (GFCI) where indicated on the plans, panel schedules and/or as required by NEC 422.5, 210.8(B), etc. Provide protection at all EWCs, vending machines, kitchen equipment, concessions equipment, etc.

H. Provide HACR listed circuit breakers on all HVAC equipment 60 amps or less.

I. All circuit breakers that have an overcurrent trip setting fixed or adjustable to 1200A or higher shall have an Energy-Reducing Maintenance Switch or similar approved method for arc energy reduction and shall meet all requirements of NEC 240.87.

J. Where AFCI protection is required per NEC 210.12, provide combination AFCI circuit breakers.

2.3 CIRCUIT IDENTIFICATION

A. Frame-mounted directory with a heat-resistant transparent face for identifying circuits. Use equipment names as reflected by Engineer. Use numbers selected by the Owner, which may differ from those shown on plans.

B. Indicate with light, erasable pencil marking, all spares and spaces.

C. Provide on all panelboards, revise existing panelboards per Division 26 with new information.

D. Mount inside the panelboard door.

2.4 SWITCHBOARDS (1,000 AMPS OR MORE)

A. Factory-assembled, dead front, metal enclosed.

B. Switchboards rated 2,000 amps or greater shall have a minimum depth of 30”.

C. Features:
1. Phase Bus: Tin plated copper of sufficient cross-sectional area to continuously conduct rated full load current with temperature rise limits in accordance with NEMA Standards, and industry standards.
2. Ground Bus: Full length, sized at 25% of phase bus and bonded to each section.
3. Neutral Bus: Full length, sized at 100% of phase bus.
4. Fault Withstandability: Suitable for operation at the available fault current.

D. Short Circuit Current Rating:
1. Switchboard: More than 100,000 RMS symmetrical amperes.

E. Overcurrent protection devices: Provide circuit breakers unless the drawings indicate that fused switches are required.

F. Switch Handles: Clearly indicate on and off positions and size of breaker or fused switch.

G. Fused Switches: Provide with Class R fuses.

H. Circuit Breakers: Capable of field-installable shunt trip, ground fault shunt-trip or under voltage trip.

I. Construction:
   1. Provide a single-withstanding short circuit current rating for each switchboard as shown on the plans.
   2. Provide the required number of sections of the required size to fit in the space provided.
   3. Connect sections with bussing. Cabled connections are not allowed.
   4. Use front accessible overcurrent protection devices.
   5. Label to indicate the maximum available fault current rating. This rating consists of the structure, bussing, switchboard main disconnects and switchboard branch circuit devices.

2.5 SURGE PROTECTION

A. Provide a surge protective device at the main switchgear in accordance with section 26 43 00.

2.6 IDENTIFICATION OF SWITCHGEAR

A. Information shall include the following:
   1. Panel type
   2. Style
   3. Amperage
   4. Neutral amperage
   5. Panel voltage
   6. Phase
   7. Number of wires

B. Provide information on each piece of equipment, on factory or contractor made nameplate.

C. Series Rated Panels: In accordance with NEC Article 240.86(B), provide a label affixed by the manufacturer indicating the tested and approved series rating combinations. Provide an additional label affixed behind the panel door to be field marked in accordance with NEC Article 110.22(C).

2.7 MANUFACTURERS

A. ABB (GE)

B. Square D

C. Siemens

D. Eaton Corporation (formerly Cutler-Hammer)

PART 3 EXECUTION

3.1 INSTALLATION

A. Install in the locations as shown and as recommended in NEMA PB1.1. Mount the panelboards such that the center of the switch or circuit breaker in the highest position will not be more than 6-1/2 feet above the floor or working platform. Space all panelboards and switchboards to meet the requirements of Article 110 and 340 of the N.E.C. Anchor enclosures firmly to walls and structural surfaces, ensuring that they are permanently and mechanically secured.

B. Provide required SPD breaker for each panel/switchboard as required by the manufacturer.

C. Provide a sign at each switchboard 1600 amp and greater, which reads "Danger High Voltage" in red/white/black.

D. Install panelboards and enclosures, including electrical connections, in accordance with the manufacturer's written instructions, the applicable requirements of NEC and the NECA "Standard of Installation", and in accordance with recognized industry practices to ensure that products serve the intended function.

E. Coordinate installation of panelboards and enclosures with cable and raceways installation work.

F. Connect A, B and C phases respectively to bus number 1, 2 and 3 from left to right or top to bottom. Balance panels by checking each phase of all panels under full load and arrange so that all phases carry the same load as near as possible.

G. Furnish and install an engraved laminated nameplate for each circuit breaker or fused switch in distribution panelboards. Refer to electrical equipment identification section of the specifications. Place free standing or floor mounted equipment on housekeeping pads.

H. Series rated panels: Field mark the factory furnished label in accordance with NEC Article 110.22(C).

3.2 INSTALLATION OF CONDUCTORS

A. More than one conductor shall not be installed in any termination in a panelboard unless the termination is marked as suitable for more than one conductor.

END OF SECTION

SECTION 26 27 26

WIRING DEVICES

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions, Division 1 Specifications and Section 26 00 00, apply to this Section.

1.2 SECTION INCLUDES

A. AC Switches

B. Receptacles

C. Connectors

D. Finish plates

E. Relays

1.3 RELATED SECTIONS

A. Section 26 00 00 - Electrical

B. Section 26 05 19 - Low-Voltage Electrical Power Conductors and Cables

C. Section 26 05 26 - Grounding and Bonding for Electrical Systems

D. Section 26 05 33.13 - Boxes and Fittings for Electrical Systems

1.4 REFERENCES

A. ANSI/UL 20 - General - Use Snap Switches

B. ANSI/UL 498 - Electrical Attachment Plugs and Receptacles

C. UL 943 - 2006 - Ground Fault Circuit Interrupters

D. NEMA WD 1 - General - Purpose Wiring Devices

E. NEC - National Electrical Code

F. Applicable Federal Specifications - WC - 596-F, WS-896E

G. Mounting heights per Americans with Disabilities Act

1.5 SUBMITTALS

A. Submittals required in this section shall conform to and be submitted in accordance with the General Conditions, Division 1, and Division 26, Section 26 00 90 requirements.

B. Product Data: Clearly mark product data for each product specified and/or proposed for use. Product cut sheet data shall include, but not limited to the following:
   1. receptacle devices
   2. switch devices
   3. isolated ground receptacle devices
   4. weatherproof receptacles
   5. device plates
   6. enclosures
   7. keys
   8. cord reels

1.6 DESCRIPTION OF WORK

A. Provide factory fabricated wiring devices of the type and electrical rating for the service indicated, provide proper selection to fulfill the wiring requirements. Wiring devices, including receptacles and switches shall be colored to match wall plates. Special purpose outlets shall be of appropriate color.

B. Provide a compatible receptacle for the cap or plug and cord of all other equipment installed in this project.

C. Relays, if any, shall be multipole, mechanically held, 30 amperes 120V operating coil, 600V contacts, auxiliary contacts as required for two wire operation, coil clearing contacts: Zenith ESS Series or equal.

D. Provide switch, receptacle, outlet, conduit, and special purpose wall plates for wiring devices, with ganging and cutouts as indicated, provided with metal screws for securing plates to devices, screw heads colored to match finish of plate.

E. Provide oversize plates where required to completely cover wall opening. Where oversize plates are used, all plates in room shall be oversize style.

F. Use plates and Raco narrow gang boxes in storefront mullions and where narrow boxes are required.

G. Mount all switches, thermostats, etc. at the same height when located horizontally within 6 feet on same wall. See mechanical drawings for thermostat locations.

PART 2 PRODUCTS

2.1 AC SWITCHES

A. Quiet-type, specification grade, heavy duty, back and side-wired with grounding terminals. Furnish AC switches which comply with NEMA WD-1 Standards, UL20 and Federal Specification WC896. Special purpose switches shall be of appropriate color. Switches shall be rated for 120-277 volt AC, number of poles as required.

B. Provide 120/277 volt NEMA 5-20 self-grounding specification grade devices only.

C. Provide 20 ampere ratings for all loads. Rated amperage capacity shall be 100% for all lighting loads, and 80% for all motor loads.

D. Single Pole:
   1. Leviton 1221-S
   2. Hubbell CS1221
   3. P&S CSB20AC1

E. Double Pole:
   1. Leviton 1222-S
   2. Hubbell CS1222
   3. P&S CSB20AC2

F. Three Way:
   1. Leviton 1223-S
   2. Hubbell CS1223
   3. P&S CSB20AC3

G. Four Way:
   1. Leviton 1224-S
   2. Hubbell CS1224
   3. P&S CSB20AC4

H. Motor Rated Switches:
   1. 20A. 2P Motor: 20AC2-HP (6806U-DAC);
   2. 30A. 2P Motor: 30AC2-HP (6808U-DAC);
   3. 30A. 3P Motor: 7803 (7810-UO);

I. Wall Timer Switches:
   1. Watt Stopper TS-400 with optional flash warning
   2. Equals by P&S RT24 series.
   3. Paragon will not be accepted.

2.2 RECEPTACLES

A. Furnish receptacles which comply to NEMA WD-1 Standards, UL 498 and Federal Specification WC596F.

B. 125 volt Nema 5-20R duplex, side wired, self-grounding with ground lug, specification grade hard use

C. 20A. Duplex: Leviton 5362; P&S 5362

D. GFCI Receptacles: 20-amp, duplex. Comply with NEMA WD 1, NEMA WD 6, UL 498, Federal Specification W-C-596, and UL943, Class A. Subject to compliance with requirements, products that may be incorporated into the work include, but are not limited to, the following:
   1. Pass & Seymour; 2097, 2097 (NAFTA Compliant), PT2097 (use with PTRA6STRNA prewired pigtail connector), PT2097NA (NAFTA Compliant - use with PTRA6STRNA prewired pigtail connector).
   2. Equivalent by Leviton
   3. Equivalent by Hubbell

E. Weatherproof Receptacles:
   1. Provide GFCI receptacle as specified above.
   2. Receptacle covers protected from rain shall be zinc die-cast weather-resistant cover with self-closing lid, Leviton 4992, P&S WIUCAST1, or equivalent.
   3. Receptacle covers not protected from rain shall be “While-In-Use” cover, Leviton 5977DGY, P&S WIUC10DGL, or equivalent.

4. Do not use feed through feature for any GFCI receptacle.
5. Install separate GFCI device at each location.

2.3 DEVICE PLATES

A. In finished spaces use smooth nylon device plates and covers.

B. At exposed boxes in dry interior spaces use heavy cadmium-plated sheet steel. Plate edges must be flush with edges of boxes.

C. Device plate manufacturer and device manufacturer shall be the same so colors will match. Stainless steel plates will not match the device.

2.4 DEVICE COLOR

A. Device color to be white except as otherwise indicated or required by code.

2.5 MANUFACTURERS

A. Products to be equivalent to the manufacturer, Pass & Seymour (P&S), and model numbers listed in this section. Subject to compliance with requirements, provide products by one of the following:
1. Eaton Corp. (Arrow Hart Division - formerly Cooper Industries)
2. Bryant
3. Coxreels
4. Hubbell Inc. - Richard Prather, 512-795-4058 x8325
5. KH Industries - Wendy Caparco, 716-312-0088 x144
6. Leviton MFG. Co., Inc. - Jordan Steele, 214-683-1438
7. Pass & Seymour/Legrand/Wiremold - Tracey Cain, 214-683-9726

PART 3 EXECUTION

3.1 INSTALLATION

A. Wall Switches:
1. Install in a suitable outlet box on the strike side of the door.
2. Mount at a height of 44" from the finished floor to the bottom of the switch.
3. Position switches in a uniform position so that the same direction of operation will open and close the circuits throughout the job. Position up or to the left for the ON position.
4. Do not install behind markerboards, millwork, permanent mounted equipment, etc. Verify on drawings before installation. Where installed in unsuitable location, the Contractor will move as directed at no cost to Owner.
5. Prewired pigtail connectors that accommodate UL Fed Spec receptacles are approved for installation. P&S PlugTail or equal.

B. Receptacles:
1. Install in a suitable steel outlet box.
2. Mount vertically at a height of 18 inches from the finished floor to the bottom of the receptacle or as shown on the drawings.
3. The Architect can move any receptacle, before installation, up to 6 feet in any direction at no additional cost.
4. Do not install behind markerboards, millwork, permanent mounted equipment, etc. Verify on Architectural drawings before installation. Where installed in unsuitable location, the Contractor will move as directed at no cost to Owner.

5. Prewired pigtail connectors that accommodate UL Fed Spec receptacles are approved for installation. P&S PlugTail or equal.
6. Provide AFCI protection per NEC 210.12.

C. Device Plates:
1. Install device plates for each outlet box of the type required for service.
2. Use a single one-piece device plate for ganged devices (switches & receptacle).
3. Use separate device plates for dimmers, volume controls and electronic devices.

END OF SECTION

SECTION 26 43 00

SURGE PROTECTIVE DEVICES (SPD)

PART 1 GENERAL

1.1 SUMMARY

A. This section supplements section 26 00 00 Electrical and contains additional requirements applicable to surge protective devices.

1.2 SECTION INCLUDES

A. Surge protective devices (SPD) provided in accordance with NEC article 285.

B. SPD for phone, data, security and other systems.

1.3 RELATED SECTIONS

A. Section 26 00 00 - Electrical

B. Section 26 00 90 - Electrical Submittal Procedures

1.4 REFERENCES

A. NEC - NFPA 70 National Electrical Code, most current edition

B. UL 1449 - Underwriters Laboratories, UL 1449, Standard for Safety, Surge Protection Devices 4th Edition March 2016 Type 1, Type 2 and Type 3 Protectors

C. ANSI/IEEE C62: Complete C62: Complete 1990 Edition: Guides and Standards for Surge Protection

D. UL 497 Paired Conductor Communications Circuits

1.5 SUBMITTALS

A. Submit in accordance with Section 26 00 90 Electrical Submittal Procedures.

B. Product Data: Submit product data for all SPD used on this project. Provide evidence that SPD are listed to the most current edition of UL1449 by an OSHA approved safety testing agency (i.e. UL, ETL, or CSA). Provide a submittal package that includes specifications and 3rd party testing and listing letters.

1.6 WARRANTY

A. All surge suppression devices and supporting components shall be guaranteed by the installing contractor to be free of defects in materials and workmanship for a period of five years minimum excluding installation labor. Lightning damage to the SPD is not grounds for voiding any/all warranties of the SPD.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Subject to compliance with requirements, provide products by one of the following.
   1. ACT Communications
   2. Eaton Corporation (formerly Cutler Hammer)
   3. Emerson - Liebert
   4. ABB (formerly GE Industrial)
   5. Mersen (formerly Ferraz Shawmut)
   6. Schneider Electric - Square D
   7. Surge Suppression - ILSCO

2.2 MANUFACTURED UNITS

A. Technology: Construction shall be metal oxide varister (MOV) componentry with bidirectional operation.

B. Protection Modes: Provide at least seven mode protection (L-N, L-G, N-G) with discrete protection elements on each mode.

C. Protection: Each SPD shall be protected upstream by a dedicated UL rated fuse or disconnecting means.

D. Filtering: Provide surge protection plus filtering of disruptive noises, EMI/RFI interference to >-40db from 3kHz to 1 MHz according to NEMA LS-1 Specification.

E. Listing and ratings: SPD shall be tested and performance rated per UL1449. Clamping voltage shall be clearly stated on both submittals and equipment installed.

F. Voltage ratings:

Rated Line Voltage	Maximum Continuous Operating Voltage (MCOV)	Voltage Protection Rating (VPR)
120/240; 120/208 volt	150 volts	700 volts (L-N, L-G), 1000 (L-L)
240/480; 277/480 volt	320 volts	1000 volts (L-N, L-G), 1800 (L-L)
480 volts (2 ph. Delta)	600 volts	1800 volts (L-N, L-G), 3000 (L-L)

G. Alarms and monitoring: Provide SPD with the following.
   1. LED indicator lights for power and protection status.
   2. Audible alarm, with silencing switch, to indicate when protection has failed.
   3. One set of dry contacts rated at 5A and 240V for remote monitoring of protection.

H. SPD at the electrical service entrance (main distribution panel or main service disconnecting means) shall meet the following additional criteria.
   1. Modular construction and field replaceable.
   2. Bus Bar connected for low impedance connections.
   3. UL rated as Type 1 and Type 2 SPD device
   4. SCCR: 200kAIC
   5. Nominal Discharge Current (I_n): 20,000 amperes (8 x 20 us waveform)
   6. Maximum Single Impulse Current rating: >135,000 amperes (8 x 20 us waveform) / mode.
   7. Repetitive Surge testing per IEEE C62.41.2 C3 10,000 amps: 20,000 impulses

I. SPD at electrical sub-panels shall meet the following additional criteria.
   1. Modular or System construction
   2. UL rated as Type 2 device
   3. SCCR: 100kAIC or no less than specified rating of the electrical subpanel.
   4. Nominal Discharge Current (I_n): 10,000 amperes (8 x 20 us waveform)
   5. Maximum Single Impulse Current rating: >65,000 amperes (8 x 20 us waveform) / mode.
   6. Repetitive Surge testing per IEEE C62.41.2 C3 10,000 amps: >2,500 impulses

J. SPD at rooftop units and condensers shall meet the following additional criteria.
   1. NEMA 4X enclosure suitable for outdoor installation
   2. Nipple-mounted
   3. SCCR: 100kAIC
   4. Squared D SDSA series or equivalent.

PART 3 EXECUTION

3.1 INSTALLATION

A. For new construction, provide SPD at each of the following locations. For renovations and additions, provide SPD at the following locations which are affected by the project but do not already have SPD.
   1. Each electrical service entrance equipment.
   2. At each panelboard noted on drawings in addition to above requirements.
   3. On all outdoor rooftop HVAC units and on all condensing unit switches. Mount to bottom of switch or as recommended by the manufacturer.

END OF SECTION

SECTION 26 28 13

FUSES

PART 1 GENERAL

1.1 SUMMARY

A. This section supplements section 26 00 00 - Electrical and contains additional requirements applicable to fuses.

1.2 SECTION INCLUDES

A. Low voltage fuses rated below 600 volts and 2000 amperes.

1.3 RELATED SECTIONS

A. Section 26 00 00 - Electrical

B. Section 26 00 90 - Electrical Submittal Procedures

1.4 SUBMITTALS

A. Submit product data for fuses in accordance with Section 26 00 90 Electrical Submittal Procedures.

1.5 QUALITY ASSURANCE

A. Prior to ordering fuses or fuse holders, coordinate fuse ratings with the mechanical contractor to verify that fuses for HVAC equipment matches the MOCP values of the HVAC equipment being provided.

1.6 EXTRA MATERIALS

A. Spare fuses: For each size and type fuse installed, provide to the owner at substantial completion six each or 10% of the quantity used on the project, whichever is less.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. All fuses shall be from a single manufacturer. Products of the following manufacturers are acceptable.
   1. Bussman
   2. Littelfuse
   3. Mersen (formerly Ferraz Shawmut)

2.2 MANUFACTURED UNITS

A. 600-amp and less: Class RK-1 dual element, time delay.

B. 601-amp and larger: Class L or J

PART 3 EXECUTION

3.1 INSTALLATION

A. Check fasteners on fuse clips for tightness when installing fuses.

B. Install fuses so label is in an upright, readable position. Fuses without labels are not acceptable.

C. Do not install fuses until equipment is ready to be energized.

D. Fuse cabinet: For new buildings only, provide a fuse cabinet in the main electrical room. Cabinet to be lockable with depth equal to largest fuse provided. Minimum of 24" W x 24" H x 4" deep.

END OF SECTION

SECTION 26 28 16

ENCLOSED SWITCHES AND CIRCUIT BREAKERS

PART 1 GENERAL

1.1 SUMMARY

1.1.1 SECTION INCLUDES

A. Safety Switches

B. Disconnect Switches

1.1.2 RELATED SECTIONS

A. Section 26 00 00 - Electrical

B. Section 26 00 90 - Electrical Submittal Procedures

C. Section 26 05 53 - Electrical Identification

D. Section 26 28 13 - Fuses

1.2 REFERENCES

A. ANSI/UL 98 - Safety Standard for Enclosed Switches.

B. NEMA KS 1 - Enclosed Switches.

1.3 SYSTEM DESCRIPTION

A. Safety switches shall be of the same manufacturer as distribution switchgear.

B. Both the safety switch and disconnect are to indicate the requirement for a fused disconnecting means, unless a non-fused disconnect is specifically requested on the contract drawings.

C. The extent of safety switches, disconnect switches is indicated on the drawings and by the requirements of this section.

D. In accordance with the service indicated, use 240 or 600 volt switches, single throw, fusible, or non-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 N.E.C.

E. Use switches which have number of poles required, dependent on equipment requirements.

F. Use NEMA 3R switches where exposed to weather, with weatherproof threaded hubs for top or side conduit entries into switch.

G. Use fuse clips which are rejecting type to accept Class RK or L fuses only.

H. Size fuses serving motor loads at 125% to 175% of motor nameplate rating, or the next standard size and as specifically recommended by motor or equipment manufacturer.

I. Provide a manual switch at each motor, class 2510 Square D, for motors shown with "MS." Provide a 20-AMP rated switch at each motor not otherwise noted.

J. Where switches/breakers are listed as requiring GFCI protection in specifications or drawings, coordinate with the equipment manufacturer to provide proper GFCI requirements to determine whether they are intended to be for personnel (5ma) or equipment (30ma).

1.4 SUBMITTALS

A. Submittals required in this section shall conform to and be submitted in accordance with the General Conditions, Division 1 and Division 26, Section 26 00 90 requirements.

1.5 PRODUCT DATA

A. Submit product data for the following.
   1. Safety and Disconnect Switches

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. GE / ABB

B. Square D

C. Siemens

D. Eaton Corporation (formerly Cutler-Hammer)

2.2 SWITCHES

A. Provide safety switches and disconnects with a voltage rating suitable for the nominal voltage of the system in which they are to be applied. Contacts are quick-make, quick-break.

B. Provide surge protective devices in accordance with section 26 43 00.

2.3 CIRCUIT BREAKERS

A. All circuit breakers that have an overcurrent trip setting fixed or adjustable to 1200A or higher shall have an Energy-Reducing Maintenance Switch or similar approved method for arc energy reduction and shall meet all requirements of NEC 240.87.

2.4 CONSTRUCTION

A. Indoor dry locations, 30 amp thru 100 amp, use NEMA 1 general duty (GD).

B. All outdoor locations use NEMA 3R heavy duty (HD).

C. The handle shall be suitable for padlocking in the OFF position. Defeatable, front accessible, coin-proof door interlock to prevent opening the door when the switch is in the ON position and to prevent turning the switch ON when the door is open. Incoming line terminals with an insulated shield.

D. Provide switches with rejection-type fuse holders suitable for use with fuses specified under Section 26 28 13.

PART 3 EXECUTION

3.1 INSTALLATION

A. Mount switches no more than 6 inches above and within 6 feet of the equipment served at the direction of the Engineer, so that operating handle is easily accessible. Align tops of switches when grouped together.

B. Provide a housekeeping pad for all free standing or floor mounted safety switches whether they are mounted inside or outside.

C. Mount vertically on required separate support system hardware with switch easily accessible (door to open 90 degrees minimum).

D. Permanently mount safety switches from inside with plated or stainless bolts, toggle bolts or anchors.

E. Exposed mounting bolts, screws, etc. are not acceptable.

F. Permanently install fusible switches with class R fuse kits so that fuses are readable when looking at open switch.

G. Do not mount switches/disconnects to access panels or on nameplate data or equipment.

H. Installation of Conductors: Switches shall not be used as “junction boxes” between HVAC units (splicing or “pig tailing” is not permitted). The maximum number of conductors allowed per termination is determined by the manufacturer’s approved rating for each terminal or lug. Multiple conductor configurations shall be highlighted in the contractor’s submittal package. Exceptions to this rating must be obtained in writing from the engineer’s office on a case by case basis.

I. Coordinate and verify exact fuse sizes with mechanical contractor. Fuses shown on drawings are based on one manufacturer. Fuse sizes vary depending on manufacturer.

J. Identification: Refer to Section 26 05 53 for Electrical Identification. Provide nameplate identification on all HVAC equipment regardless of equipment location.

END OF SECTION