furlow associates
consulting engineers

HEATING PLANT MODIFICATIONS

AT

EDEN SUPPORT CENTER

July 30, 2015

furlow associates, inc.
consulting engineers
1206 Society Drive
Claymont, Delaware

Christina School District

Eden Support Center
Heating Plant Modifications

Invitation to Bid

July 15, 2015

- Deadline to Respond –
July 30, 2015
2:00 pm E.S.T.

Eden Support Center
Heating Plant Modifications

ALL BIDDERS:

The enclosed packet contains an "INVITATION TO BID" for Eden Support Center, Heating Plant Modifications. The invitation consists of the following documents:

INVITATION TO BID

1 INDEX
2 DEFINITIONS and GENERAL PROVISIONS
3 SPECIAL PROVISIONS and SPECIFICATIONS
4 BID QUOTATION REPLY SECTION
A - NO BID REPLY FORM
B - BID BOND
C - NON-COLLUSION STATEMENT AND ACCEPTANCE
D - QUOTATION SUMMARY
E - OFFICE OF MINORITY AND WOMEN BUSINESS ENTERPRISE (OMWBE) APPLICATION
F – AIA DOCUMENT A-201-2007
5 PREVAILING WAGE RATES
6 DRAWING LIST
7 TECHNICAL SPECIFICATIONS
DIVISION 1 REQUIREMENTS
DIVISION 23 – MECHANICAL

In order for your bid to be considered, the bid quotation reply section shall be executed completely and correctly and returned in a sealed envelope clearly displaying the contract number, by July 30, 2015, 2:00 pm (EST).

Bids shall be submitted to:

Christina School District
c/o Furlow Associates, Inc.
Attn: Robert W Jordan
Project Manager
1206 Society Drive
Claymont, Delaware 19703

Please review and follow the information and instructions contained in the general and special provisions section of the invitation. Should you need additional information, please call 302-798-3515.

DEFINITIONS
AND
GENERAL PROVISIONS

The attached Definitions and General Provisions apply to all contracts and are part of each invitation to bid. The requirement to furnish a bid bond and performance bond is applicable unless waived in the Special Provisions. Should the General Provisions conflict with the Special Provisions, the Special Provisions shall prevail. Bidders or their authorized representatives are required to fully acquaint themselves as to State procurement laws and regulations prior to submitting bid.

DEFINITIONS

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

STATE: The State of Delaware

AGENCY: State Agency as noted on cover sheet.

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

BID INVITATION: The "bid invitation" or "invitation to bid" is a packet of material sent to vendors and consists of General Provisions, Special Provisions, specifications, and enclosures.

GENERAL PROVISIONS: General Provisions are instructions pertaining to contracts in general. They contain, in summary, requirements of laws of the State, policies of the Agency, and instructions to vendors.

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

BIDDER OR VENDOR: Any individual, firm, or corporation formally submitting a proposal for the material or work contemplated, acting directly or through a duly authorized representative.

PROPOSAL: The offer of the bidder submitted on the approved form and setting forth the bidder's prices for performing the work or supplying the material or equipment described in the specifications.

SURETY: The corporate body which is bound with and for the contract, or which is liable, and which engages to be responsible for the contractor's payments of all debts pertaining to and for its acceptable performance of the work for which it has contracted.

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

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

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

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

SECTION A - GENERAL PROVISIONS

1. **BID INVITATION**:

   See "Definitions".

2. **PROPOSAL FORMS**:

   The invitation to bid shall contain pre-printed forms for use by the vendor in submitting its bid. The forms shall contain basic information such as description of the item and the estimated quantities and shall have blank spaces for use by the vendor for entering information such as unit bid price, total bid price, etc.

3. **INTERPRETATION OF ESTIMATES**:

   a. The attention of bidders is called to the fact that, unless stated otherwise, the quantities given in the proposal form are to be considered to be approximate only and are given as a basis for the comparison of bids. The Agency may increase or decrease the amount of any item as may be deemed necessary or expedient, during the period of the contract.

   b. An increase or decrease in the quantity for any item is not sufficient ground for an increase or decrease in the unit price.

4. **SILENCE OF SPECIFICATIONS**:

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

5. **EXAMINATION OF SPECIFICATIONS AND PROVISIONS**:

   The bidder shall examine carefully the proposal and the contract forms for the material contemplated. The bidder shall investigate and satisfy itself as to the conditions to be encountered, quality and quantities of the material to be furnished, and the requirements of the Special Provisions and the contract. The submission of a proposal shall be conclusive evidence that the bidder has made examination of the aforementioned conditions.

6. **PREPARATION OF PROPOSAL**:

   a. The bidder's proposal shall be written in ink or typewritten on the form provided.

   b. If items are listed with a zero quantity, bidder shall state unit price **ONLY** (intended for open end purchases where estimated requirements are not known). The proposal shall show a total bid price for each item bid and the total bid price of the proposal excluding zero quantity items.

7. **PRICES QUOTED**:

The prices quoted are those for which the material will be furnished F.O.B. Ordering Agency and include all charges that may be imposed during the period of the contract.

8. **DISCOUNT**:

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

9. **SAMPLES OR BROCHURES**:

Samples or brochures may be required by the agency for evaluation purposes. They shall be such as to permit the Agency to compare and determine if the item offered complies with the intent of the specifications.

10. **PROPOSAL GUARANTY; BID BOND**:

a. Each bidder shall submit with its proposal a guaranty in sum equal to at least 10% of the total value of its bid, according to Delaware Code Title 29, Section 6927(a).

b. This bid bond shall be submitted in the form of good and sufficient bond drawn upon an insurance or bonding company authorized to do business in the State of Delaware, to the State of Delaware for the benefit of the Agency, or a certified check drawn on a reputable banking institution and made payable to the Agency in the requirement amount. If Agency bond form is not utilized, the substituted bond forms must conform to the minimum of conditions specified in the Agency bond form.

11. **DELIVERY OF PROPOSALS**:

Proposals shall be delivered in sealed envelopes, and shall bear on the outside the name and address of the bidder as well as the designation of the contract. Proposals forwarded by U.S. Mail shall be sent first class to the address listed below. Proposals forwarded by delivery service other than the U.S. Mail or hand delivered must be delivered to the address listed below.

Christina School District
c/o Furlow Associates, Inc.
ATTN: Robert W. Jordan
1206 Society Drive
Claymont, Delaware 19703

All proposals will be accepted at the time and place set in the advertisement. Bidder bears the risk of delays in delivery. Proposals received after the time set for public opening will be returned unopened.

12. **WITHDRAWAL OF PROPOSALS**:

A bidder may withdraw its proposal unopened after it has been deposited, if such a request is made prior to the time set for the opening of the proposal.

13. **PUBLIC OPENING OF PROPOSALS**:

The bids shall be publicly opened at the time and place specified by the Agency. Bidders or their authorized representatives are invited to be present.

14. **PUBLIC INSPECTION OF PROPOSALS**:

If the bidder designates a portion of its bid as confidential, it shall isolate and identify in writing the confidential portions. The bidder shall include with this designation a statement that explains and supports the firm's claim that the bid items identified as confidential contain trade secrets or other proprietary data.

15. **DISQUALIFICATION OF BIDDERS**:

Any one or more of the following causes may be considered as sufficient for the disqualification of a bidder and the rejection of its proposal or proposals:

a. More than one proposal for the same contract from an individual, firm, or corporation under the same or different names.

b. Evidence of collusion among bidders.

c. Unsatisfactory performance record as evidenced by past experience.

d. If the unit prices are obviously unbalanced either in excess or below reasonable cost analysis values.

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

f. Non-attendance of mandatory pre-bid meetings may be cause of disqualification.

SECTION B - AWARD AND EXECUTION OF CONTRACT

1. **CONSIDERATION OF BIDS**:

a. After the proposals have been opened, the bids will be tabulated and the results will be made available to the public. Tabulations of the bids will be based on the correct summation of items at the unit price bid.

b. The right is reserved to waive technicalities, to reject any or all bids, or any portion thereof, to advertise for new proposals, to proceed to do the work otherwise, or to abandon the work, if in the judgment of the Agency or its agent, the best interest of the State will be promoted thereby.

2. **MATERIAL GUARANTY**:

Before any contract is awarded, the successful bidder may be required to furnish a complete statement of the origin, composition and manufacture of any or all of the material to be used in the contract together with such samples as may be requested for the purpose of testing.

3. **CONTRACT AWARD**:

Within thirty days from the date of opening proposals, the contract will be awarded or the proposals rejected.

4. **EXECUTION OF CONTRACT**:

   a. The bidder to whom the award is made shall execute a formal contract and bond within twenty days after date of official notice of the award of the contract.

   b. If the successful bidder fails to execute the required contract and bond, as aforesaid, within twenty days after the date of official notice of the award of the contract, its proposal guaranty shall immediately become forfeited as liquidated damages. Award will then be made to the next lowest qualified bidder of the work or re-advertised, as the Agency may decide.

5. **REQUIREMENT OF CONTRACT BOND**:

   a. Successful bidders shall furnish bond, simultaneously with the execution of the formal contract, to the State of Delaware for the benefit of the Agency with surety in the amount of 100% of the total contract award or as otherwise provided in the Special Provisions. Said bonds shall be conditioned upon the faithful performance of the contract.

   b. The bond forms shall be provided by the Agency and the surety shall be acceptable to the Agency.

6. **WARRANTY**:

   The successful bidder(s) shall be required to extend any policy guarantee usually offered to the general public, FEDERAL, STATE, COUNTY, or MUNICIPAL governments, on material in this contract against defective material, workmanship, and performance.

7. **THE CONTRACT(S)**:

   The contract(s) with the successful bidder(s) will be executed with the Christina School District – Facilities Services acting for all participating agencies.

8. **INFORMATION REQUIREMENT**:

   The successful bidder's shall be required to advise the Christina School District – Facilities Services of the gross amount of purchases made as a result of the contract.

9. **CONTRACT EXTENSION**:

   The State reserves the right to extend this contract on a month-to-month basis for a period of up to three months.

10. **TERMINATION FOR CONVENIENCE**:

Contracts shall remain in effect for the time period and quantity specified unless the contract is terminated by the State. The State may terminate the contract at any time by giving written notice of such termination and specifying the effective date thereof, at least sixty (60) days before the effective date of termination.

11. **TERMINATION FOR CAUSE**:

If, for any reasons, or through any cause, the Contractor fails to fulfill in timely and proper manner its obligations under this Contract, or if the Contractor violates any of the covenants, agreements, or stipulations of this Contract, the State shall thereupon have the right to terminate this contract by giving written notice to the Contractor of such termination and specifying the effective date thereof, at least 5 days before the effective date of such termination. In that event, all finished or unfinished documents, data, studies, surveys, drawings, maps, models, photographs, and reports or other material prepared by the Contractor under this Contract shall, at the option of the State, become its property, and the Contractor shall be entitled to receive just and equitable compensation for any satisfactory work completed on such documents and other materials which is usable to the State.

SECTION C - GENERAL

1. **AUTHORITY OF AGENCY**:

On all questions concerning the interpretation of specifications, the acceptability and quality of material furnished and/or work performed, the classification of material, the execution of the work, and the determination of payment due or to become due, the decision of the Agency shall be final and binding.

2. **LAWS TO BE OBSERVED**:

The contractor is presumed to know and shall strictly comply with all National, State, or County laws, and City or Town ordinances and regulations in any manner affecting the conduct of the work. The contractor shall indemnify and save harmless the State of Delaware, the Agency, and all Officers, Agency and Servants thereof against any claim or liability arising from or based upon the violation of any such laws, ordinances, regulations, orders, or decrees whether by itself or by its employees.

3. **PERMITS AND LICENSES**:

All necessary permits, licenses, insurance policies, etc. required by local, State or Federal laws, shall be provided by the contractor at its own expense.

4. **PATENTED DEVICES, MATERIAL AND PROCESSES**:

a. The contractor shall provide for the use of any patented design, device, material, or process to be used or furnished under this contract by suitable legal agreement with the patentee or owner, and shall file a copy of this agreement with the Agency.

b. The contractor and the surety shall hold and save harmless the State of Delaware, the Agency, the Director, their Officers or Agents from any and all claims because of the use of such patented design, device, material, or process in connection with the work agreed to be performed under this contract.

5. **EMERGENCY TERMINATION OF CONTRACT**:

a. Due to restrictions which may be established by the United States Government on material, or work, a contract may be terminated by the cancellation of all or portions of the contract.

b. In the event the contractor is unable to obtain the material required to complete the items of work included in the contract because of restrictions established by the United States Government and if, in the opinion of the Agency, it is impractical to substitute other available material, or the work cannot be completed within a reasonable time, the incomplete portions of the work may be cancelled, or the contract may be terminated.

6. **TAX EXEMPTION**:

a. Material covered by this proposal is exempt from all FEDERAL and STATE TAXES. Such taxes shall not be included in prices quoted.

b. Any material which is to be incorporated in the work or any equipment required for the work contemplated in the proposal may be consigned to the Agency. If the shipping papers show clearly that any such material is so consigned, the shipment will be exempt from the tax on the transportation of property under provisions of Section 3475 (b) of the Internal Revenue Code, as amended by Public Law 180 (78th Congress). All transportation charges shall be paid by the contractor. Each bidder shall take its exemption into account in calculating its bid for its work.

7. **OR EQUAL (PRODUCTS BY NAME)**:

Specifications of products by name are intended to be descriptive of quality or workmanship, finish and performance. Desirable characteristics are not intended to be restrictive. Substitutions of products for those named will be considered provided the vendor certifies that the function, characteristics, performance and endurance qualities of the material offered is equal or superior to that specified.

8. **BID EVALUATION AND AWARD**:

The Christina School District – Facilities Services will award this contract to the lowest responsible bidder(s) which in their judgment best serves the interest of the State of Delaware in accordance with Delaware Code Title 29, Section 6923(k). Personnel with experience and technical background may be utilized by the Christina School District – Facilities Services in making judgment. In case of error in price extension, the unit price(s) shall prevail.

9. **INVOICING**:

After the awards are made, the agencies participating in the bid may forward their purchase orders to the successful bidder(s) in accordance with State Purchasing Procedures. The State will generate a payment voucher upon receipt of an invoice from the vendor.

SECTION D - EQUAL OPPORTUNITY

1. **EQUALITY OF EMPLOYMENT OPPORTUNITY ON PUBLIC WORKS**:

During the performance of any contract for public works financed in whole or in part by appropriation of the State of Delaware, the contractor agrees as follows:

a. The contractor will not discriminate against any employee or applicant for employment because of race, creed, color, sex, age, or national origin. The contractor will take affirmative action to ensure that applicants are employed and that employees are treated equally during employment without regard to their race, creed, color, sex, age, or national origin. Such action shall include, but not be limited to the following: advertising, lay-off or termination, rates of pay or other forms of compensation, and selection for training including apprenticeships. The contractor agrees to post in conspicuous places, notices to be provided by the contracting agency setting forth the provisions of this non-discrimination clause.

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

c. The term "contractor for public works" means construction, reconstruction, demolition, alteration, and/or repair work, maintenance work, and paid for in whole or in part out of the funds of a public body except work performed under a vocational rehabilitation program. The manufacture or furnishing of materials, articles, supplies or equipment is not a public work within the meaning of this subsection unless conducted in connection with and at the site of the public work.

Eden Support Center
Heating Plant Modifications
SPECIAL PROVISIONS

1. **CONTRACT REQUIREMENTS**:

This contract will be issued to cover the Eden Support Center Heating Plant Modifications requirements for Christina School District.

2. **CONTRACT PERIOD**:

Each vendor's contract shall be valid from July, 2015 to December, 2015.

3. **PRICES**:

Prices shall remain firm for the term of the contract.

4. **PRICE ADJUSTMENT**:

If during the initial term of the contract, the Vendor is not prohibited from offering a price reduction on its services or materiel offered under the contract. The State is not prohibited from requesting a price reduction on those services or materiel during the initial term or any subsequent options that the State may agree to exercise

If agreement is reached to extend this contract for the second, optional year, Christina School District – Facilities Services shall have the option of offering a determined price adjustment and shall not exceed the current Philadelphia All Urban Consumers Price Index (CPI-U), U.S. City Average. If the CPI-U is used, any increase/decrease shall reflect the change during the previous published twelve (12) month period at the time of renegotiation.

5. **SHIPPING TERMS**:

F.O.B. destination; freight pre-paid.

6. **QUANTITIES**:

The attention of bidders is called to the fact that, unless stated otherwise, the quantities given in the proposal are best estimates and are given as a basis for the comparison of bids. Quantities ordered may be increased or decreased by any eligible agency as deemed necessary during the period of the contract.

7. **FUNDING OUT**:

The continuation of this contract is contingent upon funding appropriated by the legislature.

8. **BID BOND REQUIREMENT**:

a. Each bidder shall furnish a bond to the State of Delaware for the benefit of Christina School District – Facilities Services in the amount equal to 10% of the respective bid value. The bond shall be drawn upon an insurance or bonding company authorized to do business in the State of Delaware. If the enclosed standard State of Delaware bond form is not used, the substitute bond must reflect the minimum conditions specified in the standard form. A certified check made out to Christina School District – Facilities Services in an amount equal to 10% of the respective proposed value may be submitted in lieu of a proposal bond.

b. Bid Bond Waived.

9. **PERFORMANCE BOND REQUIREMENT**:

a. Contractors awarded contracts are required to furnish a 100% Performance Bond in accordance with Delaware Code Title 29, Section 6927, to the State of Delaware for the benefit of Christina School District – Facilities Services with surety in the amount of 100% of the specific award. Said bonds shall be conditioned upon the faithful performance of the contract. This guarantee shall be submitted in the form of good and sufficient bond drawn upon an Insurance or Bonding Company authorized to do business in the State of Delaware. If Christina School District – Facilities Services bond form is not utilized, the substituted bond form must reflect the minimum conditions specified in Christina School District – Facilities Services Bond Form.

b. Performance Bond Waived

10. **MANDATORY INSURANCE REQUIREMENTS**:

A. Certificate of Insurance and/or copies of insurance policies for the following:

1. As a part of the contract requirements, the contractor must obtain at its own cost and expense and keep in force and effect during the term of this contract, including all extensions, the minimum coverage limits specified below with a carrier satisfactory to the State. All contractors must carry Comprehensive General Liability and at least one of the other coverages depending on the type of service or product being delivered.

a. Comprehensive General Liability - $1,000,000.00 per person/$3,000,000 per occurrence.

and

b. Medical/Professional Liability - $1,000,000.00 per person/$3,000,000 per occurrence.

or

c. Miscellaneous Errors and Omissions - $1,000,000.00 per person/$3,000,000 per occurrence.

or

d. Product Liability - $1,000,000.00 per person/$3,000,000 per occurrence.

2. Automotive Liability Insurance covering all automotive units used in the work with limits of not less than $100,000 each person and $300,000 each accident as to bodily injury and $25,000 as to property damage to others.

3. Forty-five (45) days written notice of cancellation or material change of any policies is required.

Administrator, Nicholas Vacirca
Christina School District
925 Bear-Corbitt Road
Bear, Delaware 19701

Note: The State of Delaware shall not be named as an additional insured.

11. **BASIS OF AWARD**:

Christina School District – Facilities Services shall award this contract to the lowest responsible and responsive bidder(s) who best meets the terms and conditions of the bid. The award will be made on basis of price, product evaluation, and prior history of service and capability.

Christina School District – Facilities Services reserves the right to reject any or all bids in whole or in part, to make multiple awards, partial awards, award by types, item by item, or lump sum total, whichever may be most advantageous to the State of Delaware.

12. **STATE OF DELAWARE BUSINESS LICENSE**:

Prior to receiving an award, the successful vendor shall either furnish Christina School District – Facilities Services with proof of State of Delaware Business Licensure or initiate the process of application where required. An application may be requested in writing to: Division of Revenue, Carvel State Building, P.O. Box 8750, 820 N. French Street, Wilmington, DE 19899 or by telephone to one of the following numbers: (302) 577-8201 - Public Service, (302) 577-8205 - Licensing Department.

Information regarding the award of this contract will be given to the Division of Revenue. Failure to comply with the State of Delaware licensing requirements may subject your organization to applicable fines and/or interest penalties.

13. **HOLD HARMLESS**:

The successful bidder agrees that it shall indemnify and hold the State of Delaware and all its agencies harmless from and against any and all claims for injury, loss of life, or damage to or loss of use of property caused or alleged to be caused, by acts or omissions of the successful bidder, its employees, and invitees on or about the premises and which arise out of the successful bidder's performance, or failure to perform as specified in the Agreement.

14. **OWNERSHIP OF INTELLECTUAL PROPERTY:**

All copyright and patent rights to all papers, reports, forms, materials, creations, or inventions created or developed in the performance of this contract shall become the sole

property of the State of Delaware. On request, the contractor shall promptly provide an acknowledgment or assignment in a tangible form satisfactory to the State to evidence the State's sole ownership of specifically identified intellectual property created or developed in the performance of the contract.

15. **NON-PERFORMANCE**:

In the event the vendor does not fulfill its obligations under the terms and conditions of this contract, the ordering agency may purchase equivalent product on the open market. Any difference in cost between the contract prices herein and the price of open market product shall be the responsibility of the vendor. Under no circumstances shall monies be due the vendor in the event open market products can be obtained below contract cost. Any monies charged to the vendor may be deducted from an open invoice.

16. **FORCE MAJEURE**:

Neither the vendor nor the ordering agency shall be held liable for non-performance under the terms and conditions of this contract due, but not limited to, government restriction, strike, flood, fire, or unforeseen catastrophe beyond either party's control. Each party shall notify the other in writing of any situation that may prevent performance under the terms and conditions of this contract.

17. **CONTRACTOR NON-ENTITLEMENT**:

State of Delaware Contractors for Materiel and for Services shall not have legal entitlement to, nor seek business from another Contractors' Central Contract. Additionally, they shall not utilize other Central Contracts to fulfill the requirements of their respective contract as they are not a "Covered Agency" as defined by Title 29 Chapter 69 of the State Procurement Code.

18. **EXCEPTIONS**:

Bidders may elect to take minor exception to the terms and conditions of this ITB. Christina School District – Facilities Services shall evaluate each exception according to the intent of the terms and conditions contained herein, but Christina School District – Facilities Services must reject exceptions that do not conform to State bid law and/or create inequality in the treatment of bidders. Exceptions shall be considered only if they are submitted with the bid or before the date and time of the bid opening.

19. **BUSINESS REFERENCES**:

In order to have your bid considered, please supply three (3) business references consisting of current or previous customers with your reply. Please include name, address, telephone number, and a contact person.

20. **ORDERING PROCEDURE**:

Successful contractors are required to have either a local telephone number within the (302) area code, a toll free (800) number, or agree to accept collect calls. Each agency is responsible for placing their orders and may be accomplished by written purchase order, telephone, fax or computer on-line systems. The contractor or vendor must accept full

payment by procurement (credit) card and/or conventional check and/or other electronic means at the State's option, without imposing any additional fees, costs or conditions.

21. **BILLING**:

The successful vendor is required to "Bill as Shipped" to the respective ordering agency(s). Ordering agencies shall provide contract number, ship to and bill to address, contact name and phone number.

22. **PAYMENT**:

The agencies or school districts involved will authorize and process for payment each invoice within thirty (30) days after the date of receipt of a correct invoice. The contractor or vendor must accept full payment by procurement (credit) card and/or conventional check and/or other electronic means at the State's option, without imposing any additional fees, costs or conditions.

23. **PRODUCT SUBSTITUTION**:

All items delivered during the life of the contract shall be of the same type and manufacture as specified or accepted as part of the bid proposal unless specific approval is given by Christina School District – Facilities Services to do otherwise. However, awarded vendors are highly encouraged to offer any like substitute product (s); either generic or brand name, at any time during the subsequent contract term, especially if an opportunity for cost savings to the state exists. In such cases, the state may require the submission of written specifications and/or product samples for evaluation prior to any approvals being granted.

24. **BID/CONTRACT EXECUTION**:

Both the non-collusion statement that is enclosed with this Invitation to Bid and the contract form delivered to the successful bidder for signature **shall** be executed by a representative who has the legal capacity to enter the organization into a formal contract with the State of Delaware, Christina School District – Facilities Services. The awarded vendor(s) will be required to complete the new W-9 Form by visiting the Division of Accounting's Website: http://accounting.delaware.gov.

25. **CONTRACTOR RESPONSIBILITY**:

The State will enter into a contract with the successful contractor. The successful contractor shall be responsible for all products and services as required by this ITB. Subcontractors, if any, shall be clearly identified in the financial proposal.

26. **PERSONNEL**:

a. The Contractor represents that they have, or will secure at their own expense, all personnel required to perform the services required under this contract.

b. All of the services required hereunder shall be performed by the Contractor or under its direct supervision, and all personnel, including subcontractors, engaged in the

work shall be fully qualified and shall be authorized under State and local law to perform such services.

c. None of the work or services covered by this contract shall be subcontracted without the prior written approval of the State.

28. **LIFE CYCLE COSTING**:

If applicable, the specifications contained within this ITB have been developed through Life Cycle Cost Analysis that will allow the State to realize the lowest total cost of ownership and operation over the useful life of the equipment.

29. **ENERGY STAR PRODUCTS**:

The contractor **must** provide products that earn the ENERGY STAR rating and meet the ENERGY STAR specifications for energy efficiency. The offeror is encouraged to visit www.energystar.gov for complete product specifications and updated lists of qualifying products.

30. **TERMINATION FOR CONVENIENCE**:

Contracts shall remain in effect for the time period and quantity specified unless the contract is terminated by the State. The State may terminate the contract at any time by giving written notice of such termination and specifying the effective date thereof, at least sixty (60) days before the effective date of termination.

31. **TERMINATION FOR CAUSE**:

If, for any reasons, or through any cause, the Contractor fails to fulfill in timely and proper manner its obligations under this Contract, or if the Contractor violates any of the covenants, agreements, or stipulations of this Contract, the State shall thereupon have the right to terminate this contract by giving written notice to the Contractor of such termination and specifying the effective date thereof, at least 5 days before the effective date of such termination. In that event, all finished or unfinished documents, data, studies, surveys, drawings, maps, models, photographs, and reports or other material prepared by the Contractor under this Contract shall, at the option of the State, become its property, and the Contractor shall be entitled to receive just and equitable compensation for any satisfactory work completed on such documents and other materials which is usable to the State.

32. **VENDOR EMERGENCY RESPONSE POINT OF CONTACT**:

The awarded vendor(s) shall provide the name(s), telephone, or cell phone number(s) of those individuals who can be contacted twenty four (24) hours a day, seven (7) days a week to meet a critical need for commodities or services when the Governor of the State of Delaware declares a state of emergency under the current Delaware Emergency Operations Plan. Failure to provide this information could render the bid as non-responsive.

33. **ELECTRONIC CATALOG**:

The successful vendor(s) may be required to submit their items list in electronic format designated by the State.

Note: The State of Delaware is in the process of implementing a new financials system, which will require the use of:

- Electronic catalogs
- Commodity/classification code: United Nations Standard Products and Services Code (UNSPSC).
- A unique item ID for all items in our system

The state has made the determination to include the requirement in this contract for two reasons:

1. To find out what vendors can offer.
2. To give the agencies and school districts a level of comfort in using electronic catalogs.

TECHNICAL SPECIFICATIONS

DIVISION 1: GENERAL REQUIREMENTS

DIVISION 22: PLUMBING

DIVISION 23: HVAC

DIVISION 26: ELECTRICAL

BID QUOTATION REPLY SECTION

Eden Support Center
Heating Plant Modifications

Please fill out the attached forms fully and completely and return with your bid in a sealed envelope clearly displaying the contract number to Furlow Associates, Inc. by July 30, 2015, 2:00 pm (EST) at which time bids will be opened.

Bids shall be submitted to:

CHRISTINA SCHOOL DISTRICT
c/o Furlow Associates, Inc.
1206 Society Drive
Claymont, Delaware 19703

PUBLIC BID OPENINGS

The public bid opening insures the citizens of Delaware that contracts are being bid fairly on a competitive basis and comply with Delaware procurement laws. The agency conducting the opening is required by law to publicly open the bids at the time and place specified and the contract shall be awarded within thirty (30) days thereafter. The main purpose of the bid opening is to reveal the name(s) of the bidders(s), not to serve as a forum for determining the apparent low bidders. The disclosure of additional information, including prices, shall be at the discretion of the contracting agency until such time that the responsiveness of each bid has been determined.

After receipt of a fully executed contract(s), the Delaware public and all bidders are invited to make an appointment with the contracting officer in order to review pricing and other non-confidential information.

NOTE: ONLY THE BIDDER'S NAME WILL BE READ AT THE BID OPENING

BID QUOTATION

Eden Support Center
Heating Plant Modifications

DELIVERY CONTRACT TOTAL VALUE $_____

Ship Stock _____ days ARO

Ship Non-Stock _____ days ARO

COMPANY

_____

_____

_____

Signature_____ Date: _____

CHRISTINA SCHOOL DISTRCIT
C/O FURLOW ASSOCIATES, INC
1206 SOCIETY DRIVE
CLAYMONT, DELAWARE 19703

NO BID REPLY FORM

BID TITLE: Eden Support Center
Heating Plant Modifications

To assist us in obtaining good competition on our Request for Bids, we ask that each firm that has received an invitation, but does not wish to bid, state their reason(s) below and return in a clearly marked envelope displaying the contract number. This information will not preclude receipt of future invitations unless you request removal from the Bidder's List by so indicating below, or do not return this form or bona fide bid.

Unfortunately, we must offer a "No Bid" at this time because:

_____ 1. We do not wish to participate in the bid process.

_____ 2. We do not wish to bid under the terms and conditions of the Request for Bid document. Our objections are:

_____

_____

_____ 3. We do not feel we can be competitive.

_____ 4. We cannot submit a Bid because of the marketing or franchising policies of the manufacturing company.

_____ 5. We do not wish to sell to the State. Our objections are: _____

_____

_____ 6. We do not sell the items/services on which Bids are requested.

_____ 7. Other: _____

_____ _____
FIRM NAME SIGNATURE

_____ We wish to remain on the Bidder's List **for these goods or services**.

_____ We wish to be deleted from the Bidder's List **for these goods or services**.

10% BOND TO ACCOMPANY PROPOSAL
(NOT NECESSARY IF CERTIFIED CHECK IS USED)

KNOW ALL MEN BY THESE PRESENTS That _____ of _____ of the County of _____ and State of _____ principal, and _____ of _____ of the County of _____ and the State of _____ as surety, legally authorized to do business in the State of Delaware, are held and firmly bound unto the State of Delaware in the sum of _____ Dollars or _____ per cent (not to exceed _____ Dollars) of amount bid on Contract No. _____ to be paid to said State of Delaware for the use and benefit of the _____ of said State, for which payment well

(hereinafter referred to as Agency)

and truly to be made, we do bind ourselves, our and each of our heirs, executors, administrators, and successors, jointly and severally for and in the whole, firmly by these presents.

NOW THE CONDITION OF THIS OBLIGATION IS SUCH That if the above bounden principal _____ who has submitted to said Agency of the State of Delaware, a certain proposal to enter into a certain contract to be known as Contract No. _____, for the furnishing of certain products and/or services within the said State of Delaware shall be awarded said Contract No. _____, and if said _____ shall well and truly enter into and execute said Contract No. _____ and furnish therewith such surety bond as may be required by the terms of said contract and approved by said Agency, said contract and said bond to be entered into within twenty days after the date of official notice of the award thereof in accordance with the terms of said proposal, then this obligation to be void or else to be and remain in full force and virtue.

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

SEALED AND DELIVERED IN THE
Presence Of _____ _____ (Seal)
Name of Bidder (Principal)

Witness

_____ BY _____
(Seal)

Corporate
Seal

_____
Title

_____ BY _____ (Seal)
Name of Surety

_____ (Seal)

_____Title

TITLE: Eden Support Center Heating Plant Modifications
OPENING DATE: July 30, 2015

NON-COLLUSION STATEMENT

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

It is agreed by the undersigned bidder that the signed delivery of this bid represents the bidder's acceptance of the terms and conditions of this Invitation to Bid including all specifications and special provisions.

NOTE: Signature of the authorized representative **MUST** be of an individual who legally may enter his/her organization into a formal contract with the State of Delaware, Christina School District – Facilities Services.

COMPANY NAME _____ Check one)

	Corporation
	Partnership
	Individual

NAME OF AUTHORIZED REPRESENTATIVE
(Please type or print) _____

SIGNATURE _____ TITLE _____

COMPANY ADDRESS _____

PHONE NUMBER _____ FAX NUMBER _____

EMAIL ADDRESS _____

FEDERAL E.I. NUMBER _____ STATE OF DELAWARE LICENSE NUMBER _____

	(circle one)		(circle one)		(circle one)	
COMPANY CLASSIFICATIONS: CERT. NO._____	Women Business Enterprise (WBE)	Yes No	Minority Business Enterprise (MBE)	Yes No	Disadvantaged Business Enterprise (DBE)	Yes No

[The above table is for information and statistical use only.]

PURCHASE ORDERS SHOULD BE SENT TO:
(COMPANY NAME) _____

ADDRESS _____

CONTACT _____

PHONE NUMBER _____ FAX NUMBER _____

EMAIL ADDRESS _____

AFFIRMATION: Within the past five years, has your firm, any affiliate, any predecessor company or entity, owner, Director, officer, partner or proprietor been the subject of a Federal, State, Local government suspension or debarment?

YES _____ NO _____ if yes, please explain _____

_____

THIS PAGE SHALL BE SIGNED, NOTARIZED AND RETURNED FOR YOUR BID TO BE CONSIDERED

SWORN TO AND SUBSCRIBED BEFORE ME this _____ day of _____, 20 _____

Notary Public _____ My commission expires _____

City of _____ County of _____ State of _____

OMWBE Certification Application found here:
http://gss.omb.delaware.gov/omwbe/certify.shtml

State of Delaware

Office of Minority and Women Business Enterprise
Certification Application

Complete application and mail, email or fax to:

Office of Minority and Women Business Enterprise (OMWBE)
100 Enterprise Place, Suite 4
Dover, DE 19904-8202
Telephone: (302) 857-4554 Fax: (302) 739-3779
Email: deomwbe@state.de.us
Web site: www.deomwbe.delaware.gov

Drawing List

MEP-1 MECHANICAL/ELECTRICAL PLANS

MEP-2 MECHANICAL SCHEDULES & DETAILS

STATE OF DELAWARE
DEPARTMENT OF LABOR
DIVISION OF INDUSTRIAL AFFAIRS
225 Corporate Boulevard, Suite 104
Newark, Delaware 19702

TELEPHONE (302) 761-8200
(302) 451-3423
Fax (302) 368-6604

Via Facsimile and Regular Mail

May 14, 2015

Mr. Robert Jordan
Furlow Associates Inc.
1206 Society Drive
Claymont, DE 19703

Re: Contract # CHR-2015-20 Christina SD, Eden Support Center Heating Plant Modifications, New Castle County, DE

Dear Mr. Jordan:

I am responding to your request for a category determination for Contract # CHR-2015-20 Christina SD, Eden Support Center Heating Plant Modifications, which is a state funded construction project located in New Castle County, DE. The work consists of replacement of boilers and piping. You estimate the total cost of construction for this project to be $150,000.00.

Based upon the information you provided the Department of Labor has determined that this project is a Building Construction project.

Delaware's Prevailing Wage Regulations provide that the rates applicable to a project are the rates in effect on the date of publication of the specifications for that project. I have enclosed a certified copy of the March 13, 2015, prevailing wage rates for Building Construction to be included in your bid specification. However, please be advised that, in the event that a contract for a project is not executed within one hundred and twenty (120) days from the earliest date the specifications were published, the rates in effect at the time of the execution of the contract shall be the applicable rates for the project.

If you have any questions or I can provide any additional assistance, please do not hesitate to contact me at (302) 451-3406.

Sincerely,

David Burns

David Burns
Labor Law Enforcement Officer
David.Burns@state.de.us

Enclosure

SECTION 010450

CUTTING AND PATCHING

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes administrative and procedural requirements for cutting and patching.

B. Refer to other Sections for specific requirements and limitations applicable to cutting and patching individual parts of the Work.

Requirements of this Section apply to mechanical and electrical installations. Refer to Division 26 Sections and drawings for other requirements and limitations applicable to cutting and patching electrical installations.

1.3 QUALITY ASSURANCE

A. Requirements for Structural Work: Do not cut and patch structural elements in a manner that would change their load-carrying capacity or load-deflection ratio.

B. Operational Limitations: Do not cut and patch operating elements or related components in a manner that would result in reducing their capacity to perform as intended. Do not cut and patch operating elements or related components in a manner that would result in increased maintenance or decreased operational life or safety.

C. Visual Requirements: Do not cut and patch construction exposed on the exterior or in occupied spaces in a manner that would, in the Architect's opinion, reduce the building's aesthetic qualities. Do not cut and patch construction in a manner that would result in visual evidence of cutting and patching. Remove and replace construction cut and patched in a visually unsatisfactory manner.

1.4 WARRANTY

A. Existing Warranties: Replace, patch, and repair material and surfaces cut or damaged by methods and with materials in such a manner as not to void any warranties required or existing.

PART 2 – PRODUCTS

2.1 MATERIALS, GENERAL

A. Use materials identical to existing materials. For exposed surfaces, use materials that visually match existing adjacent surfaces to the fullest extent possible if identical materials

STATE OF DELAWARE
DEPARTMENT OF LABOR
DIVISION OF INDUSTRIAL AFFAIRS
225 Corporate Boulevard, Suite 104
Newark, Delaware 19702

TELEPHONE (302) 761-8200
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If you have any questions or I can provide any additional assistance, please do not hesitate to contact me at (302) 451-3406.

Sincerely,

David Burns

David Burns
Labor Law Enforcement Officer
David.Burns@state.de.us

Enclosure

STATE OF DELAWARE
DEPARTMENT OF LABOR
DIVISION OF INDUSTRIAL AFFAIRS
OFFICE OF LABOR LAW ENFORCEMENT
PHONE: (302) 451-3423

Mailing Address:
225 CORPORATE BOULEVARD
SUITE 104
NEWARK, DE 19702

Located at:
225 CORPORATE BOULEVARD
SUITE 104
NEWARK, DE 19702

PREVAILING WAGES FOR **BUILDING CONSTRUCTION** EFFECTIVE MARCH 13, 2015

CLASSIFICATION	NEW CASTLE	KENT	SUSSEX
ASBESTOS WORKERS	21.87	26.94	39.20
BOILERMAKERS	39.67	33.22	48.83
BRICKLAYERS	49.39	49.39	49.39
CARPENTERS	51.86	51.86	41.22
CEMENT FINISHERS	69.27	29.11	21.20
ELECTRICAL LINE WORKERS	43.49	37.29	28.44
ELECTRICIANS	63.60	63.60	37.29
ELEVATOR CONSTRUCTORS	80.31	40.93	30.55
GLAZIERS	67.35	67.35	20.15
INSULATORS	53.38	53.38	53.38
IRON WORKERS	60.12	60.12	60.12
LABORERS	40.95	40.95	40.95
MILLWRIGHTS	47.47	65.23	51.80
PAINTERS	43.04	44.94	44.94
PILEDRIVERS	71.17	37.64	30.45
PLASTERERS	21.60	28.55	17.50
PLUMBERS/PIPEFITTERS/STEAMFITTERS	62.20	36.66	54.49
POWER EQUIPMENT OPERATORS	43.88	58.31	24.13
ROOFERS-COMPOSITION	21.82	20.45	17.63
ROOFERS-SHINGLE/SLATE/TILE	17.59	13.72	14.10
SHEET METAL WORKERS	47.05	64.16	64.16
SOFT FLOOR LAYERS	48.57	48.57	48.57
SPRINKLER FITTERS	53.52	53.52	53.52
TERRAZZO/MARBLE/TILE FNRS	54.11	52.50	45.45
TERRAZZO/MARBLE/TILE STRS	62.13	60.28	52.63
TRUCK DRIVERS	24.43	26.64	20.03

CERTIFIED: 5/14/15 BY: _____
ADMINISTRATOR, OFFICE OF LABOR LAW ENFORCEMENT

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

CLASSIFICATIONS OF WORKERS ARE DETERMINED BY THE DEPARTMENT OF LABOR. FOR ASSISTANCE IN CLASSIFYING WORKERS, OR FOR A COPY OF THE REGULATIONS OR CLASSIFICATIONS, PHONE (302) 451-3423.

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

PROJECT: CHR-2015-20 Christina SD, Eden Support Center Heating Plant Modifications, New Castle County

are unavailable or cannot be used. Use materials whose installed performance will equal or surpass that of existing materials.

PART 3 – EXECUTION

3.1 INSPECTION

A. Examine surfaces to be cut and patched and conditions under which cutting and patching is to be performed before cutting. If unsafe or unsatisfactory conditions are encountered, take corrective action before proceeding.

B. Before proceeding, meet at the Project Site with parties involved in cutting and patching, including mechanical and electrical trades. Review areas of potential interference and conflict. Coordinate procedures and resolve potential conflicts before proceeding.

3.2 PREPARATION

A. Temporary Support: Provide temporary support of work to be cut.

B. Protection: Protect existing construction during cutting and patching to prevent damage.

C. Avoid interference with use of adjoining areas or interruption of free passage to adjoining areas.

D. Avoid cutting existing pipe, conduit, or ductwork serving the building but scheduled to be removed or relocated until provisions have been made to bypass them.

3.3 PERFORMANCE

A. General: Employ skilled workmen to perform cutting and patching. Proceed with cutting and patching at the earliest feasible time and complete without delay.

B. Cut existing construction to provide for installation of other components or performance of other construction activities and the subsequent fitting and patching required to restore surfaces to their original condition.

C. Cutting: Cut existing construction using methods least likely to damage elements retained or adjoining construction. Where possible, review proposed procedures with the original Installer; comply with the original Installer's recommendations.

D. In general, where cutting, use hand or small power tools designed for sawing or grinding, not hammering and chopping. Cut holes and slots as small as possible, neatly to size required, and with minimum disturbance of adjacent surfaces. Temporarily cover openings when not in use.

E. To avoid marring existing finished surfaces, cut or drill from the exposed or finished side into concealed surfaces.

F. Cut through concrete and masonry using a cutting machine, such as a Carborundum saw or a diamond-core drill.

G. Where services are required to be removed, relocated, or abandoned, by-pass utility services, such as pipe or conduit, before cutting. Cut-off pipe or conduit in walls or partitions to be removed. Cap, valve, or plug and seal the remaining portion of pipe or conduit to prevent entrance of moisture or other foreign matter after by-passing and cutting.

H. Patching: Patch with durable seams that are as invisible as possible. Comply with specified tolerances.

I. Where feasible, inspect and test patched areas to demonstrate integrity of the installation.

J. Restore exposed finishes of patched areas and extend finish restoration into retained adjoining construction in a manner that will eliminate evidence of patching and refinishing.

K. Where removing walls or partitions extends one finished area into another, patch and repair floor and wall surfaces in the new space. Provide an even surface of uniform color and appearance. Remove existing floor and wall coverings and replace with new materials, if necessary, to achieve uniform color and appearance.

L. Where patching occurs in a smooth painted surface, extend final paint coat over entire unbroken surface containing the patch after the area has received primer and second coat.

3.4 CLEANING

A. Clean areas and spaces where cutting and patching are performed. Completely remove paint, mortar, oils, putty, and similar items. Thoroughly clean piping, conduit, and similar features before applying paint or other finishing materials. Restore damaged pipe covering to its original condition.

END OF SECTION 010450

SECTION 012000

PROJECT MEETINGS

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 1 specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section specifies administrative and procedural requirements for project meetings, including, but not limited to, the following:

1. Preconstruction conferences
2. Progress meetings

B. Related Sections: The following Sections contain requirements that relate to this Section:

1. Division 1 Section “Coordination” for procedures for coordinating project meetings with other construction activities.

2. Division 1 Section “Schedules & Reports” for submitting the Contractor’s Construction Schedule.

1.3 PRECONSTRUCTION CONFERENCE

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

B. Attendees: Authorized representatives of the Owner and their consultants; the Contractor and its superintendent; major subcontractors; manufacturers; suppliers; and other concerned parties shall attend the conference. All participants at the conference shall be familiar with the Project and authorized to conclude matters relating to the Work.

C. Agenda: Discuss items of significance that could affect progress, including the following:

1. Early Submittal of Shop Drawings, Product Data and Samples.
2. Construction schedule.
3. Procedures for processing field decisions and Change Orders.
4. Procedures for processing Applications for Payment.
5. Preparation of record documents.
6. Use of the premises.
7. Parking availability.
8. Office, work and storage areas.
9. Equipment deliveries and priorities.

10. Safety procedures.
11. Security.
12. Housekeeping.
13. Working hours.

1.4 PROGRESS MEETINGS

A. Conduct progress meetings at the Project site at regular 2 week intervals. Notify the Owner and the Engineer of scheduled meeting dates. Coordinate dates of meetings with preparation of the payment request.

B. Attendees: In addition to representatives of the Owner and the Engineer, each subcontractor, supplier or other entity concerned with current progress or involved in planning, coordination or performance of future activities shall be represented at these meetings. All participants at the conference shall be familiar with the Project and authorized to conclude matters relating to the Work.

C. Agenda: Review and correct or approve minutes of the previous progress meeting. Review other items of significance that could affect progress. Include topics for discussion as appropriate to the status of the Project.

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

E. Review the present and future needs of each entity present, including the following:

1. Interface requirements.
2. Time.
3. Sequences.
4. Status of submittals.
5. Hazards and risks.
6. Housekeeping.
7. Quality and work standards.
8. Change Orders.
9. Documentation of information for payment requests.

F. Reporting: No later than 3 days after each meeting, distribute minutes of the meeting to each party present and to parties who should have been present. Include a brief summary, in narrative form, of progress since the previous meeting and report.

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

PART 2 – PRODUCTS (Not Applicable)

PART 3 – EXECUTION (Not Applicable)

END OF SECTION 012000

SECTION 017000

PROJECT CLOSEOUT

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provision of Contract, including General and Supplementary Conditions and other Division - 1 Specification Sections, apply to this section.

1.2 SUMMARY

A. This section specifies administrative and procedural requirements for project closeout, including but not limited to:

1. Inspection procedures.
2. Project record document submittal.
3. Operating and maintenance manual submittal.
4. Submittal of warranties.
5. Final cleaning.

B. Closeout requirements for specific construction activities are included in the appropriate Sections in Divisions – 23.

1.3 SUBSTANTIAL COMPLETION

A. Preliminary Procedures: Before requesting inspection for certification of Substantial Completion, complete the following. List exceptions in the request.

1. In the Application for Payment that coincides with, or first follows, the date Substantial Completion is claimed, show 100 percent completion for the portion of the Work claimed as substantially complete. Include supporting documentation for completion as indicated in these Contract Documents and a statement showing an accounting of changes to the Contract Sum.

2. If 100 percent completion cannot be shown, include a list of incomplete items, the value of incomplete construction, and reasons the Work is not complete.

3. Submit specific warranties, workmanship bonds, maintenance agreements, final certifications and similar documents.

4. Obtain and submit releases enabling the Owner unrestricted use of the Work and access to services and utilities; include occupancy permits, operating certificates and similar releases.

5. Deliver tools, spare parts, extra stock, and similar items.

6. Make final changeover of permanent locks and transmit keys to the Owner. Advise the Owner's personnel of changeover in security provisions.

7. Complete start-up testing of systems, and instruction of the Owner's operating and maintenance personnel. Discontinue or change over and remove temporary facilities from the site, along with construction tools, mock-ups, and similar elements.

8. Complete final cleanup requirements, including touch-up painting. Touch-up and otherwise repair and restore marred exposed finishes.

B. Punch List Procedures: On receipt of a request for punch list, the Engineer will either proceed with punch list or advise the Contractor of unfilled requirements. The Agency will prepare the Certificate of Substantial Completion following punch list, or advise the Contractor of construction that must be completed or corrected before the certificate will be issued.

1. The Engineer will repeat punch list when requested by the Agency and assured that the Work has been substantially completed.

2. Results of the completed punch list by the Contractor will form the basis of requirements for final acceptance.

1.4 FINAL ACCEPTANCE

A. Preliminary Procedures: Before requesting final punch list for certification of final acceptance and final payment, complete the following. List exceptions in the request.

1. Submit the final payment request with releases and supporting documentation not previously submitted and accepted. Include certificates of insurance for products and completed operations where required.

2. Submit an updated final statement, accounting for final additional changes to the Contract Sum.

3. Submit consent of surety to final payment.

4. Submit an Affidavit of Payment of Debts and Claims.

5. Submit letter of Guarantee.

B. Repeat Punch List Procedure: The Engineer will review the Work upon receipt of notice that the Work, including punch list items from earlier inspections, has been completed, except items whose completion has been delayed because of circumstances acceptable to the Agency and Engineer.

1. If necessary, reinspection will be repeated until all punch list items have been addressed or corrected. All punch list meetings en route to satisfying the requirement that “all punch list items have been corrected” will be considered necessary punch list meetings required by this specification and the ensuing contract.

PART 2 – PRODUCTS (Not Applicable)

PART 3 – EXECUTION

3.1 CLOSEOUT PROCEDURES

A. FINAL CLEANING

1. General: General cleaning during construction is required by the General Conditions.

2. Cleaning: Employ experienced workers or professional cleaners for final cleaning. Clean each surface or unit to the condition expected in a normal, commercial building cleaning and maintenance program. Comply with manufacturer's instructions.

3. Complete the following cleaning operations before requesting review for Certification of Substantial Completion.

   a. Remove labels that are not permanent labels.

   b. Clean transparent materials, including mirrors and glass in doors and windows. Remove glazing compound and other substances that are noticeable vision-obscuring materials. Replace chipped or broken glass and other damaged transparent materials.

   c. Clean exposed exterior and interior hard-surfaced finishes to a dust-free condition, free of stains, films and similar foreign substances. Restore reflective surfaces to their original reflective condition. Leave floors broom clean. Vacuum carpeted surfaces. Wipe surfaces of mechanical and electrical equipment. Remove excess lubrication and other substances. Clean plumbing fixtures to a sanitary condition. Clean light fixtures and lamps.

   d. Clean the site, including landscape development areas, of rubbish, litter and other foreign substances. Sweep paved areas broom clean; remove stains, spills and other foreign deposits. Rake grounds that are neither paved nor planted, to a smooth even-textured surface.

4. Removal of Protection: Remove temporary protection and facilities installed for protection of the Work during construction.

5. Compliance: Comply with regulations of authorities having jurisdiction and safety standards for cleaning. Do not burn waste materials. Do not bury debris or excess materials on the Owner's property. Do not discharge volatile, harmful or dangerous materials into drainage systems. Remove waste materials from the site and dispose of in a lawful manner.

a. Where extra materials of value remaining after completion of associated work have become the Owner's property, arrange for disposition of these materials as directed.

END OF SECTION 017000

SECTION 017200

PROJECT RECORD DOCUMENTS

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. The general provisions of the Contract, including the Conditions of the Contract (General, Supplementary and other conditions, if any) and Division 1 and Division 23, apply to the work of this Section.

1.2 SUMMARY

A. This Section specifies administrative and procedural requirements for Project Record Documents.

B. Project Record Documents required include:

1. Marked-up copies of Reproducible Contract Drawings.
2. Newly prepared Drawings.
3. Field records for variable and concealed conditions
4. Per this contract, provide to the Owner a complete set of “as-built” drawings on disk.

C. Specific record copy requirements that expand requirements of this Section are included in the individual Sections of Divisions 23 and 26.

D. General project closeout requirements are included in Section "Project Closeout".

E. Maintenance of Documents and Samples: Store record documents apart from Contract Documents used for construction. Do not permit Project Record Documents to be used for construction purposes. Maintain record documents in good order, and in a clean, dry legible condition.

1.3 RECORD DRAWINGS

A. Markup Procedure: During the construction period, maintain a set of blue- or black-line white prints of Contract Drawings and Shop Drawings for Project Record Document purposes.

1. Mark these Drawings to indicate the actual installation where the installation varies appreciably from the installation shown originally. Give Particular attention to information on concealed elements which would be difficult to identify or measure and record later. Items required to be marked include but are not limited to:

a. Dimensional changes to the Drawings.
b. Revisions to details shown on the Drawings.
c. Revisions to routing of piping and conduits.
d. Revisions to electrical circuitry.
e. Actual equipment locations.

f. Duct size and routing.
g. Locations of concealed internal utilities.
h. Changes made by Change Order.
i. Details not on original Contract Drawings

2. Mark completely and accurately record prints of Contract Drawings or Shop Drawings, whichever is most capable of showing actual physical conditions. Where Shop Drawings are marked, show cross-reference on Contract Drawings location.

3. Mark record sets with red erasable colored pencil; use other colors to distinguish between changes for different categories of the Work at the same location.

4. Mark important additional information which was either shown schematically or omitted from original drawings.

5. Note construction change directive numbers, alternate numbers, change order numbers and similar identification.

6. Responsibility for Markup: Where feasible, the individual or entity who obtained record data, whether the individual or entity is the installed, subcontractor, or similar entity, is required to prepare the markup on record drawings.

   a. Accurately record information in an understandable drawing technique.

   b. Record data as soon as possible after it has been obtained. In the case of concealed installations, record and check the markup prior to concealment.

B. Immediately prior to inspection for Certification of Substantial Completion, review completed marked-up record Drawings with the Engineer. When authorized, prepare a full set of reproducible of Contract Drawings.

C. Incorporate changes and additional information previously marked on print sets. Erase, redraw and add details and notations where applicable. Identify and date each Drawing; include the printed designation "PROJECT RECORD DRAWINGS" in a prominent location on each Drawing.

D. Refer instances of uncertainty to the Engineer for resolution.

E. One set of original Contract Drawings will be furnished to the Contractor by the Engineer, if necessary, for use in recording changes and additional information. Other printing as required is the Contractor's responsibility.

F. The Contractor is responsible for printing original other Drawings as required to produce record drawings.

G. Before copying and distributing, submit corrected drawings and the original marked-up prints to the Engineer for review. When acceptable, the Engineer will initial and date each corrected drawing, indicating acceptance of general scope of changes and additional information recorded, and of the quality of drafting.

1. Corrected drawings and the original marked-up prints will be returned to Contractor for organizing into sets, printing, binding and final submittal.

H. Copies and Distribution: After completing the preparation of reproducible record drawings, print 1 blue-line or black-line print of each Drawing, whether or not changes and additional information were recorded. Organize the copies into manageable sets. Bind each set with appropriate identification, including titles, dates and other information on cover sheet identifying them as record drawings and the contractor preparing them.

1. Organize and bind original marked-up set of prints that were maintained during the construction period in the same manner.

2. Organize record documents into sets matching the print sets.

3. Submit the marked-up record set, reproducible drawings and 1 copy of prints to the Engineer for Owner's records.

I. Newly Prepared Record Drawings: Prepare new drawings instead of following procedures specified for preparation of record Drawings where new drawings are required by a Change Order issued as a result of acceptance of an alternate, substitution or other modification, and the Engineer determines that neither the original Contract Drawings nor Shop Drawings are suitable to show the actual installation.

1. Consult with the Engineer for the proper scale and scope of detailing and notations required to record the actual physical installation and its relation to other construction. When completed and accepted, integrate newly prepared drawings with procedures specified for organizing, copying, binding and submittal of record drawings.

PART 2 – PRODUCTS (NOT APPLICABLE)

PART 3 – EXECUTION

3.1 RECORDING

A. Post changes and modifications to the Documents as they occur. Do not wait until the end of the Project.

END OF SECTION 017200

SECTION 017300

OPERATING AND MAINTENANCE DATA

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section specifies administrative and procedural requirements for operating and maintenance manuals including the following:

1. Preparation and submittal of operating and maintenance manuals for building operating systems or equipment.

2. Preparation and submittal of instruction manuals covering the care, preservation and maintenance of architectural products and finishes.

3. Instruction of the Owner's operating personnel in operation and maintenance of building systems and equipment.

B. Special operating and maintenance data requirements for specific pieces of equipment or building operating systems are included in the appropriate Sections of Divisions-2 through -16.

C. Preparation of Shop Drawings and Product Data are included in General and Supplementary Conditions.

D. General closeout requirements are included in General and Supplementary Conditions, and Section 01700.

E. General requirements for submittal of Project Record Documents are included in General and Supplementary Conditions, and Section 017200.

1.3 QUALITY ASSURANCE

A. Maintenance Manual Preparation: In preparation of Maintenance Manuals, use personnel thoroughly trained and experienced in operation and maintenance of the equipment or system involved.

1. Where written instructions are required, use personnel skilled in technical writing to the extent necessary for communication of essential data.

2. Where Drawings or diagrams are required, use draftsmen capable of preparing Drawings clearly in an understandable format.

B. Instructions for the Owner's Personnel: For instruction of the Owner's operating and maintenance personnel, use experienced instructors thoroughly trained and experienced in the operation and maintenance of the building equipment or system involved.

1.4 SUBMITTALS

A. Submittal Schedule: Comply with the following schedule for submittal of operating and maintenance manuals.

1. Before substantial completion, when each installation that requires submittal of operating and maintenance manuals is nominally complete, submit two draft copies of each manual to the Engineer for review. Include a complete index or table of contents of each manual.

2. The Engineer will return one copy of the draft with comments within fifteen days of receipt.

3. Submit one copy of data in final form at least fifteen days before final punch list. This copy will be returned within fifteen days after final punch list, with comments.

4. After final punch list make corrections or modifications to comply with the Engineer's comments. Submit the specified number of copies of each approved manual to the Engineer within fifteen days of receipt of the Engineer's comments.

B. Form of Submittal: Prepare operating and maintenance manuals in the form of an instructional manual for use by the Owner's operating personnel. Organize into suitable sets of manageable size. Where possible, assemble instructions for similar equipment into a single binder.

C. Binders: For each manual, provide heavy-duty, commercial quality, durable 3-ring vinyl-covered looseleaf binders, in thickness necessary to accommodate contents, sized to receive 8-1/2" by 11" paper. Provide a clear plastic sleeve on the spine, to hold labels describing the contents. Provide pockets in the covers to receive folded sheets.

1. Where two or more binders are necessary to accommodate data, correlate data in each binder into related groupings in accordance with the Project Manual table of contents. Cross-reference other binders where necessary to provide essential information for proper operation or maintenance of the piece of equipment or system.

2. Identify each binder on the front and spine, with the typed or printed title "OPERATION AND MAINTENANCE MANUAL", Project title or name, and subject matter covered. Indicate the volume number for multiple volume sets of manuals.

D. Dividers: Provide heavy paper dividers with celluloid covered tabs for each separate Section. Mark each tab to indicate contents. Provide a typed description of the product and major parts of equipment included in the Section on each divider.

E. Text Material: Where written material is required as part of the manual, use the manufacturer's standard printed material, or if it is not available, specially prepared data, neatly typewritten, on 8-1/2" by 11", 20-pound white bond paper.

F. Drawings: Where drawings or diagrams are required as part of the manual, provide reinforced punched binder tabs on the drawings and bind in with the text.

1. Where oversize drawings are necessary, fold the drawings to the same size as the text pages and use as a foldout.

2. If drawings are too large to be used practically as a foldout, place the drawing, neatly folded in the front or rear pocket of the binder. Insert a typewritten page indicating the drawing title, description of contents and drawing location at the appropriate location in the manual.

1.5 MANUAL CONTENT

A. In each manual include information specified in the individual Specification Section, and the following information for each major component of building equipment and its controls:

1. General system or equipment description
2. Design factors and assumptions
3. Copies of applicable Shop Drawings and Product Data.
4. System or equipment identification, including:
   a. Name of manufacturer
   b. Model number
   c. Serial number of each component
5. Operating instructions
6. Emergency instructions
7. Wiring diagrams
8. Inspection and test procedures
9. Maintenance procedures and schedules
10. Precautions against improper use and maintenance
11. Copies of warranties
12. Repair instructions including spare parts listing
13. Sources of required maintenance materials and related services
14. Manual Index

B. Organize each manual into separate Sections for each piece of related equipment. As a minimum each manual shall contain a title page, a table of contents, copies of Product Data, supplemented by drawings and written text, and copies of each warranty, bond and service Contract issued.

1. Title Page: Provide a title page in a transparent plastic envelope as the first sheet of each manual. Provide the following information:

   a. Subject matter covered by the manual
   b. Name and address of the Project
   c. Date of submittal
   d. Name, address and telephone number of the Contractor.
   e. Name and address of the Engineer
   f. Cross reference to related systems in other operating and maintenance manuals

C. Table of Contents: After the Title Page, include a typewritten table of contents for each volume, arranged systematically according to the Project Manual format.

D. Include a list of each product included, identified by product name or other appropriate identifying symbol and indexed to the content of the volume.

Where more than one volume is required to accommodate data for a particular system, provide a comprehensive table of contents for all volumes in each volume of the set.

E. General Information: Provide a general information Section immediately following the Table of Contents, listing each product included in the manual, identified by product name. Under each product , list the name, address and telephone number of the Subcontractor or installer, and the maintenance contractor. Clearly delineate the extent of responsibility of each of these entities. In addition, list a local source for replacement parts and equipment.

F. Product Data: Where manufacturer's standard printed data is included in the manuals, include only sheets that are pertinent to the part or product installed. Mark each sheet to identify each part or product included in the installation. Where more than one item in a tabular format is included, identify each item, using appropriate references from the Contract Documents. Identify data that is applicable to the installation and delete references to information that is not applicable.

G. Written Text: Where manufacturer's standard printed data is not available, and information is necessary for proper operation and maintenance of equipment or systems, or it is necessary to provide additional information to supplement data included in the manual, prepare written test to provide necessary information. Organize the text in a consistent format under separate headings for different procedures. Where necessary, provide a logical sequence of instruction for each operating or maintenance procedure.

H. Drawings: Provide specially prepared drawings where necessary to supplement manufacturer's printed data to illustrate the relationship of component parts of equipment or systems, or to provide control or flow diagrams. Coordinate these drawings with information contained in Project Record Drawings to assure correct illustration of the completed installation.

Do not use original Project Record Documents as part of the Operating and Maintenance Manuals.

Warranties, Bonds and Service Contracts: Provide a copy of each warranty, bond or service contract in the appropriate manual for the information of the Owner's operating personnel. Provide written data outlining procedures to be followed in the event of product failure. List circumstances and conditions that would affect validity of the warranty or bond.

1.6 EQUIPMENT AND SYSTEMS MAINTENANCE MANUAL

A. Submit three copies of each completed manual on equipment and systems, in final form, to the Engineer for distribution. Provide separate manuals for each unit of equipment, each operating system, and each electric and electronic system.

Refer to Specification Sections for additional requirements on operating and maintenance of the various pieces of equipment and operating systems.

B. Equipment and Systems: Provide the following information for each piece of equipment, each building operating system, and each electric or electronic system.

1. Description: Provide a complete description of each unit and related component parts, including the following:

    a. Equipment or system function
    b. Operating characteristics
    c. Limiting conditions
    d. Performance curves
    e. Engineering data and tests
    f. Complete nomenclature and number of replacement parts

2. Manufacturer's Information: For each manufacturer of a component part or piece of equipment provide the following:

    a. Printed operating and maintenance instructions
    b. Assembly drawings and diagrams required for maintenance
    c. List of items recommended to be stocked as spare parts

3. Maintenance Procedures: Provide information detailing essential maintenance procedures, including the following:

    a. Routine operations
    b. Trouble-shooting guide
    c. Disassembly, repair and reassembly
    d. Alignment, adjusting and checking

4. Operating Procedures: Provide information on equipment and system operating procedures, including the following:

    a. Startup procedures
    b. Equipment or system break-in
    c. Routine and normal operating instructions
    d. Regulation and control procedures
    e. Instructions on stopping
    f. Shutdown and emergency instructions
    g. Summer and winter operating instructions
    h. Required sequences for electric or electronic systems
    i. Special operating instructions

5. Servicing Schedule: Provide a schedule of routine servicing and lubrication requirements, including a list of required lubricants for equipment with moving parts.

6. Controls: Provide a description of the sequence of operation and as-installed control diagrams by the control manufacturer for systems requiring controls.

7. Coordination Drawings: Provide each Contractor's Coordination Drawings.

8. Provide as-installed color-coded piping diagrams, where required for identification.

9. Valve Tags: Provide charts of valve tag numbers, with the location and function of each valve.

10. Circuit Directories: For electric and electronic systems, provide complete circuit directories of panelboards, including the following:

    a. Electric service
    b. Controls
    c. Communication

1.7 INSTRUCTIONS OF THE OWNER'S PERSONNEL

A. Prior to final acceptance, instruct the Owner's personnel in operation, adjustment, and maintenance of products, equipment and systems. Provide 4 hours of instruction at a mutually agreed upon time.

1. For equipment that requires seasonal operation, provide similar instruction during other seasons.

2. Use operation and maintenance manuals for each piece of equipment or system as the basis of instruction. Review contents in detail to explain all aspects of operation and maintenance.

3. All training shall be video-taped for the Owner’s use at a future date. Video taping shall be provided by the firm performing the training.

PART 2 – PRODUCTS (Not Applicable)

PART 3 – EXECUTION (Not Applicable)

END OF SECTION 017300

SECTION 220000

GENERAL PROVISIONS – PLUMBING

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. The general provisions of the Contract, including the Conditions of the Contract (General, Supplementary and other Conditions, if any) and Division 1 as appropriate, apply to work of this Section.

B. This specification or drawing and the design features or resulting construction disclosed, are the property of Furlow Associates, Inc., and shall not be reproduced without written permission.

1.2 WORK INCLUDED

A. Provide labor, materials, equipment and supervision necessary to install complete operating Plumbing Systems as indicated the drawings and specified herein, including all work at the site and within the proposed construction areas to accomplish the required work.

1.3 REGULATIONS, CODES AND STANDARDS

A. Work shall be performed in accordance with latest adopted codes, regulations and ordinances by authorities having jurisdiction. Observe all safety regulations.

B. Latest editions of any referenced standards shall govern.

C. Obtain all municipal and/or the Authorities Having Jurisdiction permits and inspection certificates and pay all charges.

D. Make or arrange for any/or all inspection agency reviews or visits and pay all charges. This includes communication with each respective agency and/or utility to verify the project system work, coordination responsibilities, fees, back charges, etc., required.

E. All fees and back charges shall be verified during the bidding phase of the work. Any discrepancy of this item between any utility, inspection agency and the Contractor shall be brought to the attention of the A/E prior to bid opening.

F. Submission of a bid will be deemed evidence of having complied with these requirements.

1.4 RELATED WORK

A. Refer to equipment shown or specified in sections of Division 1 thru 14 and 26 that will require Plumbing services.

B. Refer to work related to Plumbing as shown on the following contract drawings:
Architectural & Structural
HVAC
Electrical

1.5 COORDINATION

A. The Mechanical, Plumbing and Electrical Contractors are responsible to coordinate all manufacturer's recommended circuit breakers, starters, disconnects and fuse sizes for all equipment. Submission of a shop drawing will certify that this has been completed. Any necessary changes required will be included as part of this contract.

B. Plumbing Contractors shall coordinate scheduling, submittals and work of the various sections of the Project Manual to ensure efficient and orderly sequence of installation of independent work elements, with provisions to accommodate items that may be installed at a later time.

C. Plumbing Contractors shall verify utility requirements and all characteristics of operating equipment are compatible with the building utilities. Coordinate the work of all sections related and required for installing, connection and placing in service of all equipment.

D. Plumbing Contractors shall coordinate all space requirements, supports and installation of all mechanical, electrical, plumbing and fire protection work, which are indicated diagrammatically on the Drawings. Verify routing of all pipes, ducts, conduits and equipment connections. Maximize accessibility for other work, and service requirements for maintenance and repairs.

E. Obtain written confirmation from all related trade Contractors and the Owner or his representative that requirements, conflicts and coordination issues have been discussed and resolved.

1.6 SUBMITTALS

A. Shop Drawings & Product Data:

1. Shop drawings and product data shall be submitted in accordance with Division 1 of these specifications except where herein modified.

   NOTE: Submittals will only be reviewed once and resubmittals will be reviewed once. Any `other submittals will be billed to the Contractor at the Engineer's standard rates.

2. Listed are the required shop drawings and reports required for this project. The Engineer/Owner shall reserve the right to require additional submissions not listed below:

   - All fixtures, equipment and associated devices so listed on the Fixture Schedule on Drawing M-2.
   - Insulation
   - All specified piping systems.
   - All specified valves.
   - Gauges and thermometers
   - Hanger and supports.
   - Piping labels and identification.
   - Testing reports.

- Operating/Maintenance manuals.
- As-Built Drawings.

3. Submittals comprising complete catalog cuts, shop drawings and performance test data for Plumbing materials and equipment as required by other sections of Division 22, shall be submitted for review checking. The Contractor shall review these for conformance to contract documents prior to submission and affix contractor's signature to each submittal certifying that this review has been done. By approving and submitting shop drawings, product data, samples and similar materials, the Contractor represents that the Contractor has determined and verified materials, field measurements and field construction data that relates to the work, and has checked and coordinated this information with all of the requirements contained in the contract documents for the work of all trades.

4. All submittals shall have the following identification data, as applicable, contained therein or permanently adhered thereto.

   a. Project name.

   b. Project number.

   c. Sub-contractor's, vendor's and/or manufacturer's name and address.

   d. Product identification.

   e. Identification of deviation from contract documents.

   f. Applicable contract drawings and specification section number.

   g. Shop drawing title, drawing number, revision number, and date of drawing and revision.

   h. Resubmit revised or additional submittals as requested.

   i. Wherever shop drawings or vendor's standard data sheets indicate work to be done "by others", it shall be the responsibility of the contractor making the submission to identify by name, the contractor who is to do this work. If the contractor named is other than the contractor making the submission, the shop drawing submission must be reviewed by the named contractor and bear his mark of approval, prior to submission to the Architect/Engineer.

   j. Where equipment proposed differs from that shown on the drawings or specified, he shall submit for approval drawings showing the manner in which the layout is affected by the substitution.

   k. The Contractor shall keep one copy of approved shop drawings at the job site,, filed in a suitable metal container. The shop drawings shall be cataloged and kept in good repair, and shall be available for use by the Owner, Architect and Engineer.

   l. No equipment shall be ordered, fabricated, etc., before approval of shop drawings.

B. Contractor is responsible for the shop drawing coordination and interface with the work of other contracts and adjacent work. The relationship of Contractor's work shall be verified as it relates to adjacent and critical features of the work of this and all contracts and materials.

1.7 WARRANTY/GUARANTEE

A. All work and materials are subject to the general warranty as described in the General Conditions of the Contract and in Division 1, GENERAL REQUIREMENTS. In addition, refer to specifications for special guarantees.

B. Wherever in the specification sections of this division, reference is made to a specific warranty period, this warranty shall be in addition to and not a limitation of other rights the Owner may have against the Contractor under the contract documents.

1.8 SITE INSPECTION

A. The Contractor shall visit the site, inspect, and become aware of all conditions which may affect the work during the estimation phase of his work and prior to bid openings. Investigate utilities, protection requirements for adjacent facilities, storage locations, and access to the construction area.

B. Submission of a bid will be deemed evidence of having complied with this requirement.

1.9 SUBSTITUTIONS

A. Whenever a material, article, piece of equipment or system is identified in the following specification or indicated on the drawings by reference to manufacturers' or vendors' names, trade names, catalog numbers or the like, it is so identified for the purpose of establishing the basis of the Bid.

B. Substitution approval must be obtained and included as an addendum item prior to the submission of the bid. An approved substitution shall not be considered as an approval for the Contractor or an equipment vender to deviate from the written portion of the specifications unless so stated in the addendum.

C. The drawings illustrate the space allocated for equipment and the Contractor shall install the equipment accordingly. If changes are required in the building or arrangement due to substitution of equipment, the Contractor making the substitution must pay for the necessary modifications.

D. The listed equivalent or substituted manufacturers along with the bidding related contractor shall be completely responsible to comply with all requirements as indicated on all contract documents and as described within the specifications. This shall include, but shall not be limited to space requirements, code clearances, the type, horsepower, capacities, number and size of services required from other trades, including all required ancillary items furnished and installed by other trades. If the manufacturer or related bidding contractor does not comply with these requirements, then they shall be responsible for any and all additional costs associated with the changes required by other trades.

1.10 EQUIPMENT START-UP

A. Verify proper installation by manufacturer or his representative.

B. Advise General Contractor 2 days prior to actual start-up.

C. Verify proper operation. Obtain signed statement by manufacturer or his representative that equipment is operating within warranty requirements. Submit statement to General Contractor.

1.11 OPERATION & MAINTENANCE INSTRUCTIONS

A. Properly and fully instruct Owner's personnel in the operation and maintenance of all systems and equipment.

B. Insure that the Owner's personnel are familiar with all operations to carry on required activities.

C. Such instruction shall be for each item of equipment and each system as a whole.

D. Provide report that instruction has taken place. Include in the report the equipment and/or systems instructed, date, contractor, Owner's personnel, vendor, and that a complete operating and maintenance manual has been reviewed.

E. Manual shall include all instructions on operation, maintenance, repair parts list, lubrication requirements, brochures, catalogue cuts, wiring diagrams, piping diagrams, control sequences, service requirements, names and addresses of vendors, suppliers and emergency contacts. Three manuals shall be provided.

F. Submit manuals for review prior to operating instruction period. Manuals shall be 8-1/2 x 11" with hard cover, suitably bound.

G. Provide to the Owner any special tools necessary for operation and routine maintenance of any of the equipment.

1.12 TOOLS

A. All equipment furnished by the Contractor which requires special tools or devices other than those normally available to the maintenance or operating staff shall be furnished in duplicate to the Owner, sufficiently marked, packed or boxed for staff usage. The tools provided shall be listed by the Contractor identified as to their use or the equipment applicable in a written transmittal to the Owner.

1.13 CLEANING AND FINISHING

A. After equipment start-up and all operating tests have been made and the system pronounced satisfactory, each respective Contractor shall go over the entire project, clean all equipment, etc., installed by him and leave in a clean and working condition. Any surfaces found marred after this final cleaning shall be refinished or replaced by each Contractor at no cost to the Owner.

B. Provide for the safety and good condition of all materials and equipment until final

acceptance by the Owner. Protect all materials and equipment from damage. Provide adequate and proper storage facilities during the progress of the work. Special care shall be taken to provide protection for bearings, open connections, pipe coils, pumps, compressors and similar equipment.

C. All NEW fixtures, piping, finished surfaces and equipment installed shall have all grease, adhesive labels and foreign materials removed.

D. All new piping installed shall be drained and flushed to remove grease and foreign matter. Pressure regulating assemblies, traps, flush valves and similar items shall be thoroughly cleaned. Remove and thoroughly clean and reinstall all liquid strainer screens after the system has been in operation ten (10) days.

E. Gas piping shall be blown out with clean compressed air or inert gas.

F. When connections are made to existing systems, the Contractor shall do all cleaning and purging of the existing systems required to restore them to the condition existing prior to the start of work.

G. Clean-up: Remove from the premises, all unused material and debris resulting from the performance of work under this section.

PART 2 – PRODUCTS

2.1 GENERAL

A. All material and equipment shall be new and of present day manufacture, and shall conform to accepted standards of the trade where such a standard has been established for the particular type of equipment or material.

B. Whenever equipment or material is referred to in the singular, such as "the plumbing fixture", it shall be deemed to apply to as many such items as necessary to complete the work.

2.2 PRODUCT DELIVERY, STORAGE AND HANDLING

A. During loading, transporting and unloading exercise care to prevent damage to material.

B. Store all materials in dry enclosures or under protective coverings out of way of work progress.

C. Material shall not be allowed to be stored directly on ground.

D. Deliver in manufacturer's original cartons or on skids.

E. Handle and protect so as to prevent damage to product or any surrounding material.

2.3 CONCRETE

A. Concrete, if used on this project, shall be in accordance with Section 03300.

B. The 28-day minimum compressive strength shall be 3000 psi.

PART 3 – EXECUTION

3.1 PROTECTION

A. Plug or cap open ends of piping systems.

B. Stored materials shall be covered to prevent damage by inclement weather, sun, dust or moisture.

C. Protect all installed work until accepted in place by the Owner.

D. Plates, polished metal escutcheons and other finished devices shall not be installed until masonry, tile, and painting operations are complete unless otherwise protected.

E. Protect all work from operations which may cause damage such as hauling, welding, soldering, painting, insulating and covering.

F. Do not remove protective material until equipment is placed in service.

3.2 WORKMANSHIP

A. Install all work neat, trim and plumb with building lines.

B. Install work in spaces allocated.

C. Cutting and patching shall be performed by skilled tradesmen normally employed for the work involved.

3.3 EQUIPMENT SETTING

A. Furnish and install as a minimum, a 4 inch concrete pad beneath all floor-mounted equipment. Install anchor bolts in pour.

B. Furnish and install as a minimum, spring vibration isolation under any equipment 10 HP and over and rubber in shear vibration isolation on any equipment up to 10 HP.

C. Concrete shall be 3,000 psi, 28 day compressive strength in accordance with ACI-613. Reinforce with No. 4 rod 12" on centers both ways or as otherwise detailed.

3.4 FASTENERS, HANGERS AND SUPPORTS

A. Furnish and install all hangers and supports required to suspend, mount, or hang the work.

B. Furnish and install all miscellaneous steel angles, channels, beams, clips, brackets and anchors necessary to hang or support the work. Provide submissions for review.

C. Install concrete inserts before concrete is poured.

D. Drilled inserts shall not be loaded more than 1/4 rated capacity or 200 pounds.

E. Power-driven fasteners shall not be allowed for piping larger than 2 inch, or equipment. When used they shall not be loaded more than 1/8 rated capacity or 200 pounds.

F. All hangers, miscellaneous steel, braces and supports shall be galvanized, cadmium plated, or primed steel. Copper tubing shall be supported with copper hangers. No direct contact of dissimilar metals between the piping system and its hanger support shall be permitted.

G. Piping shall be supported from adjustable clevis type hangers with insulation pipe saddles. Where hangers are 18" or longer, provide lateral bracing at every fourth hanger. See IPC Pipe Support Table below:

PIPE SUPPORT SPACING

Material	Horizontal Max. Feet	Vertical Max. Feet
ABS Pipe	4	10
Aluminum	10	15
Brass	10	10
Brass Tube up to 1-1/4"	6	10
Brass Tube over 1-1/2"	10	10
Cast Iron	5	15
Copper up to 1-1/4"	6	10
Copper over 1-1/4"	10	10
CPVC Up to 1"	3	10
CPVC Over 1"	4	10
Lead Pipe	Continuous	4
PB Pipe/Tubing	2.6 ft. (32")	10
PVC Pipe	4	10
PEX	2.6 ft. (32")	10
Steel Tubing	8	10
Steel Pipe	12	15

3.5 SLEEVES

A. Provide each pipe passing through a masonry or concrete wall, floor or partition with a sleeve made from standard weight steel pipe for pipe with smooth edges, securely and neatly cemented in place. Provide each pipe passing through a frame or metal partition with a sleeve made from No. 22 gauge galvanized sheet metal, securely fastened in place.

B. Pipe passing through foundation wall or under foundation shall be provided with relieving arch or steel pipe per IPC Section 305.5.

C. Be responsible for the proper location and alignment of all sleeves.

D. Provide hydrostatic seals for sleeves passing through outside walls, below grade, or through hydrostatically sealed slabs or floors on grade. Provide fire-rated seals for all other sleeves.

E. Install both piping and sleeve seals so as to maintain integrity of seals with expansion and contraction of piping.

F. Fire-Rated Sealing Method:

1. Sleeves, openings and sealants shall comply with applicable codes, recommended practices and standards, and manufacturer's instructions. Fire sealants shall have ability

to prevent spread of flame, smoke or water throughout the penetration and shall pass 3 hour test, UL test ASTM E814 and UL 1479.

2. Products: Chase Corporation CTC PR-855, O. Z. Gedney CRS/CAFS, 3M Electro-Products Division Putty 303 or Caulk CP25 penetration sealing kits, General Electric Company sealants type RTV-850, 6428 or 7403, Thunderline Corporation "Link-Seal Pyro-Pak". Installation and type of sealant to be used as recommended by the manufacturer.

3. Expansion collars, fire seal/firestop collars – ASTM E814 (UL1479). Spec Seal Corporation, Inc. (plastic pipe).

3.6 OFFSETS, TRANSITIONS, MODIFICATIONS

A. Furnish and install all offsets necessary to install the work and to provide clearance for other trades.

B. Maintain adequate headroom and clearance.

C. Incidental modifications necessary to the installation of the systems shall be made as necessary and as approved by the Engineer.

3.7 LABELING

A. All Plumbing equipment such as pumps, and devices requiring identification for operating procedures shall be provided with permanent black laminated micarta white core labels with 3/8 inch letters.

B. This shall also apply to all controllers, remote start/stop pushbuttons and equipment cabinets.

3.8 ACCESS

A. Locate all equipment, valves, devices and controllers which may need service in accessible places.

B. Maintain required access clearances.

3.9 WIRING

A. Packaged plumbing system equipment shall be furnished with disconnect switches, and magnetic starters, factory furnished and wired by the unit manufacturer.

B. All control wiring shall be furnished and installed under this Division of the work.

C. All wiring shall be in accordance with the National Electrical Code and as recommended by the equipment manufacturer.

3.10 UTILITIES

A. Do not interrupt any utility or service to the Owner without adequate previous notice and schedule.

B. Arrange and pay for the relocation, disconnection or removal of, or relocate, disconnect or remove existing utilities and services where such work is shown or where such utilities or services interfere with new construction, whether or not shown. Provide all excavation, backfilling and paving required by such work.

C. Perform alteration of utilities and services in accordance with the rules, regulations and requirements of the involved utility companies, regulatory agencies having jurisdiction.

3.11 CUTTING AND PATCHING EXTERIOR SURFACES

A. This Contractor shall be responsible for returning disturbed paved and/or grass areas to original condition where excavation for utilities has been required.

B. Cut and patch paved areas to match original surface.

3.12 OPENINGS – CUTTING, REPAIRING

A. This contractor shall cooperate with the work to be done under other sections in providing information as to openings required in walls, slabs and footings for all piping and equipment, including sleeves where required.

B. Any drilling or cutting required for the performance of work under this Section, shall be the responsibility of this Contractor and the cost thereof shall be borne by him.

C. Holes in Concrete: Sleeves shall be furnished, accurately located and installed in forms before pouring of concrete. This contractor shall pay all additional costs for cutting of holes as the result of the incorrect location of sleeves. All holes through existing concrete shall be either core drill or saw cut. All holes required shall have the approval of the Structural Engineer prior to cutting or drilling.

D. It shall be the responsibility of this Contractor to ascertain that all chases and openings are properly located.

3.13 GUARANTEE

A. All materials and equipment provided and/or installed under this section of the specifications shall be guaranteed for a period of one year from the date of acceptance of the work by the Owner unless otherwise specified in Division 1. Should any trouble develop during this period due to defective materials or faulty workmanship, the Contractor shall furnish all necessary labor and materials to correct the trouble without any cost to the Owner. Any defective materials or inferior workmanship noticed at time of installation and/or during the guarantee period shall be corrected immediately to the entire satisfaction of the Owner.
In the event of occupancy by the Owner prior to final acceptance of the project, the guarantee date for equipment placed in operation shall be mutually agreed to by the Contractor and the Owner's representative.

3.14 DRAWINGS

A. The Plumbing Systems are indicated on the Contract Drawings. Certain pertinent

information and details required by the Plumbing Work appear on the Architectural, Structural and Electrical Drawings; become familiar with all Drawings; and incorporate all pertinent requirements.

B. Drawings are diagrammatic and indicate the general arrangement of systems and requirements of the Work. Do not scale Drawings. Exact locations of fixtures and equipment, not specifically shown shall be obtained before starting work.

C. When indicated on the drawings, plumbing riser diagrams are completely diagrammatic and indicate the intent of the work for both the Contractor, L&I review agencies and/or Authorities Having Jurisdiction. Where valves, shock absorbers, incidental equipment, devices, etc., including execution notes are indicated on the riser diagrams, they shall be so required and installed as part of the system work.

3.15 RECORD DRAWINGS

A. As-Built record drawings, showing dimensions, locations and depth of all buried and concealed piping, plugged outlets and equipment shall be kept up to date. Master copy shall be kept on the job. No backfilling of trenches shall be permitted until as-built drawings are approved as up-to-date by the Owner/Representative. No plumbing progress payments shall be approved unless as-built drawings are up- to-date. Depth of sewers shall be from a permanent bench mark as shown on the contract drawings. Refer to project record drawings under General Conditions.

END OF SECTION 220000

SECTION 220010

BASIC MATERIALS AND METHODS – PLUMBING

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. The general provisions of the Contract, including the Conditions of the Contract (General, Supplementary and other Conditions, if any) and Division 1 as appropriate, apply to the work specified in this Section.

1.2 REFERENCE

A. Install all piping, fixtures, equipment, etc., to meet the requirements of the following:

New Castle County Department of License and Inspection
International Plumbing Code
State of Delaware Fire Marshal's Office
NATIONAL Plumbing Code
International Plumbing Code (All applicable sections)
International Mechanical Code (All applicable sections)
International Fuel Gas Code (All applicable sections)
Gas Utility Company
Water Company
NFPA
OSHA

All requirements of the above governing agencies shall be in compliance with the latest issues, rules or regulations in effect.

B. Appliances and materials governed by UL requirements shall meet such requirements and bear the label.

1.3 QUALITY ASSURANCE

A. Provide adequate supervision of labor force to assure all aspects of specifications are being fulfilled.

B. Insure that all work and equipment is installed in accordance with manufacturer's warranty requirements.

C. Replace all pipes and fittings shown to be defective as a result of testing.

1.4 SUBMITTALS

A. Submit shop drawings and product data in accordance with Section 220000.

B. Submit the following:

1. Manufacturer's Product Data on all pipe and fittings to be used in project.

2. Manufacturer's Product Data on all valves to be used in project.

1.5 WARRANTY/GUARANTEE

A. All work and materials are subject to the general warranty as described in the General Conditions of the Contract and in Division 1, GENERAL REQUIREMENTS.

PART 2 – PRODUCTS

2.1 STEEL PIPE & FITTINGS

A. Pipe: ASTM A-53, seamless, Schedule 40.

B. Fittings:

1. Cast iron, threaded, 175 psi, ANSI B-16.4.
2. Malleable iron, threaded, ASA B 16.3.
3. Steel, socket weld, ASTM A-53.
4. Wrought iron, socket weld, ASTM A-72.

C. Thread tape shall be teflon tape, 3 mils minimum thickness. Teflon tape shall not be permitted for use on gas piping systems.

D. See Section 220130 for Gas Piping Systems.

2.2 COPPER TUBING

A. Domestic hot, cold and recirculated water:

1. Aboveground:

a. Tubing: Hard-drawn, seamless ASTM B-88, Type "L".
b. Fittings: Solder joint wrought copper ANSI B-16.22.
c. Joints: Lead-free solder 410°, ASTM B-32 alloy designation “TC”, ASTM B-828.
d. Flux: Non-toxic and non-corrosive, ASTM B-813.

2.3 VALVES (Copper Systems) – Solder ends of Threaded

A. Valves listed below shall be for domestic water systems and comply with the latest requirements of NSF 61-8. Refer to individual sections for gas valves.

B. Ball Valves: NIBCO two piece, full port, 600 psi WOG rated, cold non-shock valve with reinforced TFE seals, 316 stainless steel ball, Eco-brass body, ASTM 584, Alloy C87850, solder ends, or threaded non-blowout stem design. Acceptable NIBCO figure numbers: T/S 685-80-66-LF; T/S 595-Y-66-LF (3 piece).

C. Check Valves: NIBCO Class 125, Eco-brass body, ASTM 584, Alloy C87850, swing type, Y Pattern, threaded cap access. Acceptable NIBCO figure number: T/S 413-LF.

D. Gate Valves: NIBCO Class 125, Eco-Brass body, ASTM 584, Alloy C87850, Rising Stem. Acceptable NIBCO figure number: T/S 113-LF.

E. Balance Valves: All balance valves shall be provided with a memory stop feature with calibrated name plate to assure specific valve setting. Bronze body/brass ball, carbon filled TFE seat rings. NIBCO, Bell & Gosset, Accu-Flow, Taco or Flow Design "Accusetter". Acceptable NIBCO figure numbers: T/S 1710, F/G 737.

F. Strainers:

1. Class 125 Bronze Y-Strainer, body to be ASTM B584 or B62 bronze with threaded, solder or female press end connections and .033 inch perforated type 304 stainless steel screen or 20 mesh type 304 stainless steel screen accessible without removing the strainer from the line. Acceptable Figure numbers: NIBCO Fig. S/T-221, S/T-222, PF-221/222-A,B.

2. Class 125 Flanged Cast Iron Y-Strainer, body to be ASTM A-126 Class B cast iron. End connections to be Class 125 flanged, tapped bolted bonnet with plug. Screen shall be .033 inch perforated type 304 stainless steel screen or 20 mesh type 304 stainless steel screen accessible without removing the strainer from the line. Acceptable Figure numbers: NIBCO Fig. F 721-A.

3. Class 250 Threaded Cast Iron Y-Strainer: Strainer body to be ASTM A-126 Class B cast iron. End connections to be Class 250 threaded, tapped screw-in bonnet with plug. Screen shall be .033 inch perforated type 304 stainless steel screen or 20 mesh type 304 stainless steel screen accessible without removing the strainer from the line. Acceptable Figure numbers: NIBCO Fig. T-751-A

G. VALVES (Copper Systems) – Press Fit

1. Valves listed below shall be for domestic water systems and comply with the latest requirements of NSF-61-8.

   a. 2 Inch and Smaller Ball Valves (On/Off):

      Ball Valves with male or female press to connect shall be rated at 200 PSI CWP to +225°F maximum. Valves shall be manufactured in accordance with MSS SP-110 and constructed of dezincification resistant cast bronze bodies. Brass with more than 15% zinc shall not be approved. Valve shall have reinforced PTFE Seats, Blow-out Proof Stem, Full Port Ball, Chrome/Nickel Plated or Stainless Steel Ball for aggressive water.

   b. 2 Inch and Smaller Check Valves (Swing Type):

      Check valves shall be swing type Y pattern with male or female press to connect ends and shall be rated 200 PSI CWP to + 250°F maximum. Valves shall be manufactured in accordance with MSS SP-80. Body & cap shall be manufactured of dezincification resistant cast bronze ASTM B62 or ASTM B584 Alloy C8440. Valves shall have PTFE seat disc.

   c. 2 Inch and Smaller Check Valves (Lift or Spring Type):

      Incline resilient disc, spring actuated, 250psi rating, non-shock cold working

pressure, 2500F maximum working temperature, bronze ASTM B584 alloy C84400. Stainless steel stem and disc holder and spring, EDPM O-ring.

H. Insofar as possible, all valves of the same type shall be of the same manufacturer.

I. Valve Manufacturers: Subject to compliance with requirements, provide valves of one of the following:

Apollo/Conbraco
Stockham
Nibco
Milwaukee
Watts
Hammond
Webstone

J. System Application:

1. Domestic Water:
   a. Check Valves - 2" & Smaller - threaded or soldered.
   b. Ball Valves - 3" & Smaller - threaded or soldered.
   c. Balance Valves - All sizes - threaded.
   d. Butterfly Valves - 4" and larger - flanged.
   e. Butterfly Valves – 3” and smaller – wafer type.

2.4 THERMOMETERS

A. Separable socket, inserted into fluid flow, adjustable, hermetically sealed, red mercury, die-cast, baked enamel finish, double strength glass lens, white scale and black graduations.

B. Scale: Select range of thermometer to indicate normal operating temperature at mid-point of scale for domestic water systems.

C. Manufacturer: U.S. Gauge, H.O. Trerice, Moeller, Duro.

2.5 GAUGES

A. Phosphor bronze bourdon tube, polypropylene case, gasketed glass crystal, aluminum dial, black graduations 4-1/2 inch diameter.

B. Range: 0 to 150 psi, 5 pound intervals, 1/2 pound graduations.

C. Manufacturers: Danton, U.S. Gauge, H.O. Trerice, Moeller.

D. Install with bronze gauge cock.

2.6 ISOLATING FITTINGS

A. Furnish isolating fittings between all sections of dissimilar piping materials or piping, general supports, equipment and supports, including piping hanger and rack supports where one material is ferrous and the other is non-ferrous.

B. Install copper or brass piping or tubing in such a way as not to touch or come in contact with ferrous metals.

C. Where ferrous piping or equipment is connected to copper or brass piping, make connection with insulating or dielectric unions to prevent electrolytic action between the ferrous and non-ferrous metals.

D. Where copper or brass piping, tubing or fittings are anchored to, supported by or may come in contact with ferrous metal construction, provide an insulating nonconductor spacer of rubber, fiber or equivalent material to assure prevention of electrolysis.

E. Manufacturer: Epco Sales, Inc., or insulated unions by Central Plastic Co.

2.7 ANCHORS AND GUIDES

A. Anchors and guides shall be provided to support and maintain pipes in position and properly distribute expansion. The anchors and guides must be securely fastened to the building structure, and must be completely installed before the system is tested.

B. Guides shall be as manufactured by J.J. McNally, Inc., Flexonics, Inc., Tube-Turns, American District Steam Co.

2.8 UNIONS

A. Up to and including 2 inch pipe size: Screwed pattern, bronze-to- bronze seat.

B. Above 2 inch pipe size: 125 Class Flanged pattern, A.S.A. sweat copper fitting, with gaskets, bolts and nuts.

C. Copper tubing unions shall have sweated type ends. Flanged unions on copper tubing may be soldered connections.

D. Materials and pressure ratings shall be the same as specified for the respective pipe and fitting system unless otherwise specified.

PART 3 – EXECUTION

3.1 PIPING SYSTEM INSTALLATION REQUIREMENTS

A. Drawings are generally diagrammatic and due to small scale, it is impossible to indicate all fittings, valves, gauges and specialties required. Provide complete operating systems and all necessary fittings, valves gauges and specialties whether or not indicated.

B. Install all piping in accordance with the best practices of the trade and latest code requirements. Use uniform system materials throughout the building. All branch take-offs shall be off the top of the pipe.

C. Pipe and fittings shall be clean from cutting burrs, foreign materials and defects in structure and threading. Make all cuts square. Ream after cutting. Clean off scale and dirt inside and outside, before assembly. Remove welding slag or other foreign material.

D. Keep all piping as high as possible, consistent with proper pitch, to maintain maximum headroom. Cut piping accurately to measurements established at the building, work into place without springing, forcing or cutting of the building structure, and install as directly as possible between connecting points parallel with or at right angles to building construction, except as required to obtain pitch.

E. Unless otherwise shown, run piping within the building, concealed in the walls, furred spaces, pipe spaces or above suspended ceilings. Unless otherwise noted, do not build in or bury horizontal piping in partitions. Install all exposed piping as closely as possible to walls, ceilings and columns, consistent with access and applicable insulation requirements.

F. This project includes a return air plenum ceiling. Regardless of materials specified, all system piping and/or materials shall be non-combustible and shall be in full compliance with the requirements set forth in the IPC.

G. All piping to drain to low points. Low points will be provided with drain valves with hose thread. All piping shall have high points vented with ball valve, nipple and threaded cap.

H. Do not install trapped lines where water cannot be drained or air can accumulate without being vented.

I. Piping shall run square with building lines.

J. Piping shall not be insulated or covered until tested and until building is closed in.

K. Necessary drains, off-sets, vents and drips shall be provided for coordination of the work as part of the contract.

L. Piping shall not be installed over electrical transformers, panels, switchgear, substations, and control panels as per the National Electric Code. No piping shall be installed in elevator machine rooms unless it is directly related to the room's system equipment.

M. Allow clearance for expansion and contraction.

N. Install isolating fittings between sections of ferrous and non- ferrous pipe or connected equipment.

O. Valves shall be installed with stems above horizontal.

P. Valves shall be installed on all sides of equipment and control valves to allow isolation for repair.

Q. Do not support piping from other piping, conduits or equipment. Provide additional bracing to prevent movement of trapeze piping, or any singular run of pipe to fixtures. Provide additional bracing on all piping through walls to flush valves to prevent movement during normal operation or performing maintenance on valves.

R. Thermometers and gauges shall be installed where indicated on the drawings, required by equipment specifications and where indicated elsewhere in the specifications. Gauges shall be located at an elevation that can be readable.

S. Unions shall be provided adjacent to all valves, at equipment connections, and where necessary to facilitate dismantling of the piping system.

T. Ball valves to be installed with the proper clearance for operating the valve handle. A minimum clearance of 10" from center of valve to wall must be maintained for ease of operation.

U. Thermometers are to be located so they can easily be seen from the floor in front of unit. Make final adjustment by tilting thermometer. Locate bulb in waterway with an oversized tee or elbow fitting.

V. Install pressure gauges on incoming services both domestic water and fire services. Locate pressure gauge after main shut-off valve and ahead of water meter if one is provided within building.

W. All pipe unions installed shall be accessible. Unions shall not be concealed or located in places where they cannot be maintained.

X. Support and bracing of 4" and above pipe shall be in accordance with the CISPI Standards and IPC Chapter 3.

3.2 TAGS, CHARTS, AND IDENTIFICATION

A. All piping shall be labeled in accordance with IPC 303.1 and 303.4.

B. Identify each valve in all systems with black, numbered and stamped 1-1/2" brass or aluminum tags fastened to valve by brass chain and S-hook.

C. Piping Identification: Provide identification and safety products, semi-rigid plastic, wraparound pipe markers with flow arrows and conforming to ANSI A13.1. Locate marker at each valve, changes in direction, where pipes pass thru barriers and every 25' of horizontal runs. Lettering on background shall be in accordance with the following colors:

Legend	Background	Lettering
1. Gas	- Yellow	- Black
2. Domestic Cold Water	- Green	- White
3. Domestic Hot Water (110° ^ 140°)	- Yellow	- Black
4. Domestic Hot Water Return (110° ^ 140°)	- Yellow	- Black
5. Condensate Drainage	- Yellow	- Black

D. Provide 1/8" scale diagrams showing location, number and service or function of each tagged item.

1. Frame diagrams in approved metal frames with clear acrylic front, hinges, and locks.
2. Secure to wall in Mechanical Room.
3. Provide two additional separate copies permanently covered and bound.

E. Available Manufacturers: Subject to compliance with requirements, manufacturer's offering identification markers which may be incorporated in the work are limited to the following:

Seton
Brimar
B-Line
Marking Services, Inc.

3.3 WELDING

A. All concealed and inaccessible black steel piping shall be welded.

B. All black steel piping larger than 2 inch shall be fusion welded.

C. All elbows, tees and branch connections shall be made with welding fittings ANSI B16.9.

D. Welding shall be in accordance with the ASME Boiler and Pressure Vessel Code Section IX.

E. Furnish welder test certificate for review. Certificates of successful qualification by the following organizations shall be acceptable.

1. ASME Boiler and Pressure Vessel Code
2. ANSI Code for Pressure Piping
3. National Certified Pipe Welding Bureau
4. Military Specification MIL-STD-248

3.4 SOLDERING/BRAZING

A. Connections between copper tubing and copper sweat fittings shall be made by soldering using Taramet Sterling or approved substitute. Flux shall be non-corrosive type “Nokorode” or approved substitute or as recommended by the manufacturer of the solder.

B. All solder shall be “lead nickel and antimony free” in accordance with the Federal Safe Drinking Water Act Amendments of 1986 and 1996 as is ASTM B-32 Grade TC.

Composition:

Tin	95%
Copper	4.0 – 5.0%
Selenium	.04 - .2%
Tensile Strength	7,130 psi
Shear Strength	5,970 psi
Melting temperature	410°F

C. Tubing shall be cut square and then reamed and deburred. End of tubing and inside of fitting cup shall be cleaned with steel wool and the flux shall be applied to the clean surface before soldering. After soldering, the excess solder shall be wiped off while still plastic.

D. Brazed Joints:

1. All brazed joints shall be cleaned. An approved flux shall be applied; joint filler metal shall conform to AWS A5.8.

2. Flux shall meet AWS Standard A5.31, Type F83-A or F83-C.

F. 410 solder shall be used for all joints in:

1. Domestic cold water
2. Domestic hot water
3. Domestic hot water return
4. Copper drainage piping
5. Plant compressed air

G. Lead-Tin (50-50) solder or any solder containing lead shall NOT be used or permitted for joint connections on this project.

H. Where the silver brazing is performed in a confined non-ventilated space, a non-toxic, cadmium-free brazing alloy such as Stay-Brite shall be used instead of Easy-Flo. Bring joint to solder temperature or brazing temperature in as short a time as possible.

I. Form continuous solder bead or brazing filler bead around entire circumference of joint.

J. Wipe excess solder from joint area while solder is still plastic.

K. Solder joints shall be in accordance with IPC Section 605.2, 605.14.3 and ASTM B838. Flux shall conform to ASTM B-813.

3.5 PRESS-FIT SYSTEM

A. All new domestic water piping installed on this project shall be a solderless, press-fit, domestic water system. The system shall be Viega/Rigid copper press fitting system. Fittings shall be rated 0□ to 250□ at 200 psi and tested to 600 psi.

B. Fittings shall meet ANSI/NSF 61, – ASME B-16.22 and ASTM B88. Elastomeric seals shall meet ASTM D-2000.

C. Mechanical joining shall be recognized by:

IPC International Plumbing Code
SBCCI Standard Plumbing Code
IAPMO Uniform Plumbing Code
PHCC National Standard Plumbing Code

D. Copper and copper alloy press fittings shall conform to material requirements of ASME B16.18 or ASME B16.22 and performance criteria of IAPMO PS 117. Sealing elements for press fittings shall be EPDM. Sealing elements shall be factory installed or an alternative supplied by fitting manufacturer. Press end shall have SC (Smart Connect) feature design (leakage path). Smart Connect™ (SC Feature). In ProPress ½" to 4" dimensions, the Smart Connect Feature assures leakage of liquids and/or gases from inside the system past the sealing element of an unpressed connection. This feature shall provide the installer quick and easy identification of connections which have not been pressed prior to putting the system into operation.

E. Press Connections: Copper press fitting joints shall be made in accordance with the manufacturer's installation instructions. The tubing shall be fully inserted into the fitting and the tubing marked at the shoulder of the fitting. The fitting alignment shall be checked against the mark on the tubing to assure the tubing is fully engaged (inserted) in the fitting.

The joints shall be pressed using the tool approved by the manufacturer.

F. Installer shall be a qualified installer, licensed within the jurisdiction, and familiar with the installation of ProPress copper press joint systems. ProPress copper press fittings shall be installed using the proper tool, actuator, jaws and rings as instructed by the press fitting manufacturer. The installation of copper tubing for hot and cold water distribution systems shall conform to the requirements of the ICC International Plumbing Code or IAPMO Uniform Plumbing Code.

G. Note: Viega Press-fit installation shall only be permitted on this project. Push-on shark-teeth, or any type connection fittings that are not Press-Fit, shall NOT be approved.

H. T-drill mechanically formed tee fittings shall be used in conjunction with the ProPress Copper System in accordance with the IPC Chapter 6 Section 605.5.1, 605.5.1.2 and 605.14.1. Use caution around combustible material and follow all safety guidelines for open flame during silver brazing.

END OF SECTION 220010

SECTION 220030

INSULATION & COVERING – PLUMBING

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. The general provisions of the Contract, including the Conditions of the Contract (General, Supplementary and other Conditions, if any) and Division 1 as appropriate, apply to the Work specified in this Section.

1.2 DESCRIPTION OF WORK

A. This section includes insulation and covering furnished and installed on the following piping systems and equipment:

1. Domestic cold water.
2. Domestic hot water supply and return

1.3 REFERENCE STANDARDS

A. Refer to Section 220000 for a general description of requirements applying to this section.

B. Materials shall conform to the requirements of the NFPA Code.

1.4 QUALITY ASSURANCE

A. Refer to Section 220010 for a general description of requirements applying to this section.

1.5 SUBMITTALS

A. Submit shop drawings and product data in accordance with Section 220000.

B. Submit the following:

1. Product data on all insulation and covering.

1.6 WARRANTY/GUARANTEE

A. All work and materials are subject to the general warranty as described in the General Conditions of the Contract and in Division 1, GENERAL REQUIREMENTS.

PART 2 – PRODUCTS

2.1 PIPE INSULATION MATERIAL

A. Fiberglass:

1. Material: Preformed fiberglass bonded with resins to form circular pipe sleeves with factory applied, white all-service jacket bonded to reinforced foil vapor barrier jacketing.

The jacket shall have factory-applied double pressure-sensitive adhesive closure and vapor sealing of longitudinal joints. Thermal Conductivity: .25 per inch at 100 degrees F. Flame spread of 25 and developed smoke of 50 or less.

2. All Valves and Fittings:

   a. Class fiber insert and premolded PVC cover, Manville "Zeston" and "Hi-Lo Temp Inserts" for valves and fittings.
   b. Factory molded fibrous glass fitting covering for fittings.
   c. Mitered sections of pipe covering for valves.

3. Manufacturers: Johns-Manville, Certain-Teed, Owens-Corning.

B. Closed Cell:

1. Material: Flexible elastomeric foamed plastic closed cell structure insulation 25/50 rated with a flame spread rating of 25 or less and a smoke developed rating of 50 or less.

2. Flexible pipe insulation shall be a foamed plastic closed cell structure material, with a thermal conductivity of not more than 0.27 Btu/Hr./Sq. Ft./Inch at a mean temperature of 75 degrees F. The insulation shall have an average density of at least 2 pounds per cubic foot, shall be self-extinguishing, and shall have a water vapor transmission rating of not more than 0.1 perms. Between temperature limits of -40 degrees F and plus 220 degrees F, the insulation shall not indicate any deviation from its original state.

3. Manufacturers: Armacel, Insul-Tube, Nomaco Insulation.

4. Specification Compliance: (Latest accepted Standards and Codes)

IECC 804.5:	Insulation thickness for domestic hot and recirculation mains.
ASTM-E-84	Flame spread and smoke developed.
NFPA 255:	Standard method of test of surface burning of building materials.
ASTM C177:	Thermal conductivity.
NFPA 90A, 90B:	Flame & smoke rating
ASTM-C-534 Type 1 Tubular Grade, Self-Sealing	
UL 181	Factory made air ducts and air connectors. (Armacell UL181 has to do with mold growth)
UL723	Test for surface burning characteristics of building materials.
ASTM G21/C1338:	Fungi resistance
ASTM G2:	Bacterial Resistance
ASTM D1056, 2B1:	Standard spec for flexible cellular materials.
MIL-P-15280J, FORMT	
MIL-C-3133B (MIL STD 670B) Grade SBE-3	
MEA 96-85M	

C. Covering of Pipe Insulation Outdoors:

1. Wrapping: Wrap insulation with embossed .016" aluminum jacket.
2. Fastenings: Cover shall be held in place with soft aluminum bands on 12" centers.
3. Valves and Fittings: Weatherproof all valves and fittings.
4. Manufacturers: Johns-Manville, Certain-Teed, Owens-Corning, Knauf.

D. Protective cover for foam insulation in wet areas indoors:

1. PVC heavy duty fitting covers and jacketing for kitchen wet areas.
2. Fitting covers shall be glossy white, high impact, UV resistant PVC.
3. Operating Temperature Limit: Up to 150ºF.
4. Flame Spread: 25 or less.
5. Smoke Developed: 50 or less.
6. Grade: Weatherable.
7. Color: White
8. Finish: Gloss
9. Fitting covers and jacketing shall be “Zeston” 300 Series PVC, heavy duty covers and “Zeston” PVC jacketing.

PART 3 – EXECUTION

3.1 INSTALLATION

A. Do not install until systems have been tested and meet requirements.

B. Heavy work which may damage insulation shall have been completed in the vicinity of the insulation work.

C. All installations shall be made by skilled craftsmen regularly engaged in this type of work.

D. Insulation shall be continuous thru-wall, ceiling and floors.

E. Pipe and equipment to be clean and dry prior to insulating.

F. Install all insulation in strict conformance with manufacturer's instructions.

G. Install pipe insulation by slitting tubular sections and applying onto piping or tubing. Alternately, whenever possible, slide unslit sections over the open ends of piping or tubing. All seams and butt joints shall be adhered and sealed using Armaflex 520 or 520 BLV Adhesive. If when using AP Armaflex SS, only the butt joints shall be adhered using Armaflex 520 or 520 BLV Adhesive, Armaflex HT 625 Adhesive shall be used with HT Armaflex.

H. Insulation shall be pushed onto the pipe, never pulled. Stretching of insulation may result in open seams and joints.

I. Tape the ends of the copper tubing before slipping the Armaflex insulation over the new pipes to prevent dust from entering the pipe.

J. All edges shall be clean cut. Rough or jagged edges of the insulation shall not be permitted. Proper tools such as sharp, non-serrated knives must be used.

K. On cold piping, insulation shall be adhered directly to the piping at the high end of the run using a two-inch strip of Armaflex 520 or 520 BLV Adhesive on the ID of the insulation and on the pipe. All exposed end cuts of the insulation shall be coated with Armaflex 520 or 520 BLV Adhesive. All penetrations through the insulation and termination points must be adhered to the substrate to prevent condensation migration.

L. Sheet insulation shall be used on all pipes larger than 6" IPS. Insulation shall not be stretched around the pipe. On pipes larger than 12" IPS, adhere insulation directly to the pipe on the lower 1/3 of the pipe.

M. Seams shall be staggered when applying multiple layers of insulation.

3.2 VALVES, FLANGES AND FITTINGS:

A. All fittings shall be insulated with the same insulation thickness as the adjacent piping. All seams and mitered joints shall be adhered with Armaflex 520 or 520 BLV Adhesive. Screwed fittings shall be sleeved and adhered with a minimum 1" overlap onto the adjacent insulation. Armaflex HT 625 Adhesive shall be used with HT Armaflex.

B. Valves, flanges, strainers and Victaulic couplings shall be insulated using Armaflex donuts that shall then be covered with sheet or oversized tubular insulation.

3.3 HANGERS

A. Support piping system using high density inserts with sufficient compressive strength. The pipe support insulation shall be elastomeric foam with the same or greater thickness than the pipe insulation. All joints shall be sealed with Armaflex 520 or 520 BLV adhesive.

B. Standard and split hangers: Piping supported by ring hangers shall have hangers insulated with the same insulation thickness as the adjacent pipe. All seams and butt joints shall be sealed with Armaflex 520 or 520 BLV Adhesive. Armaflex HT 625 Adhesive shall be used with HT Armaflex. Ring hangers may be sleeved using oversized tubular insulation. On cold piping, insulation shall extend up the hanger rod a distance equal to four times the insulation thickness. Insulation tape may be used to a thickness equal to the adjacent insulation thickness.

C. Clevis Hangers or other pipe support systems: Saddles shall be installed under all insulated lines at unistrut clamps, clevis hangers or locations where the insulation may be compressed due to the weight of the pipe. All piping shall have wooden dowels or blocks of a thickness equal to the insulation inserted and adhered to the insulation between the pipe and the saddle.

   It is highly recommended for continuous insulation protection to use hanger sizes equal to the outer diameter of the pipe plus insulation thickness

D. Armafix IPH o Armafix NPH can be used to prevent compression of insulation at standard split, clevis hangers or other pipe support systems. To minimize the movement of Armafix, it is recommended that a pair of non-skid pads be adhered to the clamps. In addition, to prevent loosening of the clamps, use of an antivibratory fastener, such as a nylon-locking nut, is also recommended.

3.4 PIPE COVERING (FOAMED PLASTIC TYPE)

A. All joints and seams shall be sealed with a compatible adhesive. Approved adhesives are as follows:

Armacel No. 520 (Low VOC use 520 BLV
Benjamin Foster Company No. 85-75 up to 200 degrees F.

Contractor may use self-sealing insulation in lieu of above.

B. Fitting covers shall be fabricated from the foamed plastic pipe insulation or from sheet insulation of the identical material. The fabrication shall be in accordance with manufacturer's instructions, and all seams mitered joints shall be joined using the adhesives described.

3.5 PIPE INSULATION – TYPES & THICKNESSES

A. Flexible Closed Cell:

Piping System	Up to 3"	Over 3" to 6"	Over 6"
Cold Water	½"	½"	¾"
Hot Water (120º)	1"	1"	1-1/2"
Hot Water Return (120º)	1"	1"	1-1/2"

B. Fiberglass:

Piping System	Up to 3"	Over 3" to 6"	Over 6"
Cold Water	½"	½"	¾"
Hot Water	1"	1"	1-1/2"
Hot Water Return	1"	1"	1-1/2"

END OF SECTION 220030

SECTION 220130

GAS PIPING SYSTEMS – PLUMBING

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. The general provisions of the Contract, including the Conditions of the Contract (General, Supplementary and other Conditions, if any) and Division 1 as appropriate, apply to the work specified in this Section.

1.2 DESCRIPTION OF WORK

A. This Section includes:

1. Natural gas piping system as indicated on drawings and schedules, and by requirements of this section.

2. Applications for natural gas piping systems include the following:

   a. Elevated pressure (psi) gas from meter location to rooftop gas-fired equipment.
   b. Low pressure (WC) from the meter location to all other equipment and outlets, requiring gas service.

3. Applications for propane gas piping systems include the following:

   a. All gas piping from the exterior secondary regulator assembly location to all equipment and outlets, requiring gas service.

4. Trenching and backfill required in conjunction with exterior gas distribution as specified in Section 220000 is included as work of this section. Refer to Division 1.

1.3 REFERENCE STANDARDS

A. Refer to Section 220000 for a general description of requirements applying to this Section.

1.4 QUALITY ASSURANCE

A. Refer to Section 220010 for a general description of requirements applying to this section.

1.5 SUBMITTALS

A. Submit shop drawings and product data in accordance with Section 220000.

B. Submit the following:

1. Product data on gas valves.

1.6 WARRANTY/GUARANTEE

A. All work and materials are subject to the general warranty as described in the General Conditions of the Contract and in Division 1, GENERAL REQUIREMENTS.

PART 2 – PRODUCTS

2.1 NATURAL GAS PIPING MATERIALS AND PRODUCTS

A. Provide piping materials and factory-fabricated piping products of sizes, types, pressure ratings, and capacities as indicated. Where not indicated, provide proper selection as determined by Installer to comply with installation requirements. Provide materials and products complying with ANSI B31.2 where applicable, base pressure rating on natural gas piping system maximum design pressures. Provide sizes and types matching piping and equipment connections; provide fittings of materials which match piping materials used in natural gas piping systems. Where more than 1 type of material or product is indicated, selection is Installer's option.

2.2 BASIC IDENTIFICATION

A. Provide identification complying with Division 22 Sections and in accordance with the following listing:

Building Distribution Piping: Plastic pipe markers.

Gas Valves: Plastic valve tags.

2.3 BASIC PIPE, TUBE AND FITTINGS

A. Provide pipe, tube and fittings complying with Section 220010 Basic Materials and Methods - Plumbing and in accordance with the following listing:

1. Interior Piping: Schedule 40 black steel ASTM A-53, A-106

   Fittings: Malleable black iron, threaded

2.4 BASIC PIPING SPECIALTIES

A. Provide piping specialties complying with applicable Division 22 Sections and in accordance with the following listing:
Pipe escutcheons
Pipe sleeves
Sleeve seals

2.5 SPECIAL VALVES

A. Valves required for gas piping systems on this project shall be the following types:

Gas Valves: (Up to 3")

1. Apollo 80-100 Series bronze gas ball valve. Threaded, 600 PSIG WOG, cold non-shock. 250 PSIG LP-Gas. 150 PSIG saturated steam. Vacuum service to 29 inches Hg. Federal Specification: WW-V-35C, Type: II, Composition: BZ, Style: 3.

2. Features:
   - UL Listed for LP-Gas and natural gas.
   - Large ports to reduce pressure drop
   - Reinforced TFE seats and seals
   - Blow-out-proof stem design
   - Optional tee handle available
   - Quarter turn on-off
   - Adjustable packing gland
   - One piece bronze body
   - Chromium plated ball

3. UL Listings:
   - Guide YRPV: Gas shut-off valve for use with natural and manufactured gases.

4. This valve shall be used for all pipe sizes up to 3" in the system.

Gas Valves (4" and Larger)

1. Apollo 88A-100 Series carbon steel, ANSI Class 150 flanged standard port ball valves.

   Standards of Compliance:
   IFGC: Section 409 (Valves)
   ASME B16.5 – Pipe Fittings and Flanges
   ASME B16.33 – Manual Operated Metal Gas Valves up to 125 psig
   ASME B16.38 – Large Metal Valve Gas Distribution
   ASME B31.8 – Gas Transmission and Distribution Piping Systems
   UL 125

B. Manufacturers: Subject to compliance with requirements, provide gas valves of one of the following:

Apollo/Conbraco
Stockham
Milwaukee
NIBCO, Inc.
Watts

PART 3 – EXECUTION

3.1 INSTALLATION OF BASIC IDENTIFICATION

A. Install mechanical identification in accordance with applicable Division 22 Sections.

3.2 INSTALLATION OF NATURAL GAS PIPING (INTERIOR)

A. Install natural gas distribution piping in accordance with Section 220010 Basic Materials and Methods - Plumbing and in accordance with applicable codes IFGC latest edition, and local Utility Company requirements.

B. Use sealants on metal gas piping threads which are chemically resistant to natural gas. Use sealants sparingly, and apply to only male threads of metal joints.

C. Remove cutting and threading burrs before assembling piping.

D. Do not install defective piping or fittings. Do not use pipe with threads which are chipped, stripped or damaged.

E. Plug each gas outlet, including valves, with threaded plug or cap immediately after installation and retain until continuing piping or equipment connections are completed.

F. Install drip-legs in gas piping where indicated, and where required by code or regulation.

G. Install "Tee" fitting with bottom outlet plugged or capped at bottom of pipe risers.

H. Use dielectric unions where dissimilar metals are joined together.

I. Install piping with 1" drop in 60' pipe run (0.14%) in direction of flow.

J. Install piping parallel to other piping, but maintain minimum of 12" clearance between gas piping and steam or hot water piping above 200 degrees F (93 degrees C).

K. For piping buried in building substrate, or below floor slabs, install in welded conduit, ventilated to outdoors on both ends, and tested to same requirements as gas piping.

L. Gas valves shall not be installed above ceilings without access and signage.

M. Supports:

1. All pipe, fittings, valves, installation and testing shall be in accordance with the IFGC, Chapter 4.

2. Gas piping shall be supported in accordance with the International Fuel Gas Code's latest accepted 2003 Edition, Section 407, as follows:

3. Support intervals shall be in accordance with the IFGC listed above and in Section 415, Table 415.1 as follows:

    a. Steel pipe ½" nominal size – not to exceed 6 ft.
    b. Steel pipe ¾" to 1" nominal size – not to exceed 8 ft.
    c. Steel pipe 1-1/4" and larger nominal size horizontal – not to exceed 10 ft.
    d. Steel pipe 1-1/4" and larger nominal size, vertical not to exceed every floor.

4. Support and spacing of CSST Systems shall be in accordance with CSST manufacturer's instructions.

3.3 INSTALLATION OF VALVES

A. Gas valves: Provide at connection to gas train for each gas-fired equipment item; and on risers and branches where indicated.

B. Locate gas valves where easily accessible, and where protected from possible damage.

3.4 EQUIPMENT CONNECTIONS

A. Connect gas piping to each gas-fired equipment item, with drip leg, union and shutoff gas valve. Comply with equipment manufacturer's instructions. Drip legs shall not be installed on any exterior gas piping.

B. Equipment furnished by the Owner, or Contractors other than this Contractor: After equipment has been set in place, this Contractor shall furnish all labor and material required to make final connections between roughing-in and the equipment. Install valves, fittings, trim and appurtenances furnished with the equipment. Piping shall be of the same material as the system to which it connects.

C. All rooftop, gas-fired equipment shall be provided with gas pressure regulating valve to reduce gas pressure from 5 psi to 10" WC. All regulators shall be provided with relief vent discharge piping of lengths as required for minimum distance of equipment air intake grilles.

3.5 INSTALLATION OF GAS PRESSURE REGULATORS

A. This Contractor shall furnish and install gas pressure regulating valves for all shown on the drawings. Installation shall be in strict accordance with the requirements of the Utility Company and the Canadian Gas Association.

B. All regulators installed shall be tagged with data noting the inlet and outlet pressure for each individual regulator installed.

C. Medium or High Pressure (MP) (HP) Regulators shall comply with the following:

1. The MP regulator shall be approved and shall be suitable for the inlet and outlet gas pressures for the application.

2. The MP regulator shall maintain a reduced outlet pressure under lockup (no flow) conditions.

3. The capacity of the MP regulator, determined by published ratings of its manufacturer, shall be adequate to supply the appliances served.

4. The MP pressure regulator shall be provided with access. Where located indoors, the regulator shall be vented to the outdoors or shall be equipped with a leak-limiting device, in either case complying with Section 410 of the IFGC.

5. A tee fitting with one opening capped or plugged shall be installed between the MP regulator and its upstream shutoff valve. Such tee fitting shall be positioned to allow connection of a pressure-measuring instrument and to serve as a sediment trap.

6. A tee fitting with one opening capped or plugged shall be installed not less than 10 pipe diameters downstream of the MP regulator outlet. Such tee fitting shall be positioned to allow connection of a pressure-measuring instrument.

END OF SECTION 220130

SECTION 220190

TESTING – PLUMBING

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. The general provisions of the Contract, including the Conditions of the Contract (General, Supplementary and other conditions, if any) and Division 1 as appropriate, apply to the work specified in this Section.

1.2 DESCRIPTION OF WORK

A. Extent of plumbing systems to be tested is indicated on the drawings and by requirements of this section.

B. Applications of tests include the following:

1. Interior Piping

    a. Domestic cold, hot & hot water return piping
    b. Gas piping

C. See Fire Protection Specifications for testing of Fire Protection Systems.

1.3 REFERENCE STANDARDS

A. Refer to Section 220000 for a general description of requirements applying to this section.

1.4 QUALITY ASSURANCE

A. Refer to Section 220010 for a general description of requirements applying to this section.

1.5 SUBMITTALS

A. Submit test reports in accordance with Section 220000.

1.6 WARRANTY/GUARANTEE

A. All work and materials are subject to the general warranty as described in the General Conditions of the Contract and in Division 1, GENERAL REQUIREMENTS.

PART 2 – PRODUCTS

2.1 PIPE & FITTING REPLACEMENTS

A. Refer to Section 220010 for replacement of any defective pipe or fittings. Replacement shall include all required uncovering, excavating, recovering and backfilling.

PART 3 – EXECUTION

3.1 GENERAL

A. All exterior or interior piping shall be tested and approved before backfilling or concealing. Failure to secure the approval of the Municipal Inspector, Utility Company's Inspector or the Inspector of the Architect/Engineer makes it mandatory for the Contractor to completely expose the piping for testing. All expense involved in the uncovering of the piping for the test and recovering shall be borne by the respective Contractor with no change in Contract.

B. All equipment, material and labor required for testing a plumbing system or part thereof shall be furnished by the Plumbing Contractor responsible for installing the work.

3.2 INTERIOR PIPING

A. Domestic Water Piping: All new, altered, extended or replaced interior water piping installed shall be tested at 100 psig maintaining the pressure for four hours with not more than 1% drop in pressure. The system shall be filled with water which shall remain in the system until the water and the piping are the same temperature. If water pipe testing is under the jurisdiction of the local inspector, his requirements shall be used; however, they shall be not less than specified herein. The tests shall be performed in the presence of the representative of the Architect/Engineer and to his satisfaction.

B. Natural Gas Piping:

1. All new, altered, extended or replaced interior natural gas piping installed shall be tested in accordance with the requirements of the National Fire Protection Association, latest edition of the IFGC, Section 107, and the requirements of the local Utility Company as applicable. In the absence of a specific test required by the Authorities, or if such requirements are less stringent than the test hereinafter specified, then the interior gas piping shall be tested as follows in the presence of the representative of the Architect.

2. Before appliances are connected, piping shall be filled with air or nitrogen, to a pressure of 10 psi and proved tight with no drop in pressure for the length of time required to inspect the joints, but in no case less than 30 minutes. The source of pressure shall be isolated before the pressure tests are performed. Pressure shall be measured with a mercury manometer, or slope gauge or equivalent device so calibrated as to be read in increments of not greater than one-tenth pound. All piping which will be concealed shall be tested, prior to being closed in by construction.

3.3 STERILIZATION

A. After final testing for leaks, all new potable water piping installed including water service piping, shall be flushed to remove foreign material.

B. Before placing domestic water systems in service, a qualified service organization shall be engaged, to sterilize the entire building including the exterior water service piping in accordance with the following procedure:

1. Contractor shall provide a 3/4" hose connection somewhere in the main entering the building, or in the Mechanical Room and/or in the meter pit, pump in sufficient sodium hypochlorite to produce a free available chlorine residual of not less than 100 PPM.

2. Proceed upstream from the point of chlorine application opening all faucets and taps until chlorine is detected. Close faucets and taps when chlorine is evident. Consult with the local code department for additional concentrations and durations.

3. When chlorinated water has been brought to every faucet and tap with a minimum concentration of 200 PPM chlorine, retain this water in the system for at least three hours.

4. At the end of the retention period, no less than 100 PPM of chlorine shall be present at the extreme end of the system.

5. Proceed to open all faucets and taps and thoroughly flush all new lines until the chlorine residual in the water is less than 1.0 PPM.

6. Obtain representative water samples from the system for analysis by a recognized Bacteriological Laboratory.

7. If all samples tested for impurities and organisms are negative, a letter and laboratory reports shall be submitted by the service organization to the contractor, certifying successful completion of the sterilization.

8. If any samples tested indicate the presence of harmful impurities and organisms, the entire sterilization procedure shall be repeated.

9. Plumbing Contractor shall provide plumbing connections and power for pumping chlorine solution into the system.

Warning: PVC and CPVC Pipe: Do not use a dry granular calcium hypochlorite as a disinfecting material for water purification in potable water piping systems. The introduction of granules or pellets of calcium hypochlorite with solvent cements and primers (including their vapors), may result in violent chemical reactions.

C. Available Service Organizations: Subject to compliance with requirements, provide the sterilization service of one of the following:

Water Chem
Arc Company, Inc.
Nova Consultants
Artesian Water Co.

END OF SECTION 220190

SECTION 230200

GENERAL PROVISIONS – HVAC

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. The general provisions of the Contract, including the Conditions of the Contract (General, Supplementary and other Conditions, if any) and Division 1 as appropriate, apply to work of this Section.

B. This specification or drawing and the design features or resulting construction disclosed, are the property of Furlow Associates, Inc., and shall not be reproduced without written permission.

C. All Mechanical Systems shall be part of and included in all of the following: 230200 thru 230950.

1.2 WORK INCLUDED

A. Provide labor, materials, equipment and supervision necessary to install complete operating HVAC Systems, including all work at the site and within the proposed construction areas to accomplish the required work.

B. Wherever the term "provide" is used, it shall be understood to mean both "furnish" and "install".

1.3 REGULATIONS, CODES AND STANDARDS

A. Work shall be performed in accordance with latest adopted codes, regulations and ordinances by authorities having jurisdiction. Observe all safety regulations.

B. Obtain all permits and inspection certificates and pay all charges.

C. Make or arrange for utility connections and pay all charges.

D. Latest editions of any referenced standards shall govern.

1.4 RELATED WORK

A. Refer to equipment shown or specified in sections of Division 1 thru 14 and 26 that will require Mechanical services and provide such service.

B. Refer to work related to HVAC as shown on the following contract drawings:

Plumbing
Electrical

1.5 COORDINATION

A. The Mechanical, Plumbing and Electrical Contractors are responsible to coordinate all manufacturer's recommended circuit breakers, starters, disconnects and fuse sizes for all equipment. Submission of a shop drawing will certify that this has been completed. Any necessary changes required will be included as part of this contract.

B. Mechanical Contractor shall coordinate scheduling, submittals and work of the various sections of the Project Manual to ensure efficient and orderly sequence of installation of independent work elements, with provisions to accommodate items that may be installed at a later time.

C. Mechanical Contractor shall verify utility requirements and all characteristics of operating equipment are compatible with the building utilities. Coordinate the work of all sections related and required for installing, connection and placing in service of all equipment.

D. Mechanical Contractor shall coordinate all space requirements, supports and installation of all mechanical, electrical, plumbing and fire protection work, which are indicated diagrammatically on the Drawings. Verify routing of all pipes, ducts, conduits and equipment connections. Maximize accessibility for other work, and service requirements for maintenance and repairs. Develop overall coordination drawing (all trades) and submit for review prior to fabrication/installation.

E. Obtain written confirmation from all related trade Contractors and the Owner or his representative that requirements, conflicts and coordination issues have been discussed and resolved.

F. Submit coordination drawings to verify access and clearances.

1.6 DEFINITIONS

A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct shafts, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawl spaces, and tunnels.

B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.

C. Exposed, Exterior Installations: Exposed to view outdoors, or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations..

D. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and in duct shafts.

E. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants, but subject to outdoor ambient temperatures. Examples include installation within unheated shelters.

1.7 SUBMITTALS

A. Shop Drawings:

1. Shop drawings shall be submitted in accordance with Division 1 of these specifications except where herein modified.

2. Shop drawings comprising complete catalog cuts, performance test data for HVAC equipment as required by other sections of Division 23, shall be submitted for review checking. The Contractor shall review these shop drawings for conformance to contract documents prior to submission and affix contractor's signature to each submittal certifying that this review has been done. By approving and submitting shop drawings, product data, samples and similar materials, the Contractor represents that the Contractor has determined and verified materials, field measurements and field construction data that relates to the work, and has checked and coordinated this information with all of the requirements contained in the contract documents for the work of all trades.

   a. The Contractor and equipment manufacturer shall clearly indentify in all submittals and shop drawings any and all applications standards which require additional work to accommodate this equipment and provide a complete and operational system as described in the contract documents.

   b. The Contractor shall be completely responsible for any and all additional costs associated with the changes required by this and all other trades.

3. Submit a 1/4" scale layout of the Boiler Room. All equipment and pads shall be to scale of equipment being furnished. Obtain size information of any and all equipment from other trades and indicate on drawings. The drawings shall be fully coordinated with all trades prior to submission. Indicate coil pull areas, filter pull areas, maintenance clearances, and access as applicable.

4. All shop drawing submittals shall have the following identification data, as applicable, contained therein or permanently adhered thereto.

   a. Project name.
   b. Project number.
   c. Sub-contractor's, vendor's and/or manufacturer's name and address.
   d. Product identification.
   e. Identification of deviation from contract documents.
   f. Applicable contract drawings and specification section number.
   g. Shop drawing title, drawing number, revision number, and date of drawing and revision.

5. Resubmit revised or additional shop drawings as requested.

6. Wherever shop drawings or vendor's standard data sheets indicate work to be done "by others", it shall be the responsibility of the contractor making the submission to identify by name, the contractor who is to do this work. If the contractor named is other than the contractor making the submission, the shop drawing submission must be reviewed by the named contractor and bear his mark of approval, prior to submission to the Engineer.

7. Where equipment proposed differs from that shown on the drawings or specified, he shall submit for approval drawings showing the manner in which the layout is affected by the substitution.

8. The Contractor shall keep one copy of approved shop drawings at the job site,, filed in a suitable metal container. The shop drawings shall be cataloged and kept in good repair, and shall be available for use by the Owner and Engineer.

9. No equipment shall be ordered, fabricated, etc., before approval of shop drawings.

B. Contractor is responsible for the shop drawing coordination and interface with the work of other contracts and adjacent work. The relationship of Contractor's work shall be verified as it relates to adjacent and critical features of the work of this and all contracts and materials.

C. The Contractor shall submit a complete schedule of all shop drawings required for the scope of work covering all materials and equipment listed in all sections of Division 23, Mechanical, including all documents required for contract closeout, Owner instructions and training, and all turnover items at the completion of the work. This schedule shall be submitted for review and approval within thirty days of contract award and before any subsequent materials are provided for review.

D. The shop drawings provided by the Contractor will be reviewed only once and resubmittals will be reviewed only once. Any other submittals will be billed to the Contractor at the Engineer's standard rates.

1.8 SITE INSPECTION

A. The Contractor shall visit site, inspect, and become aware of all conditions which may effect the work during the estimation phase of his work prior to bid openings. Investigate utilities, protection requirements for adjacent facilities, storage locations, and access to the construction area.

B. Submission of a bid will be deemed evidence of having complied with this requirement.

1.9 SUBSTITUTIONS

A. Whenever a material, article, piece of equipment or system is identified in the following specification or indicated on the drawings by reference to manufacturers' or vendors' names, trade names, catalog numbers or the like, it is so identified for the purpose of establishing the basis of the Bid.

B. Substitution approval must be obtained and included as an addendum item prior to the submission of the bid. An approved substitution shall not be considered as an approval for the Contractor or an equipment vendor to deviate from the written portion of the specifications unless so stated in the addendum.

C. The drawings illustrate the space allocated for equipment and the Contractor shall install the equipment accordingly. If changes are required in the building or arrangement due to substitution of equipment, the Contractor making the substitution must pay for the necessary modifications.

D. The listed equivalent or substituted manufacturers along with the bidding related contractor shall be completely responsible to comply with all requirements on all contract documents. This shall include, but not be limited to all: space requirements, code clearances, type-horsepower-capacities-number and size of services required from other trades including all auxiliary items provided by this Contractor and all other trades, and all manufacturer's

specific equipment applications standards and requirements, for approved equipment including that which is basis of design or a substitution. The bidding related contractor and equipment manufacturers shall clearly identify in all submittals and shop drawings any and all applications standards which require additional work to accommodate this equipment and provide a complete and operational system as described in the contract documents. If the bidding contractor or manufacturer does not comply with these requirements then they shall be completely responsible for any and all additional costs associated with the changes required by this and all other trades.

E. Where only one brand name or manufacturer is identified, no substitutions are permitted.

F. Substitutions:

1. Until a date no later than seven (7) days before the date Bids are due, Engineer will consider written requests from bidders for substitution of Products. Engineer will review requests and will notify Bidders in an Addendum if the requested substitution is acceptable.

2. Submit a separate request for each Product, supported with complete data, with drawings and samples as appropriate, including:

   a. Comparison of the qualities of the proposed substitution with that specified.
   b. Changes required in other elements of the work because of the substitution.
   c. Effect on the construction schedule.
   d. Cost data comparing the proposed substitution with the Product specified.
   e. Any required license fees or royalties.
   f. Availability of maintenance service, and source of replacement materials.

3. Engineer shall be the judge of the acceptability of the proposed substitution.

4. A request for a substitution constitutes a representation that Bidder:

   a. Has investigated the proposed Product and determined that it is equal to or superior in all respects to that specified.

   b. Will provide the same warranties or bonds for the substitution as for the Product specified.

   c. Will coordinate the installation of an accepted substitution into the work, and make such other changes as may be required to make the work complete in all respects.

   d. Waives all claims for additional costs, under his responsibility, which may subsequently become apparent.

1.10 LUBRICATION

A. Provide and maintain all required lubrication of any equipment operated prior to acceptance by the Owner. Lubrication shall be as recommended by the equipment manufacturer.

B. Provide one year's supply of lubricants to Owner at date of acceptance.

C. Verify that required lubrication has taken place prior to any equipment start-up.

1.11 EQUIPMENT START-UP

A. Verify proper installation by manufacturer or his representative.

B. Advise Owner's Representative 2 days prior to actual start-up.

C. Verify proper operation. Obtain signed statement by manufacturer or his representative that equipment is operating within warranty requirements. Submit statement to Owner's Representative.

D. Perform field mechanical balancing in accordance with Section 230950: TESTING AND BALANCING OF MECHANICAL SYSTEMS.

E. The Mechanical Contractor shall own as part of his work, the following:

Provide one (1) additional drive set, if necessary, to obtain final design balancing requirements. The Mechanical Contractor shall coordinate with Balancing Firm and equipment manufacturer for drive selection, including belts and pulleys.

1.12 OPERATION & MAINTENANCE INSTRUCTIONS

A. Properly and fully instruct Owner's personnel in the operation and maintenance of all systems and equipment.

1. Contractor to demonstrate all systems to Engineer for verification of operation prior to Owner's instruction period.

2. Provide two (2) 4-hour sessions of training to School District Maintenance Staff.

B. Insure that the Owner's personnel are familiar with all operations to carry on required activities.

C. Such instruction shall be for each item of equipment and each system as a whole.

D. Provide report that instruction has taken place. Include in the report the equipment and/or systems instructed, date, contractor, Owner's personnel, vendor, and that a complete operating and maintenance manual has been reviewed.

E. Manual shall include all instructions on operation, maintenance, repair parts list, lubrication requirements, brochures, catalogue cuts, complete schedule of air filters for each unit type in Excel spreadsheet format, wiring diagrams, piping diagrams, control sequences, service requirements, names and addresses of vendors, suppliers and emergency contacts. Three manuals shall be provided.

F. Submit manuals for review prior to operating instruction period. Manuals shall be 8-1/2 x 11" with hard cover, suitably bound.

G. Provide to the Owner any special tools necessary for operation and routine maintenance of any of the equipment.

H. Upon completion of the project, the Mechanical Contractor shall provide a complete set of legible as-built drawings for the Owner.

1.13 TOOLS

A. All equipment furnished by the Mechanical Contractor which requires special tools or devices other than those normally available to the maintenance or operating staff shall be furnished in duplicate to the Owner, sufficiently marked, packed or boxed for staff usage. The tools provided shall be listed by the Mechanical Contractor identified as to their use or the equipment applicable in a written transmittal to the Owner.

1.14 CLEANING AND FINISHING

A. After equipment start-up and all operating tests have been made and the system pronounced satisfactory, each respective Contractor shall go over the entire project, clean all equipment, etc., installed by him and leave in a clean and working condition. Any surfaces found marred after this final cleaning shall be refinished or replaced by each Contractor at no cost to the Owner.

B. Provide for the safety and good condition of all materials and equipment until final acceptance by the Owner. Protect all materials and equipment from damage. Provide adequate and proper storage facilities during the progress of the work. Special care shall be taken to provide protection for bearings, open connections, pipe coils, pumps, compressors and similar equipment.

C. All fixtures, piping, finished surfaces and equipment shall have all grease, adhesive labels and foreign materials removed.

D. All piping shall be drained and flushed to remove grease and foreign matter. Pressure regulating assemblies, traps, and similar items shall be thoroughly cleaned. Remove and thoroughly clean and reinstall all liquid strainer screens after the system has been in operation ten (10) days.

E. When connections are made to existing systems, the Mechanical Contractor shall do all cleaning and purging of the existing systems required to restore them to the condition existing prior to the start of work.

F. Clean-up: Remove from the premises, all unused material and debris resulting from the performance of work under this section.

PART 2 – PRODUCTS

2.1 GENERAL

A. All material and equipment shall be new and of present day manufacture, and shall conform to accepted standards of the trade where such a standard has been established for the particular type of equipment or material.

B. Whenever equipment or material is referred to in the singular, such as "the fan", it shall be deemed to apply to as many such items as necessary to complete the work.

2.2 PRODUCT DELIVERY, STORAGE AND HANDLING

A. During loading, transporting and unloading exercise care to prevent damage to material.

B. Store all materials in dry enclosures or under protective coverings out of way of work progress.

C. Material shall not be allowed to be stored directly on ground.

D. Deliver in manufacturer's original cartons or on skids.

E. Handle and protect so as to prevent damage to product or any surrounding material.

2.3 CONCRETE

A. Concrete shall be in accordance with ACI-613.

2.4 WARRANTY

A. Wherever in the specification sections of this division, reference is made to a specific warranty period, this warranty shall be in addition to and not a limitation of other rights the Owner may have against the Mechanical Contractor under the contract documents.

PART 3 – EXECUTION

3.1 PROTECTION

A. Plug or cap open ends of piping systems, conduit and ductwork.

B. Stored materials shall be covered to prevent damage by inclement weather, sun, dust or moisture.

C. Protect all installed work until accepted in place by the Owner.

D. Plates, polished metal escutcheons, thermostats and other finished devices shall not be installed until masonry, tile, and painting operations are complete unless otherwise protected.

E. Protect all work from operations which may cause damage such as hauling, welding, soldering, painting, insulating and covering.

3.2 WORKMANSHIP

A. Install all work neat, trim and plumb with building lines.

B. Install work in spaces allocated.

C. Cutting and patching shall be performed by skilled tradesmen normally employed for the work involved.

D. This Contractor shall provide a complete weathertight seal to all new systems in the building including the necessary caulking, weather-stripping and insulation.

3.3 EQUIPMENT SETTING

A. Provide as a minimum, a 4 inch concrete pad beneath all floor-mounted equipment. Install anchor bolts in pour.

B. Provide as a minimum, spring vibration isolation under any equipment 10 HP and over and rubber in shear vibration isolation on any equipment up to 10 HP. For further specifications and additional requirements, refer to other sections.

C. Concrete shall be 3,000 psi, 28 day compressive strength in accordance with ACI-613. Reinforce with No. 4 rod 12" on centers both ways or as otherwise detailed.

3.4 FASTENERS, HANGERS AND SUPPORTS

A. Provide all hangers and supports required to suspend, mount, or hang the work.

B. Provide all miscellaneous steel angles, channels, beams, clips, brackets and anchors necessary to hang or support the work. Provide submissions for review.

C. Install concrete inserts before concrete is poured.

D. Drilled inserts shall not be loaded more than 1/4 rated capacity.

E. Power-driven fasteners shall not be allowed for piping larger than 2 inch, or equipment. When used they shall not be loaded more than 1/8 rated capacity or 200 pounds.

F. All hangers, miscellaneous steel, braces and supports shall be galvanized, cadmium plated, or primed steel. Copper tubing shall be supported with copper hangers.

G. Piping shall be supported from adjustable clevis type hangers with insulation pipe saddles or pipe shields in accordance with piping support spacing table on the drawings. Where hangers are 18" or longer provide lateral bracing at every fourth hanger.

H. Support vertical piping at floor levels. Piping shall have split rings.

I. Any lintels required for openings for this work shall be provided under this Section.

3.5 SLEEVES

A. Provide each pipe, duct or conduit passing through a masonry or concrete wall, floor or partition with a sleeve made from standard weight steel pipe for pipe or conduit and No. 12 gauge galvanized steel for ducts, with smooth edges, securely and neatly cemented in place. Provide each pipe, duct or conduit passing through a frame or metal partition with a sleeve made from No. 22 gauge galvanized sheet metal, securely fastened in place.

B. Be responsible for the proper location and alignment of all sleeves.

C. Provide hydrostatic seals for sleeves passing through outside walls, either above or below grade, or through hydrostatically sealed slabs or floors on grade. Provide fire-rated seals for all sleeves which penetrate fire-rated walls.

D. Install both piping and sleeve seals so as to maintain integrity of seals with expansion and contraction of piping.

E. Set floor sleeves flush with floor surface in finished areas, 1" above the finished floor in kitchens, cafeterias, and similar service areas unless such areas are slab-on-grade; 1" above the floor in mechanical rooms, pipe chases, pipe spaces and other unfinished areas, unless otherwise indicated, and flush with the underside of slabs. Extend wall and partition sleeves through and cut flush with each surface unless otherwise indicated or specified.

F. Select sleeves two pipe sizes larger than any pipe or conduit that is to remain uncovered, unless otherwise required by the sealing method specified. Where pipes are to be covered, provide sleeves large enough to allow the covering to pass through the sleeves with sufficient clearance for sealing as specified hereinafter. Size sleeves for branch piping from vertical risers large enough to permit vertical expansion at the riser.

G. Select duct sleeve sizes to suit requirements of sealing methods as specified.

H. Place sleeves imbedded in concrete floors or walls in the forms before concrete is poured; sleeves shall have integral waterstop flanges, where they are to receive either watertight or hydrostatic seals.

I. Install sleeves passing through above-grade floors of mechanical rooms, toilet rooms, kitchens or similar service areas where liquid leaks or spillover may occur in a watertight manner. Sleeves shall be such that waterproofing membrane can be flashed around and into the sleeve where necessary.

J. Hydrostatic Sealing Method: Provide compressible synthetic rubber seals, equivalent to LINK SEAL, manufactured by the Thunderline Corporation, or THRUWALL manufactured by O.Z. Gedney. Install seals in accordance with the manufacturer's recommendations to provide air tightness aboveground and hydrostatic sealing belowgrade. Caulking or other type mastic is not acceptable.

K. Fire-Rated Sealing Method:

1. Sleeves, openings and sealants shall comply with applicable codes, recommended practices and standards, and manufacturer's instructions. Fire sealants shall have ability to prevent spread of flame, smoke or water throughout the penetration and shall pass 3 hour test, UL test ASTM E814 and UL 1479.

2. Products: Chase Corporation CTC PR-855, O. Z. Gedney CRS/CAFS, 3M Electro-Products Division Putty 303 or Caulk CP25 penetration sealing kits, General Electric Company sealants type RTV-850, 6428 or 7403, Thunderline Corporation "Link-Seal Pyro-Pak". Installation and type of sealant to be used as recommended by the manufacturer.

3.6 PLATES

A. Provide chrome plated plates wherever piping passes into finished area.

B. Plates shall be securely fastened to piping or building construction.

C. Floor plates shall cover 1 inch sleeve extension.

3.7 OFFSETS, TRANSITIONS, MODIFICATIONS

A. Provide all offsets necessary to install the work and to provide clearance for other trades.

B. Maintain adequate headroom and clearance.

C. Incidental modifications necessary to the installation of the systems shall be made as necessary and as approved by the Engineer.

3.8 RECESSES

A. Provide recesses required to install panels, boxes, and other equipment or devices which are to be recessed in walls.

B. Make offsets or modifications as required to suit final locations.

3.9 LABELING

A. All HVAC equipment such as pumps, fans, air handling units, and devices requiring identification for operating procedures shall be provided with permanent black laminated micarta white core labels with 3/8 inch letters.

B. This shall also apply to all controllers, remote start/stop pushbuttons and equipment cabinets.

C. This shall not apply to individual room thermostats.

D. Boiler Room shall be identified with a permanent placard of red-white-red laminated, commercial grade, plastic construction. Letters shall be minimum one inch high and read in capital letters: WARNING – MECHANICAL EQUIPMENT ROOM – LIMITED ACCESS. Placard shall be centered on each door leading into the mechanical room at five feet above the floor and attached at each corner with brass screws.

3.10 ACCESS

A. Locate all equipment, valves, devices and controllers which may need service in accessible places.

B. Where access is not available, access panels shall be provided.

C. Access panels shall be Nailor-Hart Industries, Karp Co., or Controlled Air Manufacturing Limited, with 16 gauge frames and 14 gauge steel door, prime painted.

D. Maintain access clearances for tube or fan removal, coil pulls, and filter removal.

3.11 WIRING AND MOTOR CONTROLS

A. Packaged equipment shall be furnished with disconnect switches, starters, overloads, factory furnished and wired by the unit manufacturer.

B. This Contractor shall furnish all information and assistance required for the Electrical Contractor to purchase all motor starters that are not specified to be part of the mechanical equipment.

C. Control wiring shall be provided under this Division of the work.

D. All wiring shall be in accordance with the National Electrical Code and as recommended by the equipment manufacturer.

3.12 UTILITIES

A. Do not interrupt any utility or service to the Owner without adequate previous notice and schedule.

B. Perform alteration of utilities and services in accordance with the rules, regulations and requirements of the involved utility companies, regulatory agencies having jurisdiction.

3.13 OPENINGS – CUTTING, REPAIRING

A. This Contractor shall cooperate with the work to be done under other sections in providing information as to openings required in walls, slabs and footings for all piping, ductwork and equipment, including sleeves where required.

B. Any drilling or cutting required for the performance of work under this Section, shall be the responsibility of this Contractor and the cost thereof shall be borne by him.

C. Holes in Concrete: Sleeves shall be furnished, accurately located and installed in forms before pouring of concrete. This Contractor shall pay all additional costs for cutting of holes as the result of the incorrect location of sleeves. All holes through existing concrete shall be either core drilled or saw cut. All holes required shall have the approval of the Structural Engineer prior to cutting or drilling.

D. It shall be the responsibility of this Contractor to ascertain that all chases and openings are properly located.

3.14 PAINTING

A. This Contractor shall be responsible for painting required in conjunction with cutting and patching of existing building construction. This Contractor shall also be responsible for painting existing equipment, and/or piping, where finish is damaged by new work, in these same areas.

B. Refer to School District Standards for types of paint, color and finish.

C. Surfaces subjected to temperatures below 180 degrees F, shall be painted with one coat of rust-resisting paint and one coat of high gloss enamel or sufficient finish coats for complete and uniform cover and high glossy finish.

D. Surfaces subjected to temperatures above 180 deg. F, shall be painted with one coat of heat-resistant paint and one coat of heat resistant enamel, or sufficient finish coats for complete and uniform cover and high glossy finish.

E. All painting shall be done in a careful, neat and workmanlike manner, with particular care being exercised to protect adjacent building and equipment finishes. All surfaces shall be thoroughly cleaned of dirt, rust, scale, dust, grease, oil, debris and sanded, sand blasted or power brushed to properly prepare to provide bond for the paint. Contractor shall be entirely responsible for cleaning and preparing all surfaces. Should evidence appear that the surface was not properly prepared, the Contractor shall remove paint, prepare surface and repaint, as required, at no additional cost.

F. All name plates, data plates that indicate manufacturer, model, size, capacity codes or identifying data on equipment painted, shall not be painted, but shall be carefully cut in.

G. Equipment factory painted and not damaged shall not be painted, except equipment herein specified to be painted a particular color. Damaged surfaces on factory painted equipment will necessitate the painting by this Contractor.

H. The Mechanical Contractor shall furnish and lay drop clothes in all areas where painters finish work is being done, to protect floors and roofs and all other work from defacement. All temporary protections or coverings removed too early from any part of the work shall be promptly replaced, and any damage from neglect to do so shall be made good at the Mechanical Contractor's expense.

I. At the end of each day, the Mechanical Contractor shall place in covered metal containers, or destroy, all cloths, waste and refuse, which have been used in the application of inflammable paint materials. At the completion of work, all staging, scaffolding, containers and debris shall be removed from premises, leaving all painting in perfect and clean condition. Upon completion, leave the work clean and free from blemishes. Hardware, tile, marble, and similar material shall be thoroughly cleaned of all paint.

3.15 GUARANTEE

A. All work shall be guaranteed to be free from defects for a period of one year of operation from date of acceptance by the Owner.

B. Guarantee shall be extended on an equal time basis for all non-operational periods due to failure within the guarantee period.

C. All materials and equipment provided and/or installed under this section of the specifications shall be guaranteed for a period of one year from date of acceptance of the work by the Owner unless otherwise specified in Division 1. Should any trouble develop during this period due to defective materials or faulty workmanship, the Mechanical Contractor shall furnish necessary labor and materials to correct the trouble without any cost to the Owner. Any defective materials or inferior workmanship noticed at time of installation and/or during the guarantee period shall be corrected immediately to the entire satisfaction of the Owner.

D. In the event of occupancy by the Owner prior to final acceptance of the project, the guarantee date for equipment placed in operation shall be mutually agreed to by the Mechanical Contractor and the Owner's representative.

E. Contractor to include an 11 month “walk-thru” of the building systems with representatives of the School District and Engineer. The purpose is to establish a list of corrective work that relates to operational issues, material/installation deficiencies, etc. prior to the expiration of the guarantee period.

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3.16 DRAWINGS

A. The Mechanical Systems are indicated on the Contract Drawings. Certain pertinent information and details required by the Mechanical Work appear on the Architectural, Structural and Electrical Drawings; become familiar with all drawings, and incorporate all pertinent requirements.

B. Drawings are diagrammatic and indicate the general arrangement of systems and requirements of the work. Do not scale drawings. Exact locations of fixtures and equipment, not specifically shown, shall be obtained before starting work.

3.17 TESTING AND BALANCING OF MECHANICAL EQUIPMENT

A. Perform field mechanical balancing in accordance with Section 230950: TESTING AND BALANCING OF MECHANICAL SYSTEMS.

B. The Mechanical Contractor shall own as part of his work, the following:

Provide one (1) additional drive set, if necessary, to obtain final design balancing requirements. The Mechanical Contractor shall coordinate with Balancing Firm and equipment manufacturer for drive selection, including belts and pulleys.

END OF SECTION 230200

SECTION 230210

BASIC MATERIALS AND METHODS – HVAC

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. The general provisions of the Contract, including the Conditions of the Contract (General, Supplementary and other conditions, if any) and Division 1 as appropriate, apply to the work specified in this section.

B. Refer to Section 230200 for HVAC General Provisions.

C. Refer to other sections in Division 23 for materials and methods not specified herein.

1.2 DESCRIPTION OF WORK

A. Included in this Section are the following:

1. Steel Pipe and Fittings
2. Copper Tubing & Fittings
3. Strainers
4. Thermometers
5. Gauges
6. Test Stations - Pressure/Temperature
7. Isolating Fittings
8. Pipe Saddles
9. Unions
10. Motors

1.3 REFERENCE STANDARDS

A. Refer to Section 230200 for a general description of requirements applying to this section.

B. Install work to meet the requirements of the following:

1. New Castle County Dept. of License and Inspections
2. International Mechanical Code
3. Gas Utility Company
4. NFPA
5. OSHA
6. Manufacturer's Standardization Society (MSS) of the valve and Fittings Industry, Inc.:
   SP-58 Pipe Hangers and Supports Materials, Design and Manufacture.
   SP-69 Pipe Hangers and Supports Selection and Application

C. Appliances and materials governed by UL requirements shall meet such requirements and bear the label.

1.4 QUALITY ASSURANCE

A. Provide adequate supervision of labor force to assure that all aspects of the specifications are being fulfilled.

B. Verify that all work and equipment is installed in accordance with manufacturer's warranty requirements.

PART 2 – PRODUCTS

2.1 STEEL PIPE AND FITTINGS

A. Water Piping:

1. ASTM A53 seamless, Schedule 40.

2. Fittings up to 2 inch shall be 150 lb. malleable iron, screwed pattern ASME B16.3. Butt weld , ASME B16.9, same thickness as pipe.

3. Fittings 2-1/2" and larger shall be butt weld ASME B16.9, same thickness as pipe.

4. Weld-O-Lets and Thread-O-Lets shall be maximum of two sizes smaller than main size; i.e., maximum of a 2-inch Weld-O-Let on a 3-inch pipe.

5. Thread tape shall be teflon tape, 3 mils minimum thickness.

2.2 COPPER TUBING & FITTINGS

A. Water Piping:

1. Tubing: Hard drawn seamless ASTM B-88 Type "L" aboveground.

2. Soft seamless ASTM B-88 Type "K" below-ground.

3. Joint Material: Brazed joints, low temperature silver-bearing solder.

   a. Flux shall be non-toxic type and non-corrosive.

4. Fittings: ASME B16.15, B16.18, B16.22, or B16.26.

B. Condensate Drain Piping:

1. Pipe: Copper tubing Type DWV.
2. Fittings: Wrought copper solder type drainage fittings, ASME B16.23 or B16.29.

2.3 STRAINERS (WATER)

A. Perforations: .033" pipe size to 2", .057" pipe size 2-1/2" to 4", 1/8" pipe size 6" and up.

B. Self-cleaning "Y" type screwed end up to 2 inch with machined seats with blow-off outlet, stainless steel screen, iron body.

C. Self-cleaning "Y" type flanged 2-1/2 inch and up, with bolted cover flange, blow-off outlet, 125 psi ANSI, brass screen.

D. Manufacturer: Muesco, Sarco, Hoffman Specialties, Metraflex, Armstrong, Watson McDaniel.

2.4 THERMOMETERS

A. Separable socket, inserted into fluid flow, adjustable, hermetically sealed, red or blue indicating fluid, non-toxic, die-cast, baked enamel finish, double strength glass lens, white scale and black graduations.

B. Scale: Heating Water - 30 deg. to 240 deg. F

C. Manufacturer: U.S. Gauge, H.O. Trerice, Moeller, Duro, Miljoco Corp., Winter Instruments.

2.5 GAUGES

A. Phosphor bronze bourdon tube, polypropylene case, gasketed glass crystal, aluminum dial, black graduations 4-1/2 inch diameter.

B. Range: 0 to 60 psi, 5 pound intervals, 1/2 pound graduations.

C. Install with bronze gauge cock.

D. Manufacturers: Danton, U.S. Gauge, H.O. Trerice, Moeller, Miljoco Corp., Winter Instruments, Weksler Instruments.

2.6 TEST STATIONS – PRESSURE/TEMPERATURE

A. Provide a SISCO 1/4" or 1/2" NPT fitting (Test Plug) of solid brass at desired indicated locations. Test plug shall be capable of receiving either a pressure or temperature probe 1/8" o.d. Dual seal core shall be neoprene for temperature to 200 degrees F. Nordel to 350 degrees F and shall be rated zero leakage from vacuum to 1000 psig. P/T plug to have grooved cap and chain.

B. P/T plugs shall be provided with extensions as required by insulation.

C. Mechanical Contractor shall also provide the following: pressure gauge adapters with 1/8" o.d. probe, 5" stem pocket testing thermometers 0° to 220° F (hot water).

D. One (1) Master Test Kit shall be furnished to the Owners. Kit shall contain one (1) 2-1/2" test gauge of suitable range, one (1) Gauge Adapter 1/8" o.d. probe, and 5" stem pocket testing thermometers - one (1) 0° - 220° F and one (1) 50° - 550° F.

E. Manufacturer: Sisco P/T Plugs.

2.7 ISOLATING FITTINGS

A. Provide isolating fittings between all sections of dissimilar piping materials or piping and equipment where one material is ferrous and the other is non-ferrous.

B. Manufacturer: Epco Sales, Inc., or insulated unions by Central Plastic Co.

2.8 PIPE SADDLES

A. Steel pipe saddles shall be welded to all black ferrous pipe, 2-1/2" pipe size and larger, at hanger locations, for systems of hot water and other heat conveying systems.

B. Steel pipe saddles shall be welded to all black ferrous hot piping at the pipe support location when roll type hangers or pipe roll supports are employed.

C. The saddles shall be packed with plastic insulating cement, and the saddle shall finish flush with the surface of the specified insulation.

2.9 UNIONS

A. Up to and including 2 inch pipe size: Screwed pattern, bronze-to- bronze seat.

B. Above 2 inch pipe size: Flanged pattern, A.S.A. forged steel, with gaskets, bolts and nuts.

C. Copper tubing unions shall have sweated type ends. Flanged unions on copper tubing may be soldered connections.

D. Materials and pressure ratings shall be the same as specified for the respective pipe and fitting system unless otherwise specified.

2.10 MOTORS

A. All single phase and polyphase motors shall be manufactured to incorporate the latest NEMA standards.

B. All single phase and polyphase motors shall have steel frames with ball bearings and copper windings. All motors to have a Class "F" insulation system with a service factor of 1.15.

C. All motors shall be 1725 RPM, 4 pole design, unless otherwise noted on the drawings, or in the equipment specifications.

D. Motors installed indoors and not exposed to moisture shall be open, dripproof, Class B temperature rise based on 40 deg. C maximum ambient temperature.

E. Motors installed outdoors and exposed to moisture shall be totally enclosed, fan cooled, Class B temperature rise based on 40 deg. C maximum ambient temperature.

F. Based on NEMA Standards, motors shall comply with the following minimum nominal efficiencies at full load.

Nominal Efficiencies for "NEMA Premium ™" Induction Motors Rated 600 Volts or Less (Random Wound)						
	Open Drip-Proof			Totally Enclosed Fan-Cooled		
HP	3500 RPM	1800 RPM	1200 RPM	3500 RPM	1800 RPM	1200 RPM
1	82.5	85.5	77.0	82.5	85.5	77.0
1.5	86.5	86.5	84.0	87.5	86.5	84.0
2	87.5	86.5	85.5	88.5	86.5	85.5
3	88.5	89.5	85.5	89.5	89.5	86.5
5	89.5	89.5	86.5	89.5	89.5	88.5
7.5	90.2	91.0	88.5	91.0	91.7	89.5
10	91.7	91.7	89.5	91.0	91.7	90.2
15	91.7	93.0	90.2	91.7	92.4	91.0
20	92.4	93.0	91.0	91.7	93.0	91.0
25	93.0	93.6	91.7	93.0	93.6	91.7

G. Motor Characteristics: Refer to Equipment Schedules for specific data.

120/208 Volt System: Motors 1/2HP & Larger - 208V, 3 Phase, 3 Wire
Motors Less than 1/2HP- 120V, 1 Phase, 2 Wire

H. All motors rated less than 1/2HP shall have thermal protection of the auto-reset type as an integral part of the motor.

I. All motors rated 1/2HP and larger shall have thermal protection provided by an external device.

J. Whenever a variable frequency PWM drive is installed to control an AC motor, a maintenance-free, circumferential, conductive micro fiber shaft grounding ring shall be installed on the AC motor drive end to discharge shaft currents to ground. Recommended part: AEGIS SGR™ Bearing Protection Ring, as made by Electro Static Technology. Install in accordance with the manufacturer's written instructions.

PART 3 – EXECUTION

3.1 PIPING SYSTEMS

A. All piping to drain to low points. Low points shall be provided with drain valves with hose thread.

B. All piping shall be arranged to have air vents at high points.

1. Air vents shall be automatic in operation when located in Boiler Rooms. All air vents shall be provided with a PVC drain line which shall be routed to the nearest floor drain. Several air vents may be tied together.

2. Air vents shall be manual in operation in all other locations.

C. Do not install trapped lines where water cannot be drained or air can accumulate without being vented.

D. Piping shall run square with building lines.

E. Piping shall not be insulated or covered until tested**.**

F. Necessary drains, off-sets, vents and drips shall be provided for coordination of the work as part of the contract.

G. Running or close nipples are not permitted.

H. Piping shall not be installed over electrical transformers, panels, switchgear, substations, and control panels.

I. Allow clearance for expansion and contraction.

J. Install eccentric piping fittings where change in sizes occurs in piping systems. Tops of pipes shall remain level for hydronic systems. Bottom of pipe shall remain level for steam systems.

K. Install isolating fittings between sections of ferrous and non-ferrous pipe or connected equipment.

L. Do not support piping from other piping, conduits or equipment.

M. Strainers shall be installed on suction of all pumps, inlets of control valves, and where indicated on drawings.

N. Thermometers and gauges shall be installed where indicated on the drawings, required by equipment specifications and where indicated elsewhere in the specifications.

O. Flexible connectors shall be provided on suction and discharge piping of all base mounted pumps.

P. Unions shall be provided adjacent to all valves, at equipment connections, and where necessary to facilitate dismantling of the piping system.

Q. Material Requirements for Systems:

1. Heating Hot Water Supply & Return Piping:

    a. Schedule 40 black steel.
    b. Type L hard copper.

2. Make-up Water: Type L hard copper.

3. Condensate Drain (including pumped condensate):

    a. Type DWV copper.

3.2 TAGS, CHARTS AND IDENTIFICATION

A. See Paragraph "Labeling" in GENERAL PROVISIONS for equipment labeling.

B. Identify each valve in all systems with black, numbered and stamped 1- 1/2" brass or aluminum tags fastened to valve by brass chain and S-hook.

C. Provide 1/8" scale diagrams showing location, number and service or function of each tagged item.

1. Frame diagrams in approved metal frames with clear acrylic front, hinges, and locks.

2. Secure to wall in Boiler Room.

3. Provide two additional separate copies permanently covered and bound.

   a. Include one (1) copy in the Operation and Maintenance Manuals.

D. Piping Identification: Identify piping with Seton "Setmark" or Brimar, semi-rigid plastic, wraparound pipe markers with flow arrows and conforming to ANSI A13.1. Locate marker at each valve, changes in direction, where pipes pass thru barriers and every 25' of horizontal runs. Lettering on background shall be in accordance with the following colors:

Legend		Background	Lettering
1.	Gas	- Yellow	- Black
2.	Heating Water Supply	- Yellow	- Black
3.	Heating Water Return	- Yellow	- Black
4.	Cold Water Make-up	- Green	- White
5.	Condensate	- Yellow	- Black
6.	Vent	- Yellow	- Black

E. Manufacturers: Seton “Setmark”, Brimar, B-Line MSI.

3.3 WELDING

A. All concealed and inaccessible black steel piping shall be welded.

B. All black steel piping larger than 1-1/4 inch may be fusion welded.

C. All elbows, tees and branch connections shall be made with welding fittings ANSI B16.9.

D. Welding shall be in accordance with the ASME Boiler and Pressure Vessel Code Section IX.

E. Furnish welder test certificate for review. Certificates of successful qualification by the following organizations shall be acceptable.

1. ASME Boiler and Pressure Vessel Code
2. ANSI Code for Pressure Piping
3. National Certified Pipe Welding Bureau
4. Military Specification MIL-STD-248

3.4 SOLDERING/BRAZING

A. Connections between copper tubing and copper fittings shall be made with the appropriate filler metal. Flux shall be non-corrosive type as recommended by the manufacturer of the filler metal, and conforming to AWS A5.8.

B. Tubing shall be cut square and then reamed and deburred. End of tubing and inside of fitting cup shall be cleaned with steel wool and the flux shall be applied to the clean surface before joining. After joining, the excess filler metal shall be wiped off while still plastic.

C. Silver brazing alloy shall be equal to Easy-Flo by Handy and Harmon or Sta-Brite silver solder and shall be used for joints in:

1. Hot water heating piping
2. Air conditioning condensate drain piping
3. Cold water fill and make-up piping

D. Where the silver brazing is performed in a confined non-ventilated space, a non-toxic, cadmium-free brazing alloy such as braze 560 by Handy & Harman shall be used.

E. Bring joint to solder temperature or brazing temperature in as short a time as possible.

F. Form continuous solder bead or brazing filler bead around entire circumference of joint.

G. Wipe excess solder from joint area while solder is still plastic.

END OF SECTION 230210

SECTION 230215

VALVES

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. The general provisions of the Contract, including the Conditions of the Contract (General, Supplementary and other conditions, if any) and Division 1 as appropriate, apply to the work specified in this section.

B. Refer to Section 230200 for HVAC General Provisions.

C. Refer to other sections in Division 23 for materials and methods not specified herein.

1.2 DESCRIPTION OF WORK

A. This Section includes the following:

1. General
2. Hot Water Heating System

1.3 QUALITY ASSURANCE

A. Provide adequate supervision of labor force to assure that all aspects of the specifications are being fulfilled.

B. Verify that all work and equipment is installed in accordance with manufacturer's warranty requirements.

PART 2 – PRODUCTS

2.1 GENERAL

A. All gate and globe valves shall be designed for repacking under pressure when fully opened, and shall be equipped with packing suitable for the intended service. When the valve is fully opened, the back seat shall protect the packing and the stem threads from the fluid. All gate and globe valves shall have a gland follower. The pressure- temperature rating of valves shall be not less than the design criteria applicable to all components of the system.

B. Insofar as possible, all valves of the same type shall be of the same manufacture.

C. Valves installed above 7 ft. in Boiler Rooms shall have chain operators.

D. All valves shall be provided with stem extensions. Valve handle shall be clear of insulation jacket.

E. Manufacturers:

Stockham
Milwaukee
Hammond
Apollo
Watts
Walworth
Nibco
Jamesbury

2.2 HOT WATER HEATING SYSTEM

A. Gate Valves - 2" and smaller:

Valves 2" and smaller shall be of Class 150 with body and union bonnet of ASTM B-62 cast bronze composition, threaded or solder ends, solid disc, copper-silicon stem, brass packing gland, Teflon- impregnated packing, and malleable handwheel.

Recommended valves:

Threaded:	Solder:
Stockham B-120 (RS)	Stockham B-124
Stockham B-130 (RS)	----
Hammond IB629	IB648
Nibco T134	S134

B. Ball Valves - 3" and smaller:

Valves 3" and smaller shall be 600 psi CWP, have cast brass bodies, replaceable reinforced Teflon seats, conventional port, blowout proof stems, chrome plated brass ball, and threaded or solder ends with extended solder cups. Provide extended valve handle to accommodate up to 2” of insulation with non-thermal conductive material, insulation plug, cap and protective sleeve.

Recommended valves:

Threaded:	Solder:
Stockham S-216-BR-RT	Stockham S-216-BR-RS
Worcester 4112 RT	---
Jamesbury II 1100TT	----
Apollo 70-100	Apollo 70-200
Nibco T580-70BR	S580-70BR-R
Inline 334	----

Drain valves, ½” or ¾”, shall be 600 psi CWP, with stainless steel trim, cast bronze body, 2-piece with cap and chain, full port stainless steel ball and stem, RTFE ball seat, threaded or soldered inlet connection, cap rated for 150 psi.

Recommended valve:

Stockham S-285-BR-R-66-HC

C. Gate Valves - 2-1/2" and larger:

Valves 2-1/2" and larger shall be Class 125 iron body, bronze mounted, with body and bonnet conforming to ASTM A-126 Class B cast iron, flanged ends, with Teflon-impregnated packing and two-piece packing gland assembly.

Recommended valves:

Stockham G-623 (OS&Y) RS
Stockham G-612 (NRS)

	OS&Y	NRS
Nibco	F618-0	F639-31
Hammond IR1140		

D. Globe Valves - 2" and smaller:

Valves 2" and smaller shall be of Class 150 with body and union bonnet of ASTM B-62 bronze, copper-silicon alloy stem, brass packing gland, Teflon-impregnated packing and malleable handwheel.

Recommended valves:

Threaded:	Solder:
Stockham B-22 (Teflon Disc)	Stockham B-24 (Teflon Disc)

Stockham B-29 (Stainless trim) ----

Comp. Disc.:	S.S. Trim:
Nibco T-235-Y	Milwaukee 591A

E. Globe Valves - 2-1/2" and Larger:

Valves 2-1/2" and larger shall be Class 125 body, bronze mounted, with body and bonnet conforming to ASTM A-126 Class B cast iron, flanged ends, with Teflon - impregnated packing and two-piece packing gland assembly.

Recommended valves:

Stockham G-512 (bronze disc)
Stockham G-514 (Teflon disc)

Hammond IR 116
Nibco F7181B

F. Check Valves - 2" and smaller:

Valves 2" and smaller shall be Class 150 with bodies and caps of ASTM B-62 bronze composition and threaded ends. Class 150 valves shall have lift-type Buna-N-disc and union caps, and are to be used in lines with globe valves.

Recommended valves:

Stockham B-322-B
Hammond IB948
Milwaukee 510

For backflow prevention in lines with gate valves, Y-pattern valves with swing-type disc are recommended.

For Class 150 Service, threaded ends:

Stockham B-321

G. Check Valves - 2-1/2" and Larger:

Valves 2" and larger shall be iron body, bronze mounted, with body and cap conforming to ASTM A-126 Class B cast iron, flanged ends, and swing-type disc.

Recommended valves:

Stockham G-931
Hammond IR1124
Nibco F918-B

OR

Alternative for the above listed check valves shall be Class 125/250 iron body, bronze mounted, Wafer Check Valve, with ends designed for flanged type connection, aluminum bronze disc, EPDM seats, 316 stainless steel torsion spring, and hinge pin.

Recommended valves:

Stockham WG-971

Mission K12 HMP
Center Line CLC Series
Marlin A125 HZDSF

PART 3 – EXECUTION

3.1 PIPING SYSTEMS

A. All piping to drain to low points. Low points shall be provided with drain valves with hose thread.

B. Valve body construction shall match piping system material.

C. Install isolating fittings between sections of ferrous and non-ferrous pipe or connected equipment.

D. Valves shall be installed with stems above horizontal.

E. Valves shall be installed on all sides of equipment and control valves to allow isolation for repair.

F. Unions shall be provided adjacent to all valves, at equipment connections, and where necessary to facilitate dismantling of the piping system.

3.2 TAGS, CHARTS AND IDENTIFICATION

A. Identify each valve in all systems in accordance with requirements of Section 230210.

END OF SECTION 230215

SECTION 230230

INSULATION & COVERING – HVAC

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. The general provisions of the contract, including the conditions of the contract (General, Supplementary and other Conditions, if any) and Division 1 as appropriate, apply to the work specified in this section.

B. Refer to Section 230200 for HVAC General Provisions

C. Refer to Section 230210 for HVAC Basic Materials & Methods.

1.2 DESCRIPTION OF WORK

A. This Section includes insulation and covering provided on the following piping and equipment:

1. Cold Water Make-Up Piping
2. Hot Water Heating Piping
3. Hot equipment surfaces.
4. Reusable Valve Covers
5. Insulated Pipe Saddles

B. Insulation shall be installed on the following duct systems:

1. All relief ductwork.

1.3 REFERENCE STANDARDS

A. Refer to Section 230200 for a general description of requirements applying to this section.

1.4 QUALITY ASSURANCE

A. Refer to Section 230210 for a general description of requirements applying to this section.

B. Install insulation in accordance with manufacturer's recommendations.

C. Provide adequate supervision of labor force to assure that all aspects of the specifications are being fulfilled.

1.5 SUBMITTALS

A. Submit shop drawings, installation instructions, and manufacturer's literature of all materials specified in accordance with Section 230200.

B. Submit fabrication instructions for pipe fitting and valve insulation.

C. Submit manufacturer's joining recommendations for butt joints and longitudinal seams.

1.6 WARRANTY/GUARANTEE

A. All work and materials are subject to the general warranty as described in the General Conditions of the Contract and in Division 1, General Requirements.

PART 2 – PRODUCTS

2.1 PIPE INSULATION MATERIAL

A. Fiberglass:

1. Material: Preformed fiberglass bonded with resin to form circular pipe sleeves with factory applied, white all service jacket bonded to reinforced foil vapor barrier jacketing. The jacket shall have factory applied double pressure-sensitive, self-sealing, adhesive closure and vapor sealing of longitudinal joints. Thermal conductivity: 0.24 Btu/Hr./SF/inch at 100 degrees F. Flame spread of 25 and developed smoke of 50 or less.

2. All Valves and Fittings:

   a. Glass fiber insert and pre-molded PVC cover, Johns Manville Corp. "Zeston" and "Hi-Lo Temp Inserts" for fittings. Glass fiber or prefabricated elastomeric foam fittings must fill the entire space within the cover completely.
   b. Factory molded fibrous glass fitting covering for fittings. Coat ends with Fosters 30-36 lagfast adhesive
   c. Mitered sections of pipe covering for valves.

3. Manufacturers: Johns Manville Corp., Certain-Teed, Owens- Corning, Knauf, Armacell.

B. Closed Cell:

1. Material: Black flexible elastomeric foamed closed cell structure insulation 25/50 rated with a flame spread rating of 25 or less and a smoke developed rating of 50 or less with both a moisture seal and a reinforced elastic foam lap seal closure system.

2. Flexible pipe insulation shall be a foamed elastomeric closed cell structure material, with a thermal conductivity of not more than 0.27 Btu/Hr./Sq. Ft./Inch at a mean temperature of 75 degrees F. The insulation shall have an average density of at least 2 pounds per cubic foot, shall be self-extinguishing, and shall have a water vapor transmission rating of not more than 0.1 perms. Between temperature limits of -40 degrees F and plus 220 degrees F, the insulation shall not indicate any deviation from its original state.

3. Specification Compliance:

   ASTM-E-84
   ASTM-C-534 Type I – Tubular, Type II – Sheet.
   ASTM-D-1056, 2B1 – Tubular, Sheet.
   MIL-C-3133B (MIL STD 670B) Grade SBE-3
   MIL-P-15S280J, Form T, Form S.

4. Manufacturers: Armacell, Nomaco, K-Flex.

C. Manufacturers: Johns Manville Corp.., Certain-Teed, Owens- Corning, Knauf.

2.2 DUCT INSULATION

A. Exposed relief air ductwork shall be insulated in finished conditioned spaces, penthouse, mechanical rooms, mezzanine areas, equipment closets, and non-conditioned spaces with 2" thick rigid fiberglass board. Insulation shall be 6 P.C.F. density with a "K" value of 0.25 Btu/Hr./SF/Inch at 75 degrees F. mean temperature and shall be U.L. listed at 25 maximum for flame spread, and 50 maximum for smoke developed. Insulation shall be applied using Graham Pins or Stik-Clips and all seams, edges and breaks shall be sealed with 4" matching tape and sealed with Vicryl CP-10 to match ASJ jacket. Insulation shall be provided with all-service jacket facing.

B. Manufacturers: Johns Manville Corp., Certain-Teed or Owens- Corning, Knauf.

2.3 REUSABLE VALVE COVERS

A. All valves, strainers, combination valves, etc. in heating hot water systems shall be insulated with a factory fabricated removable and reusable cover. (This product shall not be used for pipe and fittings.)

B. Insulation shall be either fiberglass blanket or flexible elastomeric thermal insulation as listed in Paragraph 3.2 of this specification, or prefabricated fitting from the supplier. Flame and smoke spread shall be 25/50 per ASTM 84.

C. Outer jacket shall be made of material equal to Tychem QC, overlap and completely cover the insulation, with seams joined by tabs made from Velcro or fabric straps per manufacturer's standards.

D. Outer jacket shall overlap adjoining sections of pipe insulation, and shall be non-combustible, impermeable to water, and prevent mold, mildew and condensation.

E. Installation shall not require the use of any special hand tools.

F. Manufacturers: Corick Valve Covers, NoSweat Valve Wraps.

2.4 INSULATED PIPE SADDLES

A. Insulation and facing shall each meet 25/50 flame and smoke ratings per ASTM E-84 on a component basis.

B. A section of rigid insulation shall be used at all cold pipe hangers or support locations and shall consist of:

1. A rigid 3.75 PCF phenolic foam pipe insulation designed to support pipe sizes up to and including 6" iron pipe size.

2. A rigid 5 PCF phenolic foam pipe insulation designed to support pipe sizes from 8" to 30" iron pipe size.

3. For all hot pipe hanger or support locations, the insert material shall be either rigid calcium silicate per ASTM C303 or perlite silicate per ASTM C303 with all service jacket and laminated to a steel support saddle.

C. The insulation jacket shall contain a vapor retarding material to provide low moisture vapor permeability and resistance to mold, mildew and fungus growth.

D. The insulation shall be free of any CFC or HCFC materials.

E. The insulation shall have a minimum K-factor of 0.13 at 75 deg. F mean temperature, and self-sealing lap joint with high performance acrylic pressure sensitive adhesive tape.

F. Integral insulation saddle shall be made of G-90 carbon steel, with full 180 deg. Coverage, flared edges to protect the vapor barrier jacket and insulation, and short rib surface to center the saddle inside the hanger and prevent movement.

G. Preformed insulation shall extend beyond the saddle by a minimum of 1-1/2" to accommodate a tape joint seal at the butt edges of adjoining insulation sections.

H. Minimum product dimensions shall be as follows:

Nominal pipe size (inches)	Insulation density (PCF)	Insulation length (inches)	Saddle length (inches)	Saddle gauge
½ - 3-1/2	3.75	9	6	20
4 – 6	3.75	12	9	18
8 – 18	5.0	18	12	16
20 – 30	5.0	24	18	14

I. Manufacturer: Tru-Balance insulated saddles as made by Buckaroos, Inc.

PART 3 – EXECUTION

3.1 INSTALLATION – GENERAL

A. Do not install until systems have been tested and meet requirements.

B. Heavy work which may damage insulation shall have been completed in the vicinity of the insulation work.

C. Provide non-compressible insulation saddles at all piping hanger locations, and at all piping hanger locations where piping is insulated with flexible closed cell insulation.

Option: Provide insulation coupling system as made by Klo-Shure Co.

D. All installations shall be made by skilled craftsmen regularly engaged in this type of work.

E. Insulation shall be continuous thru-wall, ceiling and floors.

F. Metal shields, 16 gauge galvanized, shall be installed between hangers and pipe insulation.

G. Pipe, ductwork and equipment shall be clean and dry prior to insulating.

H. Install all insulation per manufacturer's instructions.

I. To avoid undue compression of insulation, provide solid core inserts at all supports as recommended by the insulation manufacturer. Provide insulation shields between the insulation jacket and the hanger.

3.2 PIPE INSULATION - TYPES & THICKNESSES

A. Provide fiberglass insulation of thickness specified on:

1. Cold Water Make-Up: 1" for piping 2" and below.

2. Heating Hot Water: (Up to 200°F)

   1-1/2" for piping 1-1/2" and below
   2" for pipes 2" and over.

B. Provide flexible closed cell insulation of thickness specified on:

1. Air separators for heating hot water. 3/4" thickness
2. Hot water expansion tanks. 3/4" thickness

3.3 PIPE COVERING (FOAMED PLASTIC TYPE)

A. All joints and seams shall be sealed with a compatible adhesive. Approved adhesives are as follows:

Armstrong World Industries	No. 520
Benjamin Foster Company	No. 85-75 up to 200 degrees F.

Contractor may use Armstrong Self-Seal Armaflex 2000 insulation in lieu of the above wherever 1/2" is specified.

B. Fitting covers shall be fabricated from the foamed plastic pipe insulation or from sheet insulation of the identical material. The fabrication shall be in accordance with manufacturer's instructions, and all seams mitered joints shall be joined using the adhesives described hereinbefore.

C. Pipe insulation in concealed spaces shall require no finish coatings.

D. Pipe insulation in all other areas shall receive two coats of finish of color selected by Architect. Approved finishes are as follows:

Armstrong World Industries WB Armaflex Finish

3.4 INSULATED PIPE SADDLES

A. Insulated pipe saddles shall be installed at all hangers, rollers or supports in accordance with manufacturer’s written instructions.

B. All piping shall be clean and free of oil, rust and moisture prior to and during support installation.

C. All insulated saddles and accessories shall be stored in a dry area protected from weather before and during installation

D. Seal adjoining butt edges of pipe insulation with approved mastic and tape to insure continuity of the insulation jacket and vapor barrier, especially on cold piping system installations.

END OF SECTION 230230

SECTION 230400

HEATING GENERATION EQUIPMENT

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. The general provisions of the Contract, including the Conditions of the Contract (General, Supplementary and other Conditions, if any) and Division 1 as appropriate, apply to the work specified in this section.

B. Refer to Section 230200 for HVAC General Provisions.

C. Refer to Section 230210 for HVAC Basic Materials and Methods.

D. Refer to Section 230230 for Insulation and Covering – HVAC.

E. Refer to Section 230410 for Heating Generation Auxiliary Equipment.

1.2 DESCRIPTION OF WORK

A. This Section includes labor, material, and equipment necessary to provide a complete boiler system as specified herein and shown on the drawings:

1. Boilers - General
2. Boilers – (Condensing Type)

B. Refer to other Division 23 sections for related work.

1.3 REFERENCE STANDARDS

A. Refer to Section 230200 for a general description of requirements applying to this Section.

B. See specifications in this Section for specific compliance with NFPA, UL, ASME, etc.

C. Underwriters Laboratories:

1. UL 795 – Commercial-Industrial Gas Heating Equipment

D. American Society of mechanical Engineers:

1. ASME Section IV – Boiler and Pressure Vessel Code – Heating Boilers.

E. Hydronics Institute Boiler Testing Standards:

1. BTS-2000 – Method to Determine Efficiency of Commercial Space Heating Boilers.

1.4 QUALITY ASSURANCE

A. Refer to Section 230210 for a general description of requirements applying to this section.

B. Quality Assurance:

1. Manufacturers: Firms regularly engaged in manufacture of boilers, of types and capacities required, whose products have been in satisfactory use in similar service for not less than 5 years.

2. Regulatory Requirements:

a. NFPA Compliance: Install boilers in accordance with National Fire Protection Association (NFPA) Code 54 "National Fuel Gas Code".

b. NFPA 211 Compliance: Heating equipment burning gas, solid or liquid fuels, Section 60.

c. ASME, CSD-1

1.5 SUBMITTALS

A. Submit shop drawings and product data in accordance with Section 230200.

B. Submit the following:

1. Shop Drawings
2. Product Data
3. Evidence of specified code or other compliance.

1.6 SUBSTITUTIONS

A. The listed equivalent or substituted manufacturers along with the bidding related contractor shall be completely responsible to comply with all requirements on all contract documents. This shall include, but not be limited to, space requirements, code clearances, the type, horsepower, capacities, number and size of services required from other trades, including all required ancillary items furnished and installed by other trades. If the manufacturer or related bidding contractor does not comply with these requirements, this Contractor shall be responsible for any and all additional costs associated with the changes required by other trades.

1.7 WARRANTY/GUARANTEE

A. All work and materials are subject to the general warranty as described in the General Conditions of the Contract and in Division 1, GENERAL REQUIREMENTS. In addition, the following special guarantee applies:

1. Start-up and one year of factory service on boilers.

2. The primary cooper-fin tube heat exchanger shall carry a 5-year limited warranty, and a 20-year warranty against thermal shock.

3. The secondary 316L heat exchanger shall carry a 3-year limited warranty.

4. The burner shall carry a 10-year limited warranty.

5. All other parts shall have a 1-year limited warranty.

6. The manufactured heating units, equipped with a pressed-tubular heat exchanger constructed of stainless steel and a welded stainless steel manifold, shall be warranted by the boiler manufacturer to be free from defects in material and workmanship under normal usage for a period of ten years from the date of original installation.

PART 2 – PRODUCTS

2.1 BOILERS - GENERAL

A. Provide factory packaged type boiler, burner units for hot water heating units arranged for automatic firing with natural gas. Each unit shall include an internal, header type boiler, insulated metal jacket, pre- engineered combustion system consisting of a special vertical gas burner with forced draft wind box, refractory type combustion chamber and precut block insulation, factory wired NEMA 1 control panel for combustion programming and flame failure protection, integral draft inducer and all operating and limit controls in accordance with CSD-1. Each unit shall be provided with all castings, fittings, accessories and appurtenances necessary for assembly, connection and operation, including safety/relief valves, water column type pump control and lower water cutoff with precut piping and necessary fittings, prefabricated return yoke together with gauges and instruments as hereinafter described. Boiler/Burner package shall be a standard product of the manufacturer.

2.2 BOILER – CONDENSING TYPE

A. Boilers shall be CSA design certified as a condensing boiler. Boilers shall be designed for a minimum of 3:1 continuous turn down with constant CO2 over the turndown range. The boiler shall operate with natural gas or propane and have a CSA certified input rating as noted on the drawings, and a thermal efficiency rating of 85% at rated input and 94.3% at minimum input. The boiler shall be symmetrically air-fuel coupled such that changes in combustion air flow or flue flows affect the BTUH input without affecting combustion quality. The boiler will automatically adjust input for altitude and temperature induced changes in air density. The boiler will use a proven pilot interrupted spark ignition system. The boiler shall use a UL approved flame safeguard ignition control system using UV detection flame sensing. The design shall provide for silent burner ignition and operation. The boiler shall be down fired counter flow such that formed condensate always moves toward a cooler zone to prevent re-evaporation. An aluminum corrosion resistant condensate drain designed to prevent pooling and accessible condensate trap shall be provided.

1. Factory-packaged unit, complete with jacket, gas manifold, burner, and controls mounted and wired, as specified in this section.

2. The complete boiler shall be factory fire tested by the manufacturer and a copy of the firetest report shall be supplied with the unit.

3. The primary heat exchangers shall be constructed in accordance with Section IV of the ASME code, with straight, integral copper-finned tube constriction and a gasketless header at the top and bottom.

4. The primary heat exchanger design must allow for access and replacement of each individual tube.

5. The wall thickness of the primary heat exchanger tubes shall be no less that 0.072" with fin spacing of no less that 7 fins per inch.

6. The heat exchanger shall encompass the entire burner and be enclosed in stainless steel with a fully water-backed tube sheet.

7. Each boiler shall be contained in a minimum 16-gauge negative pressure steel jacket protected with a powder-coated finish. The unit shall be able to operate with any jacket panels removed during inspection or maintenance periods.

8. The boiler shall have a minimum of 96% thermal efficiency as listed in the Equipment Schedule of the Contract Documents.

9. The boilers must have third party (BTS-2000) certification of efficiency and documentation to be supplied to Owner.

10. All condensing in the boiler shall take place in a secondary heat exchanger. The secondary heat exchanger material shall be made of 316L stainless steel. Proper condensate removal shall be incorporated in the design to remove all condensate form the unit.

B. Construction

1. The boiler shall be constructed in accordance with the latest requirements of the ASME Boiler and Pressure Vessel Code and shall be stamped with ASME Symbol. Maximum boiler working pressure shall be 160 psig at 250°F temperature.

2. The boiler shall be factory assembled and shall be shipped to the job location complete with burner and jacket assembled at the factory and all trim mounted and wired. The complete section assembly shall be hydrostatically pressure tested before shipment in accordance with Section IV of the ASME Boiler and Pressure Vessel Code. The boiler shall be factory fire-tested before shipment and the burners shall provide 12 to 12-1/2% CO_2 with a trace to a No. 1 smoke on the Bacharach scale. Boiler shall be equipped with lifting lugs to facilitate lifting and positioning of the boiler.

3. The water boiler shall be provided with built-in air elimination system to assure positive separation of air from circulating water. The water boiler shall be constructed to provide balanced water flow through the entire section assembly so that single supply and return connections can be employed.

4. The boiler shall be provided with an insulated heavy gauge steel jacket with durable baked enamel finish. The jacket shall be easily removable and insulated with minimum 1-1/2" thick foil backed fiber glass on the front, back, top and side panels.

5. The boiler shall be furnished with a factory mounted burner assembly with a refractory mounting plate which shall be provided with the necessary holes and tappings to mount the burner, including ceramic port if required. The burner backing plate shall be fixed or hinged for access to the furnace.

6. Service Access: The boiler shall be provided with access covers for easily accessing all serviceable components. The boiler shall not be manufactured with large enclosures, which are difficult to remove and reinstall. All access must seal completely as not to disrupt the sealed combustion process. All components must be accessible and able to adjust with the removal of a single cover or cabinet component.

7. Indicating lights: Include a diagnostic control panel with a full text display indicating the condition of all interlocks and the BTUH input percentage. Access to the controls shall be through a completely removable cover leaving diagnostic panel intact and not disrupted.

C. Boiler Trim:

1. Boiler Controls:

a. The boiler shall be furnished with operating limit, and safety high limit (manual reset) temperature control. The low temperature limit control shall be set according to the design of the heating system.

b. The boiler shall be furnished with a 3-1/2" dia. combination pressure- temperature gauge to indicate boiler water temperature, system pressure.

c. The boiler shall be furnished with an ASME certified pressure relief valve and the valve shall be set to relieve at pressure schedule on the drawings. The relief valve shall be of the side outlet discharge type. The relief valve outlet shall be piped to a floor drain per applicable building codes.

d. All electrical safety boiler controls are to be of accepted quality manufacture bearing U.L. certification.

e. The Boiler shall be furnished with a U.L. certified low water fuel cut-off. The low water fuel cut-off shall have an ASME working pressure rating of at least the ASME working pressure of the boiler. The low water fuel cut-off shall be installed according to the manufacturer's instructions.

f. The boiler shall be furnished with a water flow switch to prevent burner operation during low flow conditions.

2. Burner: (Boiler Manufacturer's Standard)

a. The packaged, Natural Gas (NG) shall be U.L. certified and shall be of a design which produces flame retention with rapid intimate mixing of the fuel and combustion air. The burner shall be designed to insure high efficiency and good performance under either balanced draft or forced draft venting conditions.

b. The burner shall be arranged for modulating operation with pre-purge, low fire start, post-purge and air control. The burner shall be furnished with a pre-wired NEMA 1 control panel which incorporates an annunciating type electronic combustion control with display, electronic flame detector with UV sensor, control circuit transformer, alarm bell with silence switch, flame failure, low water alarm relays and motor starter, electronic combustion safeguard burner primary control, electronic flame detector

with UV sensor and motor starter relay. The burner shall be factory fire-tested to ensure proper operation before shipment.

c. Radiant non-corroding ceramic burner, with no morving parts. Burner operation shall be Full Modulation with minimum 3:1 turn down utilizing a VFD and air-fuel ratio valve for dependable, repeatable modulation.

d. Interrupted-type mixed fuel/air pilot system with electric spark-to-pilot ignition that utilizes a UV scanner to prove pilot before main gas valve open.

e. The entire firing control sequence shall be monitored by a UL approved, commercial-type microprocessor flame safeguard programmer with first fault annunciation and diagnostic indicator lights. Furnish pre-purge and post-purge timing. Shut down burner in the event of ignition pilot and/or main failure with manual reset.

f. Full frontal access port shall be provided for the control area.

g. The boiler will be equipped with a non-sparking blower manufactured with a cast aluminum housing.

h. Combustion air pressure switch shall be provided.

i. The blower shall be equipped with a replaceable combustion air filter, 99% efficient to one micron. The unit will have the capacity of sealed venting.

j. The noise level rating for a single boiler at full fire shall be no more that 60dB.

3. Gas valve train:

a. Gas train shall meet UL 795, CSD-1 requirements.

b. Pilot Gas Train (Mounted, Piped and Wired): A separate pilot gas cock, gas pressure regulator and pilot safety shutoff gas valve shall be provided for the ignition gas supply.

D. Boiler shall be provided with the following options:

1. Aluminum Condensate Receiver Pan
2. Low Air Pressure Switch
3. Blocked Flue Detection Switch
4. Manual Reset Low Water Cut Off (CSD-1 Field Mounted and wired)
5. Modulation Control
6. Temperature/Pressure Gauge
7. Manual Reset High Limit
8. Air inlet filter
9. Inlet/Outlet Temperature Display
10. Full Digital Text Display for all Boiler Series of Operation and Failures
11. Variable Frequency Drive and Combustion Air Fan
12. Condensate Drain, Drain Trap, and Neutralization Basin.
13. Air Inlet hood for exterior termination of air intake pipe.
14. Vent termination hood for exterior termination of vent pipe.

E. Guarantee: The boiler shall be provided with start-up by factory trained personnel and a full one year factory service to begin at start-up. The boiler shall be warranted for a minimum of twenty (20) years against thermal shock damage, non-pro-rated.

F. Manufacturers: Hydrotherm KN series, Aerco KC-1000, Lochinvar Corp.- IntelliFin Series, Buderus SB Series, Ajax Boiler, Inc. Atlas Series, Gas Master Industries, Inc., RBI Futera, Thermal Solutions EVCA.

1. Any listed equivalent manufacturer and the Mechanical Contractor shall be completely responsible to comply with all requirements on the contract documents. This shall include, but not be limited to, space requirements, code clearances, the type, horsepower, capacities, number and size of services required from other trades.

PART 3 – EXECUTION

3.1 BOILER-BURNERS

A. Install per Manufacturer's Written Instructions:

1. Properly level.

2. Set bottom of framework on concrete pad. The Contractor shall construct level concrete pad and foundations according to the manufacturer's erecting instructions. Mount boilers on 6" high concrete pads. Provide pads, with beveled edges.

3. Pipe all relief valves, blowoffs and drains to the floor drains. Pipe size shall not be less than tapping on boiler, low water cutoff, etc.

4. Adequately protect boiler-burner unit during construction.

5. Pipe all gas vents to exterior in accordance with CSD-1 and utility company requirements. Terminate with screened vent head.

6. Insulate all factory installed piping for hot water, as applicable.

B. Start-up, Contractor shall:

1. Employ the services of approved water treatment consultant who shall:

a. Test water before filling boiler and prescribe proper water treatment to prevent corrosion or deterioration due to oxygen, acid or scaling.

b. Immediately after internal inspection and refilling of boiler, check water conditions at that time and prescribe proper water treatment again.

2. Be responsible for:

a. Supplying and using prescribed ingredients. (initial water treatment)

b. Maintain proper water conditions until acceptance of boiler. After acceptance of boiler, water treatment will be provided by the Owner.

c. Cleaning systems as specified.

d. Not filling boiler until firing equipment is operable.

3. As soon as boiler is filled, ready for testing, or final acceptance.

C. Testing and Cleaning:

1. Bring water up to 210°F and circulate for two hours to drive off air.

2. Demonstrate all safety devices in presence of Owner's Representative and Engineers before final acceptance.

3. Set maximum firing rate of boiler.

4. Skim off impurities until boiler water is clear.

D. Services of Factory mechanic:

1. Arrange to have services of a factory representative trained field mechanic on site to start up the boiler(s).

2. Mechanic shall check out entire installation, including all pumps and feed apparatus and controls, shall start the units into operation and shall make all necessary tests and adjustments to have said equipment operate to his and to the Engineer's satisfaction.

3. Manufacturer shall issue a letter stating that the installation has been checked and adjusted and is ready to turn over to the Owner following the completion of this work.

4. Manufacturer is to forward three (3) copies of the starting reports to the Owner.

5. Factory mechanic shall be at the job for the initial start-up for not less than two (2) consecutive calendar days.

6. Factory mechanic shall conduct demonstration and combustion tests in the presence of the Owner for each boiler for gas firing and oil fire and shall submit written report to the Owner.

7. The same factory mechanic shall make two more trips to the job within the succeeding eight months from the date of the above-mentioned letter for the purpose of further adjusting and checking and shall be immediately available in the event of operating failure of the units within a period of one year from the date of the letter.

E. Tools and spare Parts for Each Boiler: Furnish and obtain receipt for complete set of gaskets, flue brush and scraper with light weight handles and all special tools that may be required.

END OF SECTION 230400

SECTION 230410

HEATING GENERATION AUXILIARY EQUIPMENT

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. The general provisions of the Contract, including the Conditions of the Contract (General, Supplementary and other Conditions, if any) and Division 1 as appropriate, apply to the work specified in this section.

B. Refer to Section 230200 for HVAC General Provisions.

C. Refer to Section 230210 for HVAC Basic Materials and Methods.

D. Refer to Section 230400 for Heating Generation Equipment.

1.2 DESCRIPTION OF WORK

A. This Section includes labor, material, equipment necessary for a complete boiler system as specified and shown on the drawings:

1. Gas Vent Pipe & Pipe Fittings
2. Miscellaneous Breeching Materials
3. Boiler Controls
4. Sequence of Operations

B. Provision for boiler vent and combustion air piping.

C. Refer to other Division 23 sections for related work.

1.3 REFERENCE STANDARDS

A. Refer to Section 230200 for a general description of requirements applying to this section.

1.4 QUALITY ASSURANCE

A. Refer to Section 230210 for a general description of requirements applying to this section.

B. Quality Assurance:

1. Manufacturers: Firms regularly engaged in manufacture of equipment types and capacities required, whose products have been in satisfactory use in similar service for not less than 5 years.

2. Regulatory Requirements:

a. NFPA Compliance: Install gas-fired boilers in accordance with National Fire Protection Association (NFPA) Code 54 "National Fuel Gas Code".

b. NFPA 211 Compliance: Heating equipment burning gas, solid or liquid fuels, Section 60.

1.5 SUBMITTALS

A. Submit shop drawings and product data in accordance with Section 230200.

B. Submit the following:

1. Shop Drawings
2. Product Data
3. Evidence of specified code or other compliance.

1.6 SUBSTITUTIONS

A. The listed equivalent or substituted manufacturers along with the bidding related contractor shall be completely responsible to comply with all requirements on all contract documents. This shall include, but not be limited to, space requirements, code clearances, the type, horsepower, capacities, number and size of services required from other trades, including all required ancillary items furnished and installed by other trades. If the manufacturer or related bidding contractor does not comply with these requirements, this Contractor shall be responsible for any and all additional costs associated with the changes required by other trades.

1.7 WARRANTY/GUARANTEE

A. All work and materials are subject to the general warranty as described in the General Conditions of the Contract and in Division 1, GENERAL REQUIREMENTS

PART 2 – PRODUCTS

2.1 GAS VENT PIPE & FITTINGS

A. The gas vent system shall be so engineered and constructed as to develop a positive flow adequate to exhaust all flue gases to outside atmosphere, without condensation within the vent.

B. All parts of vent system shall be of Underwriters' Laboratories, Inc., listed Metal-Fab Type CORR/Guard Model CG, double wall gas vent piping, and such piping shall be continuous from the appliance outlets into Metal-Fab vent terminal. Venting System shall be rated at 6” W.C. and tested to 15” W.C. per UL Standard 1738.

C. The Metal-Fab gas vent piping shall be installed in full compliance with the terms of its listing, with the manufacturer's installation instructions, and with nationally recognized building codes representing good practice for such installations.

D. For vent sizes 6” to 12” inside diameter, inner wall thickness shall be 0.015”, Type AL29-4C stainless steel.

Outer casing shall be 0.018”, aluminized steel.

E. Inner and outer walls shall be connected by means of spacer clips that maintain concentricity of the annular space and allow differential thermal expansion of the inner and outer walls.

F. All supports, wall penetration, terminal with miter cut and birdscreen, boiler connector and condensate drain fitting shall be included.

G. All joints shall be sealed using manufacturer's approved sealant. Joints exposed to the weather shall be sealed to prevent rainwater from entering the annular space between inner and outer walls.

H. Provide adequate accessibility, head room and dimensions so that all vent connections can be correctly sized, spaced and supported.

I. Manufacturers: Metal-Fab, Metalbestos, Heat Fab, Inc., American Metal Products, Van-Packer Co.

2.2 MISCELLANEOUS BREECHING MATERIALS

A. Provide miscellaneous materials and products of types and sizes to comply with breeching requirements including proper connection of equipment.

B. Provide PVC combustion air intake pipe and accessories:

1. Pipe: ASTM D-1785 Schedule 40, Type 1, Grade 1.
2. Fittings: ASTM D-2466, Schedule 40.
3. Solvent Cement: ASTM D-2564, Schedule 40 and DWV.
4. Uniformity: To ensure installation uniformity, all piping components shall be of one manufacturer.
5. Flux shall be non-toxic type and non-corrosive.

2.3 BOILER CONTROLS

A. System shall be Taco iWorx or approved equal.

1. Mechanical contractor shall be responsible for providing all work and material as described on contract drawings and herein.

2. Coordinate all work associated with the representative for the Boiler Manufacturer.

B. LOCAL CONTROL INTERFACE (LCI)

1. The LCI shall be a color touchscreen user interface and system configuration tool that communicates with device controllers over a LonWorks network. Its functions shall include a local touchscreen user interface, internet or dial-up connectivity for remote access, network configuration tools, database generation tool, automatic web page generation and global time of day scheduling. The LCI will provide supervisory HVAC control, and access control integration.

2. The LCI2 shall incorporate Echelon Corporation LonWorks communications, utilizing Free Topology Transceivers (FTT-10) for communication to networked controllers.

3. The LCI shall have a minimum useable touch screen area of 16.4 square inches with ¼ VGA 320x240 pixel resolution. The LCI2 display shall consists of an analog resistance-based touchscreen over an LCD display with Cold-Cathode Fluorescent (CCFL) back lighting. The touch screen shall include contrast adjustment.

4. The LCI shall automatically self configure for network addressing and communication for HVAC, access and lighting controllers upon initiation of the service pin push-button of a device controller added to the network. Systems that require PC based configuration software or portable system configuration hardware tools shall not be acceptable.

5. The LCI shall be preprogrammed and not require field programming of control proportional bands, control deadbands, reverse or direct acting control actions, control algorithms or any other programmable parameters.

6. Field programming shall only require input of setpoints, schedules and passwords.

7. As the LCI automatically creates the database for HVAC and access by the initiation of the service pin push-button, it shall create the database so that it is accessible from web-browsers. The LCI shall automatically generate web pages without administrator interaction, connection to a personal computer, or HTML programming shall not be required.

8. All data that is accessible from the local touchscreen shall be accessible remotely except for the ability to calibrate the touchscreen, change user names and enable and disable the keyclick.

9. In the event of an alarm condition, the LCI shall generate an e-mail message to up to three predefined e-mail accounts. The e-mail alarm message will provide the site name, device, alarm description, and the date and time the alarm event occurred.

10. Electrical Specifications

    a. Power requirements 28-36 VAC or 24 VAC (requires external power supply).
    b. Power consumption 24 VA.

11. The LCI2 shall include a Real Time Clock. A lithium battery shall maintain nonvolatile database memory.

C. APPLICATION SPECIFIC CONTROLLERS (ASC)

1. Each ASC shall operate as a stand-alone controller capable of performing its specified control responsibilities independent of other controllers in the network. Each ASC shall be a micro-processor based controller, multi-tasking real-time digital control processor and shall have sufficient memory to support its own operating system and data bases including:

    a. Controls processor
    b. Monitoring functions
    c. Energy management functions
    d. I/O interface and conversions

2. ASC's shall incorporate Echelon Corporation LonWorks communications, utilizing Free Topology Transceivers (FTT-10) for communication to the LCI and the Web Data Server.

3. The ASC's and LCI shall use a self-configuring control network management scheme requiring no external computers, tools, binding, or LonWorks knowledge. The LCI shall recognize and configure networked controllers when the controller's service pin is pressed. Once the service pin has been pressed, no further action shall be required by the installer, the controller will be fully accessible to the LCI.

4. The ASC's shall not require any special knowledge of programming. The ASC's shall be preprogrammed for control proportional bands, control deadbands, reverse or direct acting control actions, control algorithms or any other programmable parameters. Field programming shall be limited to input of setpoints, schedules and passwords.

5. All system setpoints, proportional bands, control deadbands, reverse or direct acting control actions, control algorithms and any other programmable parameters shall be stored such that a power failure of any duration does not necessitate the reprogramming of the controller.

6. ASCs shall be provided for control of HVAC boilers and pumps.

D. SENSORS

1. Sensor shall be RTD type, nickel silicon, platinum, or thermistor type to best meet the application. Complete with all necessary mounting hardware.

2.4 SEQUENCE OF OPERATION

A. Heating System Control

1. This system consists of two (2) high efficiency condensing boilers B-1 and B-2, each with circulating pump P-1 and P-2 respectively. Interface with the factory installed LCI sequencing system furnished with the boilers.

2. The boilers sealed combustion system shall be controlled by their integral controls which are all mounted, wired and tested at the factory prior to shipping. The boilers shall be activated/de-activated via the LCI based on outdoor air temperature, or via manual command at the LCI. Once activated, the boilers sequencing system shall stage and modulate the boilers to maintain the existing building heating loop reset water temperature set point, all adjustable.

OAT (°F)	LWT (°F)
10	180
65	100

3. When either boiler is called to fire by its integral temperature controller, its respective circulating pump shall start, the sealed combustion system shall be activated and, when both water flow and combustion air is proven, the boiler shall be allowed to fire. The boilers' sequencing system shall alarm if either boiler is called to fire and fails to start. This will be a general failure alarm which will require reset at the boiler involved in the alarm condition. Provide alarm callout through the LCI to signal a system failure.

4. Install all required hot water supply and return temperature sensors in the building and boilers hot water loop piping. Interface with the boiler LCI sequencing controls.

5. The following items shall be displayed:

   a. Boiler activated/de-activated status per boiler.
   b. Boiler failure per boiler.
   c. Outside air temperature.
   d. Hot water supply temperature at boiler header
   e. Hot water return temperature at boiler header
   f. Hot water supply and return temperature at building loop header.

6. Building Loop Pumps Control:

   Building loop pumps P-3 and P-4 shall be controlled directly by the boilers LCI system. Rotate lead pump on a minimum weekly basis or as reset manually at the system panel. Lead loop pump shall start and run continuously when the heating system is activated. When lead pump fails to start once activated, initiate an alarm to the system after a twenty second delay. Monitor flow status of each pump with a current sensor on one leg of power feeding the pump motor.

   The following items shall be available for display at the system panel:

   a. Designated lead and lag pump.
   b. Flow status/alarm.
   c. Commanded status of each pump – on/off.
   d. Loop discharge and return temperature.

7. Make-Up Water System Monitoring Control:

   a. Provide system control for the make-up water serving the heating plant.

   b. Provide a water flow meter on the make-up water supply. When the measured flow exceeds 10 gallons/minute, adjustable, close the normally open solenoid valve, generate an alarm at the LCI, and signal the plant system controls to shut down the boilers, pumps, and auxiliaries affected.

   c. Flow sensor, consisting of a removable flow sensor mounted in a cast-bronze housing, available in ½" to 1-1/2" pipe size. Sensor shall be rated for a flow range of 0.5 to 15 feet per second, 220°F max., 400 psig at 100°F maximum pressure; Nylon impeller, Pennlon bearing, tungsten carbide shaft, PPS housing and EPDM seals. Manufacturer: Kele Model 250B.

   d. Programmable analog flow transmitter shall be a loop-powered device that converts a flow sensor signal into a linear 4 – 20mA signal, with electronic signal dampening, computer programmable, and compact size in a metal enclosure. Power input, 9-35 VDC/0-1 kHz, 75 ohms at 24 VDC, accuracy of 0.1% of full scale. Manufacturer: Kele Model 310-02.

   e. The following items shall be displayed at the LCI:

(1) Water flow in gallons per minute.
(2) Command signal to the valve.
(3) High flow/equipment shut down alarm.

PART 3 – EXECUTION

3.1 GAS VENT (PRE-ENGINEERED)

A. The gas vent manufacturer shall warrant the complete system against functional failure due to defects in material and workmanship for 10 years from date of delivery. The system manufacturer shall be responsible for checking the sizing, design, and installation of the system. If any component fails to perform its intended function of exhausting combustion by-products from the boiler equipment, for any reason, within 10 years of shipment, the system supplier shall, at no expense to the Owner, provide a replacement part or parts FOB jobsite.

3.2 ELECTRICAL

A. All electrical power, conduit, etc., including final connections shall be coordinated with the Electrical Contractor.

B. All control wiring, conduit, etc., including final connections shall be by this Contractor.

C. The Contractor shall coordinate all his electrical requirements and data with the equipment manufacturer's installation diagrams.

D. All control wiring beyond that point shall be in conduit. Interior wiring shall be in EMT conduit minimum size 3/4" and exterior wiring shall be in PVC conduit minimum size 3/4".

E. All wiring shall comply with NEC, NFPA 70.

3.3 TESTING, INSTRUCTING, CHECKOUT AND BALANCING

A. Commissioning and Setup

1. Local Representative for the boiler manufacturer shall furnish personnel to check out and demonstrate workability of system before final job acceptance. Provide minimum of two commissioning and setup visits, one at the start of the heating season and one ninety (90) days later. Times to be as coordinated with the owner.

2. Fully cooperate with the mechanical contractor in providing qualified personnel to assist in the testing and checkout of the HVAC systems.

B. Instruction

1. At the completion of the job and the seasonal commissioning visit provide competent personnel to adequately instruct the Owner's personnel in the operation of the complete control system.

   a. Personnel shall sign off that they have received satisfactory instruction and understand the system.
   b. Sign-off sheet shall be forwarded to the Owner and the Engineer for matter of record.

2. Provide one additional visit to the job at the one-year anniversary to review operating sequences, operating history with the users and make any adjustment, corrections and repairs to systems which may have been evidenced during the one-year operating history

END OF SECTION 230410

SECTION 230500

PIPING SYSTEMS & ACCESSORIES – HVAC

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. The general provisions of the contract, including the conditions of the contract (General, Supplementary and other Conditions, if any) and Division 1 as appropriate, apply to the work specified in this section.

B. Refer to Section 230200 for HVAC General Provisions

C. Refer to Section 230210 for HVAC Basic Materials & Methods.

1.2 DESCRIPTION OF WORK

A. This Section includes the following equipment:

1. In-Line Circulator Pumps
2. Base-Mounted End Suction Pumps
3. Suction Diffusers
4. Diaphragm-Type Expansion Tanks (Vertical)
5. Air Separators
6. Water Feeders
7. Balancing Valves
8. Combination Valve Package for Pumps
9. Flexible Pump Connectors

1.3 REFERENCE STANDARDS

A. Refer to Section 230200 for a general description of requirements applying to this section.

1.4 QUALITY ASSURANCE

A. Refer to Section 230210 for a general description of requirements applying to this Section.

1.5 SUBMITTALS

A. Submit shop drawings and product data in accordance with Section 230200.

B. Submit the following:

1. Shop Drawings
2. Manufacturers Product Data
3. Test Reports on Piping System Tests

1.6 SUBSTITUTIONS

A. The listed equivalent or substituted manufacturers along with the bidding related contractor shall be completely responsible to comply with all requirements on all contract documents. This shall include, but not be limited to, space requirements, code clearances, the type, horsepower, capacities, number and size of services required from other trades, including all required ancillary items furnished and installed by other trades. If the manufacturer or related bidding contractor does not comply with these requirements, this Contractor shall be responsible for any and all additional costs associated with the changes required by other trades.

1.7 WARRANTY/GUARANTEE

A. All work and materials are subject to the general warranty as described in the General Conditions of the Contract and in Division 1, General Requirements.

PART 2 – PRODUCTS

2.1 IN-LINE CIRCULATOR PUMPS

A. Provide in-line circulator pumps where indicated, and of capacities as scheduled.

B. End suction with vertically split casing, close coupled, single stage, designed for 175 psi working pressure.

C. Cast iron body, 125 psi ANSI flanges of equal size, tappings for gauge and drain fittings.

D. Steel shaft with replaceable shaft sleeve and standard mechanical seal with ceramic seal seat.

E. Enclosed type impeller hydraulically and dynamically balanced, keyed to shaft and secured with locking screw.

F. Manufacturers: Subject to compliance with requirements, provide pumps of one of the following:

Armstrong Pumps
Aurora
Bell & Gossett
Ingersoll Rand
Peerless
Patterson
Paco
Taco

2.2 BASE-MOUNTED END SUCTION PUMPS

A. Provide frame-mounted end suction pumps where indicated, and of capacities and having characteristics as scheduled.

B. Horizontal mount, single stage, flexible coupling, base-mounted, designed for 175 psi working pressure.

C. Cast iron casing 125 psi ANSI flanges, tappings for gauge and drain connections.

D. Steel shaft with replaceable shaft sleeve, regreasable ball bearings and mechanical seals with carbon seal ring and ceramic seat.

E. Non-overloading motor at any point on pump curve, open, drip-proof, ball bearings, 15,000 hours bearing life, with lifting lug on top of motor.

F. Provide open drip-proof motor with regreasable ball bearings.

G. Enclosed type impeller hydraulically and dynamically balanced, keyed to shaft and secured with locking screw.

H. Structural steel baseplate with welded cross members, and open grouting area.

I. Flexible coupling capable of absorbing torsional vibration, equipped with coupling guard.

J. Manufacturers: Subject to compliance with requirements, provide pumps of one of the following:

Armstrong Pumps
Bell & Gossett
Aurora
Ingersoll Rand
Peerless
Patterson
Paco
Taco

2.3 SUCTION DIFFUSERS

A. Provide at each base-mounted pump, a suction diffuser of size required for pump connection. Units shall consist of angle type body with straightening vanes and combination diffuser-strainer-orifice cylinder with 3/16" diameter openings for pump protection. A permanent magnet shall be located within the flow stream and shall be removable for cleaning. The orifice cylinder shall be equipped with a disposable fine mesh strainer which shall be removed after system start-up. Orifice cylinder shall be designed to withstand pressure differential equal to pump shutoff head and shall have a free area equal to five times cross section area of pump suction opening. Straightening vanes shall extend the full length of the orifice cylinder and shall be replaceable. Unit shall be provided with adjustable support foot to carry weight of suction piping.

B. Manufacturers: by pump manufacturer.

2.4 DIAPHRAGM-TYPE EXPANSION TANKS (VERTICAL)

A. Fabricate tank of continuously welded steel plate of the size shown conforming to ASME Section VIII Standards, maximum working pressure of 125 psi.

B. Provide air charging valve, drain-offs, system connection and other piping connections. Paint outside of tank with a zinc chromate primer.

C. Provide a standard cleanout hole located in the tank head.

D. Tank shall have a sealed-in heavy-duty butyl diaphragm suitable for operation from 40 to 240 degrees F.

E. Tank shall be furnished with an ASME stamp.

F. The tanks shall be manufactured by Amtrol, Bell and Gossett, Patterson, Stover Tanks, Taco, Wheatley, John Wood.

2.5 AIR SEPARATORS

A. Furnish and install, as shown on plans, a centrifugal type air separator. The unit shall have NPT or flanged inlet and outlet connections tangential to the vessel shell. Vessel shell diameter to be three times the nominal inlet/outlet pipe diameter.

B. The unit shall have an internal stainless steel air collector tube with 5/32" diameter perforations and 63% open area designed to direct accumulated air to the compression tank via an NPT connection at top of unit.

C. The unit shall have a removable galvanized steel system strainer with 3/16" diameter perforations and a free area of not less than five times the cross-sectional area of the connecting pipe. A blowdown connection shall be provided to facilitate routine cleaning of the strainer.

D. Manufacturer to furnish data sheet specifying air collection efficiency and pressure drop at rated flow.

E. A manufacturers' Data Report for Pressure Vessels, Form U-1 as required by the provisions of the ASME Boiler and Pressure Vessel Code shall be furnished for each air separator upon request.

F. Manufacturers:

Armstrong
Bell & Gossett
Patterson
Taco, Inc.
Thrush Div., Amtrol, Inc.
John Woods
Wheatley

2.6 WATER FEEDERS

A. Each water circulating system shall have make-up water introduced through a pressure regulating valve provided with a three-valve bypass and a strainer.

B. The pressure regulating valve shall be manufactured by McDonnell and Miller, A.W. Cash, Bell and Gossett.

2.7 BALANCING VALVES

A. Balancing valves shall be installed where indicated.

B. Provide, as shown on the plans, balancing valves with provision for connecting a portable differential (Ft. of Head) pressure meter. Each meter connection shall have pressure/temperature readout ports.

C. The balancing valves shall be either a bronze body/brass ball valve, or a Y-pattern globe valve style design and all metal parts of non-ferrous, pressure die-cast, nonporous Ametal copper alloy. Each valve can be installed in any direction without affecting flow measurement and shall provide four (4) functions:

1. Precise flow measurement
2. Precision flow balancing
3. Positive shut-off with no drop seat and teflon disc
4. Drain port suitable for hose bib fitting.

D. The valves shall have four (4) 360 deg. adjustment turns of handwheel for maximum setting with hidden memory feature to program the valve with precision tamperproof balancing setting.

E. Design Pressure/Temperature:

1/2" - 3" NPT connections 300 psig at 250 deg. F.
1/2" and 3/4" sweat connections 200 psig at 250 deg. F.
2" – 4" flanged or grooved connections 250 psig at 250 deg. F
4" flanged connections 175 psig at 250 deg. F.

F. Flow sensor: For installation in piping 5" and larger, a precision wafer type orifice insert installed between standard 125 psi at 250 deg. F ANSI flanges to monitor system flow; cast iron body with integral brass EPT check valves to accommodate a differential pressure meter; furnish with calibrated nameplate with flow range through a range of differential head pressures; provide globe valve at each sensor to adjust flow to design conditions.

G. Manufacturers: Tour & Andersson, Armstrong, Bell & Gossett, Nexus Valve, Taco, Victaulic, Wheatley.

2.8 COMBINATION VALVE PACKAGE FOR PUMPS

A. Each centrifugal pump shall be provided with the following valve assemblies:

1. Combination silent check valve, balancing valve and shut-off valve on pump discharge.

B. The combination units shall be flanged assemblies of 125 lb. ASA Class, 175 psi. W.O.G. @ 300 degrees F. The combination units shall be suitable for vertical or horizontal installation with the stem pointing up.

C. The body and bonnet shall be cast semi-steel; and the stem, seat and disc shall be bronze. The valve shall be designed for repacking under pressure.

D. The unit shall be provided with a calibrated stem indicator, and the check valve shall have a stainless steel spring and be provided with disc designed for quiet operation at low flow rates.

E. Manufacturers: by Pump Manufacturer.

2.9 FLEXIBLE PUMP CONNECTORS

A. Provide braided stainless steel pump connector(s) manufactured with annular corrugated stainless steel close-pitch hose with stainless steel overbraid. The corrugated metal hose, braid(s), and a stainless steel ring-ferrule/band (material gauge not less than .048") must be integrally seal-welded using a 100% circumferential, full-penetration TIG weld.

B. End fittings shall be flat-face plate steel flanges with 150# ANSI drilling and outside diameter. Fittings must be attached using a 100% circumferential TIG weld. Braided stainless steel pump connector(s) must be suitable for operating temperatures up to 850°F. The rated working pressure of the braided metal hose must have a minimum 4:1 safety factor.

C. Each braided stainless steel pump connector shall be individually leak tested by the manufacturer using air-under-water or hydrostatic pressure. Flanged pump connectors shall be prepared for shipment using cut-to-length spacers, securely positioned between the flanges to prevent axial compression damage and maintain the manufactured length. Spacers must be removed prior to system start-up.

D. Manufacturers: Amber/Booth, Flex-Hose Co., Inc., Mason Industries, Metra-Flex, Patterson, Proco Products, Inc., Twin City Hose, Inc.

PART 3 – EXECUTION

3.1 CIRCULATING PUMPS

A. Pump shall be installed in accordance with recommendations of the Hydraulic Institute.

B. Suction reducers shall be eccentric and located at the pump suction. Discharge increasers shall be concentric and located at the pump discharge.

C. Suction and discharge piping shall be adequately supported without imposing any load on the pump casing.

D. Pressure gauges shall be installed at the suction and discharge of each pump.

E. Vibration isolation equipment shall be provided where noted.

F. Impeller diameter used shall be approximately 85% of the maximum impeller diameter capable of being supplied for each pump.

G. The motor nameplate horsepower shall not be exceeded under any conditions of pump operation.

H. Prior to shipment, each pump shall be tested to insure its capability to produce the required capacity at the design head, and when requested written verification of this test shall be supplied.

I. Before grouting and piping the pump, the Contractor shall check to insure pump alignment is satisfactory, and where required, realign the pump. Fill baseplate with non-shrink grout to the top of the base rail.

J. Start-up service shall be provided by the pump manufacturer or his representative. This service shall include the following:

1. Check alignment
2. Check absence of pipe strain
3. Check lubrication
4. Check rotation
5. Take suction and discharge pressure gauge readings and compare with pump nameplate for operating head.
6. Take voltage and current readings and compare with motor nameplate.
7. Insure proper maintenance manuals are available if required.

3.2 BYPASSES

A. Three-valve bypasses shall be provided in piping where indicated on drawings.

B. The bypasses shall consist of two gate valves and one globe or angle valve. The bypass pipe size shall be at least equal to the control valve size.

3.3 PIPING SYSTEM DRAINS

A. All piping shall be graded or pitched toward drain locations which shall be provided with gate valve unless otherwise indicated on drawings or specified. Individual risers may be drained through removable plugs or caps.

B. Drain valves shall be provided at all major components in systems including boilers, pumps, heat exchangers, cooling towers, and similar equipment.

3.4 ECCENTRIC PIPE FITTINGS

A. Eccentric pipe fittings shall be furnished and installed in all piping and circulated water piping where a change in pipe size occurs in a horizontal run. In water systems the top of the adjacent pipe sections shall be maintained level.

3.5 CHEMICAL CLEANING

A. New boilers shall be boiled out with an alkaline type boiling out compound to remove grease, oil, mil scale and other foreign matter. The compound should be used at the rate of 1-1/2 pounds per 20 boiler horsepower. After the boiling out period, the boiler shall be completely drained, flushed and refilled with fresh water.

B. Closed re-circulating systems shall be filled and sufficient detergent and dispersant added to remove all dirt, oil and grease. System shall be circulated for at least 48 hours after which a drain valve at the lowest point shall be opened and allowed to bleed while the system

continues to circulate. The automatic make-up valve shall be checked to be sure it is operating. Bleeding shall continue until water runs clear and all detergent is removed. A sample of water shall be tested and if pH exceeds 8.0, draining should be resumed.

C. Drain all detergent solution from system piping and equipment to nearest floor drain or indirect waste point connected to the building's sanitary system.

END OF SECTION 230500

SECTION 230510

WATER TREATMENT (HVAC)

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. The general provision of the contract, including the conditions of the contract (General, Supplementary and other Conditions, if any) and Division 1 as appropriate, apply to the work specified in this section.

B. Refer to Section 230200 for HVAC General Provisions.

C. Refer to Section 230210 for HVAC Basic Materials & Methods.

1.2 DESCRIPTION OF WORK

A. This Section includes labor, material, equipment and supervision to provide a complete water treatment system for the following:

1. Cleaning and treatment of circulating HVAC hot water system.

    a. Cleaning Compounds.
    b. Chemical Treatment for Closed Loop Systems.
    c. Chemical Cleaning of New Systems

1.3 REFERENCE STANDARDS

A. Refer to Section 230200 for a general description of requirements applying to this section.

B. Requirements established within the portions of the Project Manual titled Division 1, General Requirements, are collectively applicable to the work of this section.

C. Technical Services: Provide the services of an experienced water treatment chemical engineer or technical representative to direct flushing, cleaning, pre-treatment, training, debugging, and acceptance testing operations; direct and perform chemical limit control during construction period and monitor systems for a period of 12 months after acceptance, including not less than four service calls and written status reports. Minimum service during construction/start-up shall be 8 hours.

D. Field Quality Control and Certified Laboratory Reports: During the one year guarantee period, the water treatment laboratory shall provide not less than 12 reports based on on-site periodic visits, sample taking and testing, and review with Owner, of water treatment control for the previous period. In addition to field tests, the water treatment laboratory shall provide certified laboratory test reports. These monitoring reports shall assess chemical treatment accuracy, scale formation, fouling and corrosion control, and shall contain instructions for the correction of any out-of-control condition.

E. Log Forms: Provide one year supply of preprinted water treatment test log forms.

1.4 SUBMITTALS

In accordance with Section 230200 provide the following:

A. Manufacturer's Literature and Data:

1. Cleaning compounds and procedures.
2. Chemical treatment for closed systems.

B. Water analysis verification.

C. Materials Safety Data Sheet for all proposed chemical compounds.

D. Maintenance and operating instructions.

PART 2 – PRODUCTS

2.1 CLEANING COMPOUNDS:

A. Alkaline phosphate or non-phosphate detergent/surfactant/specifically to remove organic soil, hydrocarbons, flux, pipe mill varnish, pipe compounds, iron oxide, and like deleterious substances, with or without inhibitor, suitable for system wetted metals without deleterious effects.

B. Refer to Section, PIPING SYSTEMS & ACCESSORIES - HVAC, PART 3, for flushing and cleaning procedures.

2.2 CHEMICAL TREATMENT FOR CLOSED LOOP SYSTEMS:

A. Inhibitor: Provide sodium silicate, sodium nitrite/borate, or other approved proprietary compound suitable for make-up quality and make-up rate and which will cause or enhance bacteria/corrosion problems or mechanical seal failure due to excessive total dissolved solids. Shot feed manually. Maintain inhibitor residual as determined by water treatment laboratory, taking into consideration residual and temperature effect on pump mechanical seals.

B. pH Control: Inhibitor formulation shall include adequate buffer to maintain pH range of 8.0 to 10.0.

C. Performance: Protect various wetted, coupled, materials of construction including ferrous, and red and yellow metals. Maintain system essentially free of scale, corrosion, and fouling. Corrosion rate of following metals shall not exceed specified mills per year penetration; ferrous, 0.5; brass, 0.2; copper, 0.15. Inhibitor shall be stable at equipment skin surface temperatures and bulk water temperatures of, respectively, not less than 250 and 125 degrees Fahrenheit. Heat exchanger fouling and capacity reduction shall not exceed that allowed by fouling factor 0.0005.

D. Pot Feeder: By-pass type for chemical treatment schedule 10 gauge heads, 3/4-inch system connections and large neck opening for chemical addition. Feeder shall be bypass filter feeder, minimum five gallon, installed per detail on the drawings.

E. Water Analysis: Confirm raw water analysis or provide analysis if none is furnished.

Description	Year (Avg.)
Silica ($Si0_2$)	_____
Insoluble	_____
Iron & Aluminum	_____
Calcium (Ca)	_____
Magnesium (Mg)	_____
Sodium & Potassium (Na & K)	_____
Carbonate (CO_3)	_____
Bicarbonate (HCO_3)	_____
Sulfate (SO_4)	_____
Chloride (Cl)	_____
Nitrate (NO_3)	_____
Turbidity	_____
pH	_____
Residual Chlorine	_____
Total Alkalinity	_____
Non Carbonate Hardness	_____
Total Hardness	_____
Dissolved Solids	_____
Fluorine	_____

F. Conduct performance test to prove capacity and performance of treatment system.

Raw water total hardness, ppm.

Concentration cycles.

Raw water, pH.

System water, pH.

Chemical solution used.

Acid solution used, obe.

Quantity or chemical solution injected into system per cycle.

Quantity of acid injected into system per cycle.

Make up water required.

Waste to drain requirement.

G. Recommended Conditions

1. Buffered Nitrite:

   a. For temperatures 140ºF to 180ºF - 1000 ppm as sodium nitrite.

2. Molybdate:

   a. 50 - 100 ppm as molybdate (chilled water).

3. pH - 7.0 to 10.0

2.3 CHEMICAL CLEANING OF NEW SYSTEMS

A. Boil out boilers with an alkaline type boiling out compound to remove grease, oil, mill scale and other foreign matter. Compound should be used at the rate of 1-1/2 lbs. per 20 boiler HP. After boiling out period, completely drain, flush and refill boiler with fresh water.

B. Fill closed recirculating systems and add sufficient detergent and dispersant to remove all dirt, oil and grease. Circulate system for at least 24 hours, after which open a drain valve at lowest point, open the make-up water valve and allow to bleed while system continues to circulate. Check the automatic make-up valve to be sure it is operating. Bleeding shall continue until water runs clear and all detergent is removed. Test sample of water and if pH exceeds the pH of the makeup water, flushing shall be resumed.

C. Drain all detergent solution from system piping and equipment to nearest floor drain or indirect waste point connected to the building's sanitary system.

PART 3 – EXECUTION

3.1 INSTALLATION:

A. Delivery and Storage: Deliver all chemicals in manufacturer's sealed shipping containers. Store in designated space and protect from deleterious exposure and hazardous spills.

B. Install equipment furnished by the chemical treatment supplier and charge systems according to the manufacturer's instructions and as directed by the Technical Representative.

C. Perform tests and report results.

D. Instruct owner personnel in system maintenance and operation.

3.2 INSPECTIONS AND MAINTENANCE:

A. Furnish complete inspection and maintenance service on water treatment equipment for a period of one year after completion and acceptance of the water treatment equipment installation. This maintenance service shall begin concurrently with the guarantee. Maintenance work shall be performed by skilled personnel directly employed and supervised by the same company that provided the water treatment equipment specified herein.

B. The maintenance service shall include the following:

1. Monthly systematic examination of equipment.

2. Cleaning, lubricating, adjusting, repairing and replacing of all parts as necessary to keep the equipment in first-class condition and proper working order.

3. Furnishing all lubricant, cleaning materials and parts required.

4. The operational system shall be maintained to the manufacturer's standards specified including any changes and/or adjustments required to meet varying conditions.

5. Provide 24 hour emergency call-back service which shall consist of promptly responding to calls within two hours for emergency service should a shutdown or emergency trouble develop between regular examinations. Overtime emergency call-back shall be limited to minor adjustments and repairs required to protect the immediate safety of the equipment.

6. Service personnel shall report to the owner or his authorized representative upon arrival and again upon completion of the required work. A copy of the work ticket containing a complete description of the work performed shall be given to the owner.

7. The Contractor shall maintain a log in the boiler room. The log shall list the date and time of all monthly examinations and all trouble calls. Each trouble call shall be fully described including the nature of the call, necessary correction performed and/or parts replaced.

END OF SECTION 230510

SECTION 230600

AIR DISTRIBUTION & ACCESSORIES – HVAC

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. The general provisions of the contract, including the conditions of the contract (General, Supplementary and other Conditions, if any) and Division 1 as appropriate, apply to the work specified in this section.

B. Refer to Section 230200 for HVAC General Provisions

C. Refer to Section 230210 for HVAC Basic Materials & Methods.

1.2 DESCRIPTION OF WORK

A. This Section includes labor, material, equipment and supervision to provide a complete air distribution system as specified herein and as shown on drawings.

1. Ductwork – Single Wall, Square and Rectangular
2. Flexible Connections

1.3 REFERENCE STANDARDS

A. Refer to Section 230200 for a general description of requirements applying to this section.

B. Requirements established within the portions of the Project Manual titled Division 1, General Requirements, are collectively applicable to the work of this section.

C. IMC (International Mechanical Code).

D. SMACNA (Sheet Metal and Air Conditioning Contractors National Association, Inc.)

E. American Society of Heating, Refrigerating and Air Conditioning Engineers' recommendations in ASHRAE Guide shall apply to this work.

F. UL (Underwriter's Laboratories, Inc.)

G. NFPA 90A shall apply to this work.

H. State Fire Prevention Regulations.

1.4 QUALITY ASSURANCE

A. Refer to Section 230210 for a general description of requirements applying to this Section.

1.5 SUBMITTALS

A. Submit shop drawings and product data in accordance with Section 230200.

B. Submit the following:

1. Shop drawings of all sheet metal. Indicate all steel, piping, conduit, and Architectural/Structural features to demonstrate complete coordination. Scale shall not be less than ¼".

   a. Shop drawings shall indicate the sizes and lengths of each section of ductwork as well as all system components such as access doors and dampers. Also indicate the type of joints used and where internal acoustic lining or insulation, if required, will be utilized.

   b. The location of the duct runs and the air outlets shall be closely coordinated with all other trades by the sheet metal contractor to avoid interference. The shop drawings shall show the contact surfaces adjacent to the ducts or air outlets and the space assigned. The drawings shall indicate principal items of equipment, adjacent piping and conduit, etc., the location of which shall be secured from the contractors of other trades.

   c. Sheet Metal Contractor to include resubmissions of the shop drawings to the Engineer. The resubmissions are to include all corrections to previous submissions.

2. Manufacturer's literature and performance data of all equipment and devices.

3. Samples: Furnish color samples, etc., at request of the Engineer.

1.6 SUBSTITUTIONS

A. The listed equivalent or substituted manufacturers along with the bidding related contractor shall be completely responsible to comply with all requirements on all contract documents. This shall include, but shall not be limited to space requirements, code clearances, the type, horsepower, capacities, number and size of services required from other trades, including all required ancillary items furnished and installed by other trades. If the manufacturer or related bidding contractor does not comply with these requirements, they shall be responsible for any and all additional costs associated with the changes required by other trades.

1.7 WARRANTY GUARANTEE

A. All work and materials are subject to the general warranty as described in the General Conditions of the Contract and in Division 1, General Requirements.

PART 2 – PRODUCTS

2.1 DUCTWORK (SINGLE WALL, SQUARE AND RECTANGULAR)

A. All ductwork shall be fabricated in accordance with SMACNA "HVAC Duct Construction

Standards - Metal and Flexible" latest Edition except as described below. The minimum thickness of metal ductwork is 26 gauge. Fabrication requirements shall be based on ductwork subjected to positive or negative pressures of 2" W.G. Ductwork systems shall be sealed to SMACNA "Seal Class "A" Standards. Alternatively, "Ductmate" System 45 can be used in accordance with manufacturer's specifications. Drive slip joints are not permitted.

Exception: For ductwork smaller than 12" x 8", Contractor may provide slip and drive joints with all joints sealed with Hardcast tape and mastic system.

B. Rectangular ducts for 2" W.G. or less, positive or negative pressure shall be per SMACNA Table 1-5. Longitudinal seams shall be Pittsburgh Lock Type L-l per SMACNA Figure 1-5. Transverse joints shall be standing seam type T -15 per Figure 1-4.

1. In the event that material size is not compatible with duct size and segmenting must be utilized to fabricate duct, use SMACNA Figure 1-5, seam L-4 (Standing Seam).

C. Joints:

1. Per SMACNA Transverse Joint Reinforcement Table 1-12, only joints T -22, T -25a, T -25b and Proprietary slip on flanges will be acceptable.

2. Joints T -25a and T -25b that have stress fractures from bending will not be accepted.

3. All joints will have butyl gasket 3/16" thick by 5/8" wide installed per manufacturers installation instructions.

D. Ductwork systems for this standard shall be galvanized sheet steel, commercial quality of lock - forming grade, conforming to ASTM coating standards A-525 or A-527 with coating of designation G-60.

E. The size and configuration of each duct shall be indicated on design drawings. Where thicker sheets or different types of materials are required, they shall be specified on the design drawings or in the project specifications.

2.2 FLEXIBLE CONNECTIONS

A. Required between ductwork and suction and discharge connection of all fans and air handlers.

B. Material: Woven fiberglass with mounting hardware tested in accordance with UL Standard 181, listed and labeled as Class 0 or 1.

C. Manufacturer: Ventfabrics, Inc., Durodyne, Dynair, Ductmate Pro Flex.

PART 3 – EXECUTION

3.1 DUCTWORK

A. Dimensions on drawings are inside dimensions.

B. Ducts shall be exposed unless otherwise indicated.

C. Changes in direction shall be made with radius bends or turning vanes.

D. Supports shall be galvanized steel.

E. Do not install ductwork directly above any electrical equipment.

F. Ductwork shall be supported per SMACNA Standards except as follows:

1. Rivet or screw to side of duct when using flat strap hangers. Rivet or screw to bottom of duct when using trapeze hangers.

2. Extend hangers down the side of the duct at least 9"; pass hangers under ducts less than 9" deep.

3. Space hangers not more than 8' on centers for ducts up to 18" wide and 4' on centers for ducts over 18" wide.

4. Wire hangers are not acceptable.

5. Support ductwork from building structure with expansion bolts, rods, steel angles or channels installed to meet existing or new building conditions.

6. Driving nails into anchors is not permitted.

3.2 DUCT SYSTEM LEAK SEALING

A. Joints in duct systems at duct heaters, air monitors, fire dampers, sound traps, supply air terminals including air handling light fixtures, shall be sealed to prevent air leakage.

B. All duct joints and seams in medium pressure and high pressure duct systems shall be sealed to SMACNA Seal Class" A" Standards to prevent air leakage.

C. In the event there is in excess of 5% air leakage indicated in low pressure duct systems, it shall be the Contractors responsibility to seal the duct system. The amount of sealing necessary shall be that required to obtain the design air quantity at each terminal.

D. Duct sealing shall be by means of high velocity duct sealants such as Hardcast and/or Neoprene gaskets. Type of sealant and method of application shall conform to recommendations in SMACNA high velocity duct construction standards.

3.3 DUCTWORK TESTING

A. The following ductwork shall be pressure leak tested:

1. Exhaust ductwork

B. All tests shall be conducted in accordance with AABC National Standards.

C. Ducts to be tested at 100% maximum of static pressure before any duct is insulated externally and concealed in accordance with SMACNA Standards.

D. Calculate the allowable leakage using leakage factor of 5% of Design Air Flow.

E. Select a limited section of duct for which the estimated leakage will not exceed capacity of the test apparatus.

F. Connect the blower and flow meter to the duct section and provide temporary seals at all openings of the ductwork.

G. Start the blower motor with the inlet damper closed. Increase pressure until the required level is reached.

H. Read the flow meter and compare the leakage in cfm. Reading should be 5% or less of design flow for the duct segment being tested.

I. If reading is more than 5% of design flow, depressurize duct, repair all leaks and retest until 5% or less of design flow is obtained.

J. Complete test reports and obtain Owner's witness signature.

K. Remove all temporary blanks and seals.

L. Warning: Do not overpressure duct.

3.4 EQUIPMENT

A. Test apparatus shall consist of an airflow measuring device, flow producing unit, pressure indicating devices and accessories necessary to connect the metering system to the test specimen.

B. The Contractor conducting tests shall arrange for or provide all temporary services, all test apparatus, all temporary seals and all qualified personnel necessary to conduct the specified testing.

C. Test apparatus shall be accurate within plus or minus 7.5% at the indicated flow rate and test pressure and shall have calibration data or a certificate signifying manufacture of the meter in conformance with the ASME Requirements for Fluid Meters. Verification of above, to be supplied to Owner upon request.

D. Pressure differential sensing instruments shall be readable to 0.05" scale division for flow rates below 10 cfm or below 0.5" w.g. differential. For flows greater than 10 cfm scale divisions of 0.1" are appropriate. U-tube manometers should not be used for reading less than 1" of water.

E. Liquid for manometers shall have a specific gravity of 1 (as water) unless the scale is calibrated to read in inches of water contingent on use of a liquid of another specific gravity, in which case the associated gauge fluid must be used.

F. Instruments must be adjusted to zero reading before pressure is applied.

3.5 TEST REPORT

A. Log the project and system identification data.

B. Enter the fan CFM, the test pressure, and the leakage class specified by the designer.

C. Enter an ide ntification for each duct segment to be tested.

D. Calculate the allowable leakage factor. Enter this number on the report for each test segment.

E. Conduct and record the field tests. If the sum of the CFM measured is less than or equal to the sum of the allowable leakage, the test is passed. Record the date(s), presence of witnesses and flow meter characteristics.

F. Maintain a mechanical duct plan of all tested duct segments. Plan to include duct segment identification and dates tested.

G. Test reports shall be submitted as required by the project documents.

END OF SECTION 230600

SECTION 230605

FANS

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. The general provisions of the contract, including the conditions of the contract (General, Supplementary and other Conditions, if any) and Division 1 as appropriate, apply to the work specified in this section.

B. Refer to Section 230200 for HVAC General Provisions

C. Refer to Section 230210 for HVAC Basic Materials & Methods.

1.2 DESCRIPTION OF WORK

A. This Section includes labor, material, equipment and supervision to provide a complete air distribution system as specified herein and as shown on drawings.

1. Inline Ceiling Fan

1.3 REFERENCE STANDARDS

A. Refer to Section 230200 for a general description of requirements applying to this section.

B. Requirements established within the portions of the Project Manual titled Division 1, General Requirements, are collectively applicable to the work of this section.

C. IMC (International Mechanical Code)

D. SMACNA (Sheet Metal and Air Conditioning Contractors National Association, Inc.)

E. American Society of Heating, Refrigerating and Air Conditioning Engineers' recommendations in ASHRAE Guide shall apply to this work.

F. UL (Underwriter's Laboratories, Inc.)

G. NFPA 90A shall apply to this work.

H. State Fire Prevention Regulations.

1.4 QUALITY ASSURANCE

A. Refer to Section 230210 for a general description of requirements applying to this Section.

1.5 SUBMITTALS

A. Submit shop drawings and product data in accordance with Section 230200.

B. Submit the following:

1. Shop drawings of all sheet metal. Indicate all steel, piping, conduit, and Architectural/Structural features to demonstrate complete coordination. Scale shall not be less than 1/4" = 1'-0".

2. Manufacturer's literature and performance data of all equipment and devices.

1.6 SUBSTITUTIONS

A. The listed equivalent or substituted manufacturers along with the bidding related contractor shall be completely responsible to comply with all requirements on all contract documents and as described within the specifications. This shall include, but shall not be limited to space requirements, code clearances, the type, horsepower, capacities, number and size of services required from other trades, including all required ancillary items furnished and installed by other trades. If the manufacturer or related bidding contractor does not comply with these requirements, they shall be responsible for any and all additional costs associated with the changes required by other trades.

1.7 WARRANTY/GUARANTEE

A. All work and materials are subject to the general warranty as described in the General Conditions of the Contract and in Division 1, General Requirements.

PART 2 – PRODUCTS

2.1 INLINE CEILING FAN

A. Inline ceiling fan shall consist of a rectangular steel cabinet enclosing a true centrifugal fan directly driven by an electric motor.

B. Cabinet shall be complete with an intake grille and discharge collar equipped with a backdraft damper, metal or plastic, gravity or spring return.

C. Motor and fan shall be conveniently removable with plug-in power chord.

D. The casing shall be sound attenuated, with minimum ½” thick acoustic lining.

E. Provide electronic speed controller, wall cap, roof terminal, metal grille, isolator package, time delay switch with adjustable relay as scheduled on the drawings.

F. Unit shall be AMCA certified.

G. Manufacturers: Loren-Cook, Penn Ventilator, Acme, Carnes, Greenheck, Breidert, Panasonic.

PART 3 – EXECUTION

3.1 FANS, EQUIPMENT AND ACCESSORIES

A. Install in accordance with manufacturer's details and instructions.

B. Mount fan speed control at the fan to facilitate mechanical balancing. Power wiring shall be part of the work of Division 26.

C. Perform field mechanical balancing in accordance with Section 230950: TESTING AND BALANCING OF MECHANICAL SYSTEMS.

D. Install units in accordance with manufacturer's installation instructions. Install units plumb and level, firmly anchored in locations indicated, and maintain manufacturer's recommended clearances.

END OF SECTION 230605

SECTION 230725

TERMINAL HEATING UNITS

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. The general provisions of the contract, including the conditions of the contract (General, Supplementary and other Conditions, if any) and Division 1 as appropriate, apply to the work specified in this section.

B. Refer to Section 230200 for HVAC General Provisions

C. Refer to Section 230210 for HVAC Basic Materials & Methods.

1.2 DESCRIPTION OF WORK

A. This Section includes work necessary and/or required and materials and equipment for construction of a complete system. Such work includes, but is not limited to the following:

1. Unit Heaters

1.3 REFERENCE STANDARDS

A. Refer to Section 230200 for a general description of requirements applying to this section.

1.4 QUALITY ASSURANCE

A. Refer to Section 230210 for a general description of requirements applying to this Section.

1.5 SUBMITTALS

A. Submit shop drawings in accordance with Section 230200.

B. Submit shop drawings and descriptive date for all equipment specified in this section.

1.6 SUBSTITUTIONS

A. The listed equivalent or substituted manufacturers along with the bidding related contractor shall be completely responsible to comply with all requirements on all contract documents. This shall include, but not limited to, space requirements, code clearances, the type, horsepower, capacities, number and size of services required from other trades, including all required ancillary items furnished and installed by other trades. If the manufacturer or related bidding contractor does not comply with these requirements, this Contractor shall be responsible for any and all additional costs associated with the changes required by other trades.

1.7 WARRANTY/GUARANTEE

A. All work and materials are subject to the general warranty as described in the General Conditions of the Contract and in Division 1, General Requirements.

PART 2 – PRODUCTS

2.1 UNIT HEATERS

A. Propeller type, direct drive, resilient-mounted motor, arranged for horizontal discharge, double-deflection louvers.

B. Tested at 400 psig hydrostatic and 200 psig air under water.

C. Enclosure shall be steel, cleaned, phosphated, primed and finished in baked enamel.

D. Manufacturers: Airtherm Manufacturing Co., American Air Filter, Embassy Industries, Daikin McQuay, Modine, Rittling, Sterling, Trane, Vulcan.

PART 3 – EXECUTION

3.1 INSPECTION

A. Examine areas and conditions under which equipment is to be installed. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to Installer.

3.2 INSTALLATION OF UNIT HEATERS

A. Install heaters in accordance with manufacturer's installation instructions.

B. Uncrate units and inspect for damage. Verify that nameplate data corresponds with unit designation.

C. Hang unit from building substrate.

D. Protect units with protective covers during balance of construction.

END OF SECTION 230725

SECTION 230950

TESTING & BALANCING OF MECHANICAL SYSTEMS

PART 1 – GENERAL

1.1 JOB CONDITIONS

A. Systems shall be completely installed and in continuous operation as required to accomplish the tests.

B. Heating, ventilating and air conditioning equipment shall be completely installed and in continuous operation as required to accomplish the balance work specified.

C. Adjust and balance shall be performed when outside conditions approximate design conditions indicated for heating and cooling functions.

D. Make at least two inspections of the mechanical systems during construction to verify that balancing procedures may be accomplished. Report findings to the Engineer.

E. Balancing firm shall balance Mechanical System two (2) times. The first time shall be considered a rough balance. Any discrepancy in air flow shall be addressed to the Engineer. The final balancing will be accomplished after review of rough balance reports.

F. The final balancing reports shall be submitted and approved prior to project's being considered complete; i.e., commencement of warranties.

1.2 ENGINEER QUALIFICATIONS

A. The firm shall be an independent organization having no affiliation with construction contractors, equipment sales or design engineering.

B. The firm shall specialize in balancing heating, ventilating and air conditioning systems.

C. The firm shall show proof of having balanced and tested at least five projects of similar size and scope.

D. All field work shall be under the direct supervision of a registered Professional Engineer who is a full-time employee of the balancing firm.

E. The firm shall be certified by and a member of the AABC (Associated Air Balance Council), or NEBB (National Environmental Balancing Bureau).

1.3 REPORT

A. Data Sheets:

1. Submit data sheets on each item of testing equipment required.

2. Include name of device, manufacturer’s name, model number, latest date of calibration and correction factors.

B. Report Forms:

1. Submit specimen copies of report forms.

2. Forms shall be 8-1/2 x 11 inch paper for loose-leaf binding, with blanks for listing of the required test ratings and for certification of report.

3. Reports shall be on standard forms published by AABC or NEBB.

PART 2 – PRODUCTS

2.1 AIR BALANCE INSTRUMENTS

A. Alnor Velometer with probes and alnor pitot tube.

B. Rotating Vane Anemometer: 4 inch size.

C. ASHRAE Standard Pitot Tubes, stainless steel 5/16 inch outside diameter, lengths 18 inches and 36 inches.

D. Magnehelic Differential Air Pressure Gauges, 0 to 0.5 inches, 0 to 1.0 inch and 0 to 5.0 inches water pressure ranges, each arranged as a portable unit for use with a standard Pitot tube.

E. Combination Inclined-Vertical Portable Manometer, range 0 to 5.0 inches water.

2.2 WATER BALANCING INSTRUMENTS

A. 30 Inch Mercury U-Tube Manometer, 200 psig, with 3 valve bypass assembly and return wells or mercury check valves.

B. Inspector's gauge testing set.

C. Water Differential Pressure Gauge, 4-1/2 inch dial, 0 to 100 psi range.

D. Pressure gauge measurement points, quick connect couplings, 1/4 inch psi.

2.3 SYSTEM PERFORMANCE MEASURING INSTRUMENTS

A. Insertion Thermometers, with graduation at 0.5 degrees F for air and 0.1 degrees F for water.

B. Sling Psychrometer.

PART 3 – EXECUTION

3.1 GENERAL REQUIREMENTS

A. Arrange and pay for all tests.

B. Notify Engineer at least three working days in advance of test and conduct in presence of Engineer.

C. Tests to be performed prior to insulation, covering or concealment.

D. Provide signed report of completion of test with signature of witnesses. Report shall indicate:

1. System Tested
2. Date
3. Specified test requirements and actual testing results

E. The balancing firm shall report to and review the work required with the Engineer before beginning field balance work. The balancing firm shall make at least two inspections of the air systems during construction and shall report his findings in writing to the Engineer.

F. The balancing firm shall cooperate with the Engineer and the Mechanical Contractor to effect smooth coordination of the balancing work with the job schedule.

G. The balancing firm shall be responsible for getting the various systems into proper operation. They shall enlist the aid of the equipment suppliers and Mechanical Contractor as may be required to effect proper operation consistent with the contract plans and specifications.

H. When the balancing firm cannot balance a belt-driven piece of equipment with the supplied belts and sheaves, inform the Mechanical Contractor that the Mechanical Contractor shall provide additional sheaves as spelled out in other Division 23 Sections.

3.2 CIRCULATING WATER SYSTEM TEST

A. All piping tests shall be applied not only to piping, but also to all devices and equipment connected thereto with the exception of control valves, boilers or any other equipment which may be damaged by the test pressure. All valves shall be full open.

B. Test at 100 psi hydrostatic pressure for 6 hours:

1. Record pressures each hour
2. Repair all leaks
3. Retest until 6 hours can be completed with no leaks or loss of pressure.

C. After completion of successful test, strainers shall be cleaned, then system shall be backflushed and strainers cleaned again.

3.3 DUCTWORK TESTING

A. Witness testing conducted by the Mechanical Contractor per Section 230600, PART 3: EXECUTION.

3.4 BALANCING PROCEDURE

A. Air System Balance:

1. With the fan exhaust system set to handle normal minimum air, the balancing firm shall perform the following tests and compile the following information:

Air Handling Equipment

a. Design Conditions:

(1) CFM Exhaust Air
(2) Static Pressure
(3) Fan RPM

b. Installed Equipment:

(1) Manufacturer
(2) Size/Model Number
(3) Motor HP, Voltage, Phase, Full Load Amperes

c. Field Test:

(1) Fan Speed
(2) No Load Operating Amperes
(3) Fan Motor Operating Amperes
(4) Calculated BHP

d. Test for Total Air:

(1) Size of discharge air ducts.
(2) Number and locations of Velocity Readings taken.
(3) Duct Average Velocity
(4) Total CFM

B. Water Balance:

1. Water balance shall include heating water. The balancing agency shall perform the following tests, compile data and submit reports.

2. Pumps:

a. Design Data

(1) GPM, head
(2) RPM, BHP

b. Installed Equipment

(1) Manufacturer, Size
(2) Type Drive
(3) Motor HP, Volts, Cycles and Phase
(4) Full Load Amperes

c. Field Test

(1) Discharge Pressures: Full flow & no flow
(2) Suction Pressures: Full flow & no flow

(3) Operating Head and GPM
(4) No Load Amperes (where possible)
(5) Full Flow Amperes, No Flow Amperes
(6) Calculated BHP

3. Heating Elements Including Loop Water to all terminal Units:

a. Design Data:
(1) MBH Specified, GPM Specified
(2) Entering Water Temperature (EWT)
(3) Entering Air Temperature (EAT)
(4) Water Temperature Drop (DTW)
(5) Element Type Specified

b. Field Test:
(1) Identify each element as to location
(2) Required water temperature drop corrected for item (3) above
(3) Actual entering air and water conditions (temperature and GPM)
(4) Adjust element until required temperature drop is obtained

C. In addition to the above work, the Balancing Firm shall check the operation of all automatic temperature control equipment; verify all thermostat, aquastat, etc., set-points and operations; and enlist the aid of the Mechanical Contractor and the Control Subcontractor to make necessary adjustments where required.

END OF SECTION 230950

SECTION 260000

GENERAL PROVISIONS – ELECTRICAL

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. The general provisions of the Contract, including the Conditions of the Contract (General, Supplementary and other conditions, if any) and Division 1 as appropriate, apply to the work of this Section.

B. The specification or drawing and the design features or resulting construction disclosed, are the property of Furlow Associates, Inc., and shall not be reproduced without written permission.

1.2 DESCRIPTION OF WORK

A. Provide all materials, equipment, labor, services and all appurtenances required to completely install and satisfactorily operate the various systems. The items listed below are for general guidance only and do not necessarily include the entire requirements for the project.

1. Coordination with other trades
2. Power wiring
3. Wiring devices
4. Connections for electrically operated equipment
5. Related work as herein described or otherwise defined under the heading "Related Work".

B. Wherever the term "provide" is used, it shall be understood to mean both "furnish" and "install".

1.3 RELATED WORK

A. Equipment specified in sections of Divisions 1 thru 23 that require electric power supply.

B. Work related to this trade as defined on the following contract drawings:

HVAC

1.4 SITE CONDITIONS

A. Attention of all bidders is called to the necessity for a careful inspection of the site, its present condition and encumbrances, the extent of the work, the protection to be afforded to adjacent properties or structure, availability of utilities, the extent and nature of the material required to be excavated and the amount of fill and removal. He shall also determine local or site limitations which will affect construction.

1.5 PERMITS, INSPECTIONS AND ORDINANCES

A. All work shall be executed and inspected in accordance with local and state ordinances, rules and regulations and the requirements of public utilities having jurisdiction. The contractor shall secure and pay for all permits, inspections and connections required.

B. The Electrical Contractor shall furnish a certificate of inspection to the Owner at the time of completion.

C. Requirements of the following organization shall be considered minimum:

1. National Electrical Code
2. National Electrical Safety Code
3. OSHA
4. Local City and County Codes

D. Reference to technical societies, trade organizations and governmental agencies are in accordance with the following:

1. ANSI - American National Standards Institute
2. ASTM - American Society for Testing Materials
3. IEEE - Institute of Electrical and Electronics Engineers, Inc.
4. NEC - National Electrical Code
5. NEMA - National Electrical Manufacturer's Association
6. NFPA - National Fire Protection Association
7. MSS - Manufacturer's Standardization Society
8. IES - Illuminating Engineers Society
9. ETL - Engineering Testing Laboratories
10. EIA - Electronic Industries Association
11. OSHA - Occupational Safety and Health Administration
12. Federal Specifications
13. UL - Underwriters Laboratories, Inc.

1.6 QUALITY ASSURANCE

A. Provide adequate supervision of labor force to assure that all aspects of the contract documents are fulfilled.

B. Testing:

1. After completion of the work, the entire wiring system shall test entirely free from grounds, short circuits, opens, overloads and improper voltage.

2. The grounding system shall be tested for a resistance of 25 ohms or less.

3. Perform testing as follows: Arrange and pay for all tests, provide all equipment, materials and labor to perform test. Notify Engineer and Owner three (3) working days before tests are to be made. Conduct tests in the presence of the Engineer or authorized representative. Repeat tests after defects are corrected.

C. Special Engineering Services: In the instance of complex specialized electrical power and signaling systems, and other similar systems, the installation and final connections of these

systems shall be made by and/or under the supervision of a competent installation and service engineer who shall be a representative of the respective equipment manufacturer. Any and all expenses of these installation and service engineers shall be borne by this Contractor.

1.7 COORDINATION

A. As a requirement of this project, the Electrical Contractor shall furnish coordination for his equipment and layouts with other subcontractors furnishing equipment and services for Divisions 1 thru 23. Any and all contractors who install their equipment or furnish services prior to coordination, any contractor who changes their equipment or services after coordination has occurred, without notifying associated subcontractors, shall be held responsible for making all required changes with no additional cost to the Owner. Or delay in construction time. This coordination will include conduit layout to allow access to equipment for maintenance.

B. The Mechanical, Plumbing and Electrical Contractors are responsible to coordinate all manufacturer's recommended circuit breakers, starters, disconnects and fuse sizes for all equipment. Submission of a shop drawing will certify that this has been completed.

C. The drawings and specifications reflect the type, number and size of services required for the equipment the design is based upon. Should the supplying subcontractor elect to furnish an alternate piece of equipment requiring difference services and/or space conditions, he shall inform the subcontractor furnishing those services and be held responsible to pay for all required changes as part of this contract.

1.8 SUBMITTALS

A. Shop Drawings:

1. Shop drawings shall be submitted in accordance with Division 1 of these specifications except where herein modified.

   NOTE: Submittals will only be reviewed once and resubmittals will be reviewed once. Any other submittals will be billed to the Contractor at the Engineer's standard rates.

2. Shop drawings comprising complete catalog cuts, performance test data for electrical equipment as required by other sections of Division 26 shall be submitted for review checking. The Contractor shall review these shop drawings for conformance to contract documents prior to submission and affix contractor's signature to each submittal certifying that this review has been done. By approving and submitting shop drawings, product data, wiring diagrams and similar materials, the Electrical Contractor represents that he and/or his subcontractor has determined and verified materials, field measurements and field construction data that relates to the work, and has checked and coordinated this information with all of the Divisions 1 thru 23 subcontractors.

3. All shop drawing submittals shall have the following identification data, as applicable, contained therein or permanently adhered thereto:

   a. Project name

b. Project number

c. Sub-Contractor's, Vendor's and/or manufacturer's name and address.

d. Product identification.

e. Identification of deviation from the contract documents.

f. Applicable contract drawings and specification section number.

g. Shop drawing title, drawing number, revision number, and date of drawing and revision.

h. Resubmit revised or additional shop drawings as requested.

i. Wherever shop drawings or vendor's standard data sheets indicate work to be done "by others", it shall be the responsibility of the Contractor making the submission to identify by name, the Contractor who is to do this work. If the Contractor named is other than the Contractor making the submission, the shop drawing submission must be reviewed by the named Contractor and bear his mark of approval, prior to submission to the Architect/Engineer.

j. Where equipment proposed differs from that shown on the drawings or specified, he shall submit for approval drawings showing the manner in which the layout is affected by the substitution.

k. The Contractor shall keep one copy of approved shop drawings at the job site, filed in a suitable metal container. The shop drawings shall be cataloged and kept in good repair, and shall be available for use by the Owner, Architect and Engineer.

l. No equipment shall be ordered, fabricated, etc., before approval of shop drawings.

1.9 SUBSTITUTIONS

A. Whenever a material, article, piece of equipment or system is identified in the following specification or indicated on the drawings by reference to manufacturers' or vendors' names, trade names, catalog numbers or the like, it is so identified for the purpose of establishing the basis of the Bid.

B. Substitution approval must be obtained and included as an addendum item prior to the submission of the bid. An approved substitution shall not be considered as an approval for the contractor or an equipment vendor to deviate from the written portion of the specifications unless so stated in the addendum.

C. The drawings illustrate the space allocated for equipment and the Contractor shall install the equipment accordingly. If changes are required in the building or arrangement due to substitution of equipment, the Contractor making the substitution must pay for the necessary modifications.

D. The listed equivalent or substituted manufacturers along with the bidding related contractor shall be completely responsible to comply with all requirements on all contract documents. This shall include, but shall not be limited to space requirements, code clearances, the type,

horsepower, capacities, number and size of services required from other trades, including all required ancillary items furnished and installed by other trades. If the manufacturer or related bidding contractor does not comply with these requirements, then they shall be responsible for any and all additional costs associated with the changes required by other trades.

1.10 LUBRICATION

A. Furnish, install and maintain all required lubrication of any equipment operated prior to acceptance by the Owner. Lubrication shall be as recommended by the equipment manufacturer.

B. Provide one year's supply of lubricants to Owner at date of acceptance.

C. Verify that required lubrication has taken place prior to any equipment start-up.

1.11 ADJUSTMENT & CLEANING

A. Adjust and clean equipment to be placed in proper operation condition.

1.12 EQUIPMENT START-UP

A. Verify proper installation by manufacturer or his representative.

B. Advise General Contractor 2 days prior to actual start-up.

C. Verify proper operation. Obtain signed statement by manufacturer or his representative that equipment is operating within warranty requirements. Submit statement to General Contractor.

1.13 OPERATION AND MAINTENANCE INSTRUCTIONS

A. Properly and fully instruct Owner's personnel in the operation and maintenance of all systems and equipment.

B. Insure that the Owner's personnel are familiar with all operations to carry on required activities.

C. Such instruction shall be for each item of equipment and each system as a whole.

D. Provide report that instruction has taken place. Include in the report the equipment and/or systems instructed, date, contractor, Owner's personnel, vendor, and that a complete operating and maintenance manual has been reviewed.

E. Manual shall include all instructions on operation, maintenance, repair parts list, lubrication requirements, brochures, catalogue cuts, wiring diagrams, piping diagrams, control sequences, service requirements, names and addresses of vendors, suppliers and emergency contacts. Three manuals shall be provided.

F. Submit manuals for review prior to operating instruction period. Manuals shall be 8-1/2 x 11" with hard cover, suitably bound.

1.14 TOOLS

A. All equipment furnished by the Contractor which requires special tools or devices other than those normally available to the maintenance or operating staff shall be furnished in duplicate to the Owner, sufficiently marked, packed or boxed for staff usage. The tools provided shall be listed by the Contractor identified as to their use or the equipment applicable in a written transmittal to the Owner.

1.15 CLEANING AND FINISHING

A. After equipment start-up and all operating tests have been made and the system pronounced satisfactory, each respective Contractor shall go over the entire project, clean all equipment, etc., installed by him and leave in a clean and working condition. Any surfaces found marred after this final cleaning shall be refinished or replaced by each Contractor at no cost to the Owner.

1.16 OPERATING AND MAINTENANCE MANUALS

A. Three complete sets of instructions containing the manufacturer's operating and maintenance instructions for each piece of equipment shall be furnished to the Architect. Each set shall be furnished before the contract is completed. The following identification shall be inscribed on the covers: the words "OPERATING AND MAINTENANCE INSTRUCTIONS", the name and location of the building, the name of the Contractor and the name of the Architect and Engineer. Flysheet shall be placed before instructions covering each subject. The instruction sheets shall be approximately 8-1/2 by 11 inches, with large sheets of drawings folded in. The instructions shall include, but shall not be limited to, the following:

Approved wiring and control diagrams, with data to explain the detailed operation and control of each component.

A control sequence describing start-up, operation and shutdown.

Operating and maintenance instructions for each piece of equipment, including lubrication instructions.

Manufacturer's bulletins, cuts and descriptive data.

Parts lists and recommended spare parts.

1.17 SERVICE INTERRUPTION

A. All service interruptions to the electric or related systems, whether during regular working hours or at any other time, must be coordinated with the Owner. All such interruptions shall be so scheduled and planned as to require a minimum of time and shall occur only during a mutually satisfactory period.

1.18 INTERPRETATION OF SYSTEMS

A. The interpretation of the Architect will be final in the event there is a lack of understanding of the full scope or requirements of the systems under this contract.

1.19 LAYOUTS

A. On small scale drawings, i.e., 1/8" - 1'-0", the approximate location of the electrical branch circuit items such as receptacle, telephone, grounding and equipment outlets are shown to indicate their existence. The exact location of these items and their related raceways are governed by structural conditions, coordination with the work of other trades and the Architect's final decision. By accepting a contract, the Contractor agrees to install the work in accordance with the above statement and within the contract price.

PART 2 – PRODUCTS

2.1 MATERIAL

A. All material shall be new and of good quality. Material shall conform to all accepted trade standards, codes, ordinances, regulations, or requirements governing same, and shall be approved before being installed.

B. The Architect reserves the right to require the Contractors to submit samples of any or all articles or materials to be used on the project.

C. Where any device or equipment is herein referred to in the singular number, such as "the panel", this reference shall be deemed to apply to as many such devices or equipment as are required to complete the installation as shown on the drawings or specified.

D. All materials and equipment used in the work shall comply with the standards of recognized authorities such as UL, NEMA, IEEE, ETL, IES and EIA in every instance where such standards have been established for the particular type of materials to be installed.

E. All similar pieces of equipment or materials of the same type or classification used for the same purpose shall be of the same manufacturer.

F. All manufactured equipment shall have factory applied finishes.

2.2 WARRANTY

A. Wherever in the specification sections of this division, reference is made to a specific warranty period, this warranty shall be in addition to and not a limitation of other rights the Owner may have against the Contractor under the contract documents.

PART 3 – EXECUTION

3.1 INSPECTION

A. Prior to performing the work, examine areas and conditions; check and verify all dimensions, under which the work is to be installed and notify the Architect in writing of conditions and dimensions detrimental to the proper and timely completion of the work. Do not proceed until authorization is given by the Architect.

3.2 LAYING OUT WORK

A. The Contractor is responsible for the accuracy of all lines, elevations, and measurements, grading and utilities and must exercise proper precaution to verify figures shown on drawings

before laying out work and will be held responsible for any error resulting from his failure to exercise such precaution.

3.3 WORKMANSHIP

A. Install all work neat, trim, parallel and plumb with building lines in accordance with standard trade practice acceptable to the Architect.

3.4 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Protect all equipment and materials from damage during transportation, storage and installation.

3.5 PROTECTION

A. Protect all work, equipment and materials during construction up to the time of acceptance by the Owner.

Arrange and design the protection to prevent damage from infiltration or dust, debris, moisture, chemicals and water. Cap or plug electrical raceways.

B. Protect all surfaces against damage from welding, cutting, burning, or similar construction functions. This protection shall be accomplished by care in operations, covering and shielding. Special care is directed to exposed finished masonry, metal or wood surfaces and painted surfaces. Corrective measures required shall be accomplished by the trade which made the original installation when and as directed by the Architect at the expense of the Contractor.

C. Cover and protect all lighting fixtures as may be necessary until completion of the work. Replace damaged fixtures or damaged fixture parts as directed by the Architect at no cost to the Owner.

D. Do not install devices, polished metal fittings or parts until adjoining tile or masonry work is completed.

E. Maintain and replace protective covering when so directed by the Architect until the work is ready for acceptance.

3.6 CUTTING & PATCHING

A. Furnish information to the General Contractor as to sizes and locations of recesses required to install panel boxes and other equipment or devices. If the information is late or incorrect, this Contractor shall, at his own expense, have the trade which originally installed the work do the required cutting and patching.

B. Perform all cutting of concrete or other material for passage of raceways as required to install the work.

C. Close all such openings around raceways with material as specified under the heading "SEALING".

D. Install concealed work in place for the mason to wall-in as he carries up the walls; otherwise, this Contractor will be responsible as stated in the first paragraph.

3.7 SEALING

A. Where raceways pass through fire-rated walls and floors, seal opening with RTV foam.

B. Seal raceways entering the building to conform to the requirements of the NEC.

3.8 OFFSETS AND MODIFICATIONS

A. Furnish and install all offsets necessary to install the work and to provide clearance for the work of other trades.

B. Maintain adequate clearance as directed by the Architect/Engineer.

C. Incidental modifications necessary to the installation shall be made as necessary and at the direction and/or approval of the Architect.

3.9 SLEEVES

A. Furnish and install sleeves for all raceways passing through floors and walls. Sleeves shall be Schedule 40 galvanized steel pipe and shall extend 1" above finished floor surface. Where sleeves are set in interior walls, they shall finish flush with the wall.

B. Furnish and install watertight sleeves for all raceways extending through foundation walls into crawl spaces, mechanical rooms or basement areas from building exterior or from unexcavated areas to building interior. Sleeve shall consist of extra heavy pipe sleeve with anchor flange. Space between raceway and the sleeve shall be sealed with modular wall and casing seal similar to Thunderline Corporation "Link-Seal",, Metraseal or approved substitute. Install seal in strict accordance with the manufacturer's recommendations.

3.10 PAINTING

A. Refinish all factory applied finishes that have been damaged to match the original finish as directed by the Architect.

B. Prime coat all steel furnished under this Division with material and methods as described in another Section under the heading "PAINTING".

3.11 EQUIPMENT CONNECTIONS

A. Provide required wiring, raceways and final connections for all equipment provided by this Division and Divisions 1 thru 23.

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B. Make final connections in accordance with wiring diagrams obtained from equipment manufacturer.

C. Rough-in in accordance with approved shop drawings from the manufacturer or supplier of the equipment. Rough-in prior to shop drawing approval will be subject to change without adjustment to contract cost.

3.12 BALANCING

A. The system of feeder and branch circuits for power and lighting shall be connected to panel busses in such a manner as to electrically balance the connected load as close as is practicable. Should the Owner disclose any unfavorable conditions reacting on the service, this Contractor shall make such changes as may be suggested to balance the load.

3.13 GUARANTEE

A. All work shall be guaranteed to be free from defects for a period of one year of operation from date of acceptance by the Owner unless otherwise specified in Division 1.

B. Guarantee shall be extended on an equal time basis for all non- operational periods due to failure within the guarantee period.

END OF SECTION 260000

SECTION 260055

ELECTRICAL IDENTIFICATION

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. This section is a Division 26 Basic Materials and Methods Section, and is part of each Division 26 Section making reference to electrical identification specified herein.

1.2 DESCRIPTION OF WORK

A. Types of electrical identification specified in this section include the following:

Cable conductor identification.
Operational instructions and warnings.
Danger signs.
Equipment/system identification signs.

PART 2 – PRODUCTS

2.1 MANUFACTURERS

A. Subject to compliance with requirements, provide products of one of the following (for each type of marker):

W. H. Brady Co.
Ideal Industries, Inc.
Seton Name Plate Co.
3M Electrical Products

2.2 ELECTRICAL IDENTIFICATION MATERIALS

A. Provide manufacturer's standard products of categories and types required for each application. Where more than single type is specified for an application, selection is Installer's option, but provide single selection for each application.

2.3 COLOR-CODED PLASTIC TAPE

A. Provide manufacturer's standard vinyl tape not less than 7 mils thick by 3/4" wide.

B. Colors: Unless otherwise indicated or required by governing regulations, provide tape color as indicated in Paragraph 3.2.B.

C. Tape shall be of Type 3M Scotch 35 for color coding, Scotch Super 33+ for splices and Tem Flex 1700 for general use.

2.4 CABLE/CONDUCTOR IDENTIFICATION BANDS

A. Provide manufacturer's standard vinyl cloth, self-adhesive cable/conductor markers of

wrap-around type; either pre-numbered, plastic-coated type, or write-on type with clear plastic, self-adhesive cover flap; numbered to show circuit identification.

2.5 BAKED ENAMEL DANGER SIGNS

A. Provide manufacturer's standard "DANGER" signs of baked enamel finish on 20-gage steel; of standard red, black and white graphics; 14" x 10" size except where 10"x 7"is the largest size which can be applied where needed, and except where larger size is needed for adequate vision; with recognized standard explanation wording (as examples: HIGH VOLTAGE, KEEP AWAY, BURIED CABLE, DO NOT TOUCH SWITCH).

2.6 ENGRAVED PLASTIC-LAMINATE SIGNS

A. Provide engraved stock melamine plastic laminate, in sizes and thicknesses indicated, engraved with engraver's standard letter style of sizes and wording indicated, punched for mechanical fastening except where adhesive mounting is necessary because of substrate.

B. Thickness: 1/16" for units up to 20 sq. in. or 8" length; 1/8" for larger units.

C. Fasteners: Self-tapping stainless steel screws, except contact-type permanent adhesive where screws cannot or should not penetrate substrate.

2.7 LETTERING AND GRAPHICS

A. Coordinate names, abbreviations and other designations used in electrical identification work, with corresponding designations shown, specified or scheduled. Provide numbers, lettering and wording as indicated or, if not otherwise indicated, as recommended by manufacturers or as required for proper identification and operation/maintenance of electrical systems and equipment.

PART 3 – EXECUTION

3.1 APPLICATION AND INSTALLATION

A. Coordination: Where identification is to be applied to surfaces which require finish, install identification after completion of painting.

B. Regulations: Comply with governing regulations and requests of governing authorities for identification of electrical work.

3.2 CABLE/CONDUCTOR IDENTIFICATION

A. Apply cable/conductor identification on each cable and conductor in each box/enclosure/cabinet where wires of more than one circuit or communication/signal system are present. Match identification with marking system used in panelboards, shop drawings, contract documents, and similar previously established identification for project electrical work.

B. Conductor Color Coding:

1. All conductors used in all systems shall have insulation that is inherently colored. All conductors of a system performing the same function shall be colored alike throughout the project.

2. Equipment Grounding Conductors:

   a. Standard and/or general feeders or circuits shall be green.
   b. Isolated feeders or circuits shall be green with yellow stripe.

3. On larger conductors, where colored insulation is not available, colored tape adhesive vinyl bands 3/4" width may be installed 6" maximum from the end of the conductors. Where passing through pull boxes without splice, each conductor shall be banded.

4. Power system conductor colors shall be as follows:

   a. 120/208 Volt System

      Phase A - Black
      Phase B - Red
      Phase C - Blue
      Neutral - White or Gray

3.3 DANGER SIGNS

A. In addition to installation of danger signs required by governing regulations and authorities, install appropriate danger signs at locations indicated and at locations subsequently identified by Installer of electrical work as constituting similar dangers for persons in or about project.

B. High Voltage: Install danger signs wherever it is possible, under any circumstances, for persons to come into contact with electrical power voltages higher than 110-120 volts.

3.4 EQUIPMENT/SYSTEM IDENTIFICATION

A. Install engraved, plastic laminate sign on each major unit of electrical equipment in building, including central or master unit of each electrical system including communication/signal systems, unless unit is specified with its own self-explanatory identification or signal system. Except as otherwise indicated, provide single line of text, 1/2" high lettering on 1-1/2" high sign (2" high where 2 lines are required), white lettering in black field. Provide text matching terminology and numbering of the contract documents and shop drawing. Provide signs for each unit of the following categories of electrical work:

   1. Panelboards, electrical cabinets and enclosures.
   2. Access panel/doors to electrical facilities.
   3. Major electrical switchgear, main and feeder circuit breakers and/or disconnects..

B. Install signs at locations for best convenience of viewing without interference with operation and maintenance of equipment. Secure to substrate with fasteners, except use adhesive where fasteners should not or cannot penetrate the substrate.

3.5 JUNCTION AND PULL BOX IDENTIFICATION

A. Emergency Systems: Each junction and pull box cover shall be painted orange. Use black indelible liquid marker to label "EMERG." in 3/8" letters minimum.

B. Fire Alarm System: Each junction and pull box cover shall be painted red. Use black indelible liquid marker to label "F.A." in 3/8" letters minimum.

C. Feeders Shown on Single Line Diagram: Each junction and pull box shall be marked with black indelible liquid marker with the assigned feeder number "FDR #38" in 3/8" letters minimum.

END OF SECTION 260055

SECTION 260110

RACEWAYS

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. The general provisions of the Contract, including the Conditions of the Contract (General, Supplementary and other conditions, if any) and Division 1 as appropriate, apply to the Work specified in this Section.

B. Refer to Section 260000 for General Provisions - Electrical.

1.2 DESCRIPTION OF WORK

A. Types of raceways in this section include the following:

Rigid metal conduit
Intermediate metal conduit
Electrical metallic tubing.
Polyvinyl chloride conduit (Exterior Underground Only)
Flexible metal conduit.
Liquid-tight flexible metal conduit.

1.3 REFERENCE STANDARDS

A. Refer to Section 260000 for a general description of requirements applying to this Section.

1.4 QUALITY ASSURANCE

A. Refer to Section 260000 for a general description of requirements applying to this Section.

1.5 WARRANTY/GUARANTEE

A. All work and materials are subject to the general warranty as described in the General Conditions of the Contract and in Division 1, GENERAL REQUIREMENTS.

1.6 COORDINATION

A. The drawings and details there upon are scheme and/or diagrammatic in nature, and indicate the need and intent of the design. These are to be used for general guidance only. It shall be the responsibility of the Electrical Contractor to coordinate, with other Division Subcontractors, the installation of all raceways, raceway supports, junction boxes and required fittings. This coordination will include conduit layout to allow access to equipment for maintenance.

B. This coordination shall be carried out prior to actual installation; this shall be done to eliminate the possibility of conflicts between trades on items such as access, clearances and maintenance issues that may arise after completion of construction.

C. Should the coordination not be carried out prior to installation, and a conflict exists, the installing contractor shall remove and reinstall the equipment as required to clear the conflict at no additional cost to the Owner and no delay in project completion.

PART 2 – PRODUCTS

2.1 MATERIALS AND EQUIPMENT

A. Rigid Metal Conduit:

1. Raceway: Full weight, heavy wall rigid steel with zinc coating conforming to ANSI-C80.1.

2. Fittings: Cast malleable iron fittings with threaded hubs, insulated throat and zinc protective coating.

3. Subject to compliance with requirements, provide products of one of the following:

   Allied Tube and Conduit Corporation
   LTV Steel Tubular Products Co.
   Wheatland Tube

B. Intermediate Metal Conduit:

1. Raceway: Light weight, rigid steel, hot dipped galvanized manufactured in accordance with UL1242.

2. Fittings: Cast malleable iron fittings with threaded hubs, insulated throat and zinc protective coating.

3. Subject to compliance with requirements, provide products of one of the following:

   Allied Tube and Conduit Corporation
   LTV Steel Tubular Products Co.
   Wheatland Tube

C. Electrical Metallic Tubing:

1. Raceway: Light weight, thin wall, rigid steel, hot dipped galvanized manufactured in accordance with ANSI C80.3.

2. Fittings: Raintight, insulated throat, compression type with zinc protective coating.

3. Subject to compliance with requirements, provide products of one of the following:

   Allied Tube and Conduit Corp.
   LTV Steel Tubular Products Co.
   Wheatland Tube Co.

D. Polyvinyl Chloride Conduit:

1. Raceway: Heavy wall, rigid non-metallic, schedule 40 with bell type end, designed for above ground exposed applications, direct earth burial, and concrete encasement.

2. Fittings: Polyvinyl chloride, heavy duty, glue type, designed for Schedule 40 application.

3. Subject to compliance with requirements, provide products of one of the following:

   Allied Tube & Conduit
   Carlon
   Queen City Plastics, Inc.
   Scepter Electric Systems

E. Flexible Metal Conduit:

1. Raceway: Construct of single strip, flexible, continuous, interlocked, and double-wrapped steel, galvanized inside and outside.

2. Fittings: Steel, insulated throat, with zinc protective coating.

3. Subject to compliance with requirements, provide products of one of the following:

   AFC
   Alflex Corp.
   Electri-Flex Company

F. Liquid-Tight Flexible Metal Conduit:

1. Raceway: Construct of single strip, flexible, continuous, interlocked, and double-wrapped, galvanized inside and outside, coat with liquid-tight jacket of flexible polyvinyl chloride.

2. Fittings: Steel, water and oiltight, insulated throat, with zinc protective coating.

3. Subject to compliance with requirements, provide products of one of the following:

   AFC
   Alflex Corp.
   Electri-Flex Company

G. The above items shall include the statement "Approved Equal" and/or "Approved Substitute". This statement requires that the product or item be in compliance with the written intent of this specification and the submission meets the requirements of Section 260000.

PART 3 – EXECUTION

3.1 INSTALLATION OF ELECTRICAL RACEWAYS

A. Install electrical raceways in accordance with manufacturer's written instructions, applicable requirements of NEC and NECA "Standard of Installation", and complying with recognized industry practices.

B. Coordinate with other work as necessary to interface installation of electrical raceways, wireways and required components.

C. Raceways used for distribution, feeders, or branch circuits shall be a minimum size of 3/4" or equal equivalent cross-sectional area. Raceways used for control and signal shall be a minimum size of 1/2" or equal equivalent cross-sectional area.

D. All raceways installed in ceiling cavities and exposed within mechanical spaces shall be run parallel with building lines and installed level and square at the proper elevation/height.

E. Complete the installation of electrical raceways before starting the installation of cables/wires within the raceway.

F. Furnish and install one (1) nylon or fiberglass pull cord in each empty raceway. Each empty raceway shall be cleaned, capped, and tagged as to its termination location.

G. Install liquid-tight flexible metal conduit for connections to motors and for other electrical equipment when subject to movement and vibration, and also where subjected to one or more of the following conditions:

1. Exterior locations.
2. Moist or humid atmosphere when condensation can be expected to accumulate.
3. Corrosive atmosphere.
4. Subjected to water spray.
5. Subjected to dripping oil, grease or water.

H. Install Electrical Metallic Tubing for building interior electrical work except:

1. Underground
2. In gravel, cinder, concrete or other sub-base floor construction.
3. Horizontal runs in concrete floor slabs.
4. Where exposed to the elements.
5. In masonry construction below finished grade.
6. Vertically in poured concrete walls.

I. Where and whenever possible, install horizontal electrical raceways as tight to building construction as possible and above water, drain and steam piping. A separation of at least six (6) inches shall be maintained between electrical conduits and hot water and steam piping.

J. In accordance with NEC requirements, install Rigid or Intermediate Metal Conduit where Electrical Metallic Tubing is not permitted.

3.2 CLEANING

A. Upon completion of installation of raceways, inspect interiors of raceways; remove burrs, dirt and construction debris.

END OF SECTION 260110

SECTION 260120

WIRES AND CABLES

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. This section is a Division 26 Basic Materials and Methods section and is part of each Division 26 Section making reference to wires and cables specified herein.

1.2 DESCRIPTION OF WORK

A. Electrical wire and electrical cable work is indicated by drawings and specifications.

B. Types of wire, cable and connectors in this section include, but not limited to the following:

Copper conductors.
Tap type connectors.
Split-bolt connectors.

C. Refer to other sections of Division 26 for, but not limited to, raceways, connections used in conjunction with wire and cable work.

D. Applications for wire, cable and connectors required for project are as follows unless otherwise indicated:

1. Power Distribution Circuitry.
2. Appliance and Equipment Circuitry.
3. Motor Branch Circuitry.
4. Control Circuitry.

PART 2 – PRODUCTS

2.1 MANUFACTURERS

A. <u>Wire and Cable</u>

Anaconda Wire and Cable Co.
Advance Wire and Cable, Inc.
American
Cerro Wire and Cable Co.
Electrical Conductors, Inc.
General Cable Corp.
Rome Cable Corp.
Southwire Company
Triangle PWC,, Inc.
General Electric Co.

Connectors

Burndy Corp.
Eagle Electric Mfg. Co., Inc.
Gould, Inc.
Ideal Industries, Inc
Joslyn Mfg. and Supply Co.
O-Z/Gedney Co.
Pyle National Co.
Thomas and Betts Co.

2.2 WIRE, CABLE AND CONNECTIONS

A. Except as otherwise indicated, provide wire, cable and connectors of manufacturer's standard materials, as indicated by published product information; designed and constructed as recommended by manufacturer, and as required for the installation. Minimum wire and cable size is #12 AWG for power and branch circuits and #14 AWG for control and signal/communication circuits unless otherwise indicated.

B. Wire: Provide factory fabricated wire of sizes, ratings, materials and types indicated for each service. Where not indicated, provide proper selection as determined by Installer to comply with project's installation requirements and NEC standards. Select from the following types, materials, conductor configurations, insulation and coverings:

UL Type: THHN
UL Type: TW
UL Type: THW
UL Type: THWN
UL Type: TF
UL Type: XHHW

Material: Copper

Conductors: Solid (AWG 14 to AWG 10 only).
Conductors: Concentric-lay-stranded (standard flexibility)

Outer Covering: Nylon
Outer Covering: Thermoplastic

C. Connectors: Provide factory fabricated metal connectors of sizes, ratings, materials, types and classes as required for each service. Where not indicated, provide proper selection as determined by Installer to comply with installation requirements and NEC standards. Select from the following types, classes, kinds and styles.

Type: Pressure
Type: Crimp
Type: Threaded

Class: Insulated
Class: Non-insulated

Kind: Copper (for CU to Cu connection).

Style: Butt connection
Style: Elbow connection
Style: Combined "T" and straight connection
Style: "T" connection.
Style: Split-bolt parallel connection
Style: Tap connection
Style: Pigtail connection

PART 3 – EXECUTION

3.1 INSTALLATION

A. Install electrical cables, wires and connectors, in compliance with manufacturer's written instructions, applicable requirements of NEC and NECA's "Standard of Installation", and in accordance with recognized industry practices.

B. Coordinate cable and wire installation work with electrical raceway and equipment installation work, as necessary for proper interface. Pull conductors together where more than one is being installed in a raceway. Use pulling compound or lubricate, where necessary; compound must not deteriorate conductor or insulation. Use pulling means including fish tape, cable or rope which cannot damage raceway. Rope must be used as pulling means when pulling wires or cables into plastic conduit and duct. Keep conductor splices to a minimum and install in junction boxes only. No splices shall be permitted within conduit. Install splices and tapes which have mechanical strength and insulation rating equivalent or better than conductor. Use splice and tape connectors which are compatible with conductor material.

3.2 FIELD QUALITY CONTROL

A. Prior to energization, test cable and wire for continuity of circuitry and also for short circuits. Correct malfunctions when detected.

B. Subsequent to wire and cable hook-ups, energize circuitry and demonstrate functioning in accordance with requirements.

END OF SECTION 260120

SECTION 260121

WIRE CONNECTIONS AND DEVICES

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. This section is a Division 26 Basic Materials and Methods Section and is part of each Division 26 Section making reference to connectors and termination devices specified herein.

1.2 DESCRIPTION OF WORK

A. Extent of electrical connectors and termination work is indicated by drawings and specifications.

B. Types of connectors and termination devices in this section include, but are not limited to the following:

1. Tap type connectors.
2. Split-bolt connectors.

C. Refer to other sections of Division 26 for, but not limited to, raceways, wires and cables used in conjunction with connectors and termination devices.

D. Applications for connectors and termination devices required for project are as follows unless otherwise indicated:

1. Branch circuitry
2. Equipment circuitry
3. Control circuitry

1.3 SUBMITTALS

A. Product Data: Submit manufacturer's data on electrical connectors, high voltage termination to the Engineer.

PART 2 – PRODUCTS

2.1 MANUFACTURERS

A. Subject to compliance with requirements, provide connectors, high voltage terminations of one of the following manufacturers for each item used:

Burndy Corp.
Eagle Electric Mfg. Co., Inc.
Gould, Inc.
Ideal Industries, Inc.
Joslyn Mfg. and Supply Co.
O-Z/Gedney Co.

Pyle National Co.
Thomas and Betts Co.
Cooper Power Systems

2.2 CONNECTORS

A. Provide factory fabricated metal connectors of sizes, ratings, materials, types and classes as indicated for each service. Where not indicated, provide proper selection as determined by Installer to comply with installation requirements and NEC standards.

Type: Pressure
Crimp
Threaded

Class: Insulated
Non-Insulated

Kind: Copper (for CU to Cu connection).

Style: Butt Connection
Elbow connection
Combined "T" and straight connection
"T" connection
Split-bolt parallel connection
Tap connection
Pigtail connection

PART 3 – EXECUTION

3.1 600 VOLT CABLE CONNECTOR INSTALLATION

A. Install electrical connectors, in compliance with manufacturer's written instructions, applicable requirements of NEC and NECA's "Standard of Installation", and in accordance with recognized industry practices.

B. Coordinate cable, wire and connector installation work with electrical raceway and equipment installation work, as necessary for proper interface. Pull conductors together where more than one is being installed in a raceway. Use pulling compound or lubricate, where necessary, compound must not deteriorate conductor of insulation, and must be in accordance with wire and cable manufacturer's recommendations. Use pulling means including fish tape, cable or rope which shall not damage raceways including plastic conduits and ducts.

3.2 HIGH VOLTAGE TERMINATION INSTALLATION

A. Install high voltage terminations in compliance with manufacturer's written instructions, applicable requirements of NEC and NECA's "Standard of Installation", and in accordance with recognized industry practices.

B. Coordinate terminations with cable, raceway and equipment installation work, as necessary for proper interface. Contractor shall coordinate termination kits with the size, type and style of high voltage cable being installed, in accordance with cable and termination manufacturer's written instructions and recommendations.

3.3 FIELD QUALITY CONTROL

A. Prior to energization, test cable and wire for continuity of circuitry and also for short circuits. Correct malfunctions when detected.

B. Subsequent to wire and cable hook-ups, energize circuitry and demonstrate functioning in accordance with requirements.

END OF SECTION 260121

SECTION 260135

ELECTRICAL BOXES & FITTINGS

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. This section is a Division 26 Basic Materials and Methods section, and is a part of each Division 26 section making reference to electrical wiring boxes and fittings specified herein.

1.2 DESCRIPTION OF WORK

A. Types of electrical boxes and fittings in this section include the following:

Outlet boxes.
Junction boxes.
Pull boxes.
Conduit bodies.
Bushings.
Locknuts.
Knockout closures.

PART 2 – PRODUCTS

2.1 INTERIOR METALLIC OUTLET BOXES

A. Provide galvanized flat rolled sheet steel interior outlet non-gangable wiring boxes, of types, shapes and sizes, including box depths, to suit each respective location and installation; construct with stamped knockouts in back and sides and with threaded screw holes with corrosion-resistant screws for securing box covers and wiring devices.

B. Provide outlet box accessories as required for each installation, including mounting brackets, wallboard hangers, extension rings, fixture studs, cable clamps and metal straps for supporting outlet boxes, which are compatible with outlet boxes being used and fulfilling requirements of individual wiring situations. Choice of accessories is Installer's option.

C. Manufacturer: Subject to compliance with requirements, provide interior outlet boxes of one of the following:

Appleton Electric Co.
Bell Electric/Square D Co.
Pass and Seymour, Inc.
RACO, Inc.
Steel City/Midland-Ross Corp.

2.2 WEATHERPROOF OUTLET BOXES

A. Provide corrosion resistant cast-metal weatherproof outlet wiring boxes, of types, shapes and sizes, including depth of boxes, with threaded conduit ends, cast-metal face plates with spring-hinged waterproof caps suitably configured for each application, including face plate

gaskets and corrosion-resistant fasteners.

B. Manufacturer: Subject to compliance with requirements, provide weatherproof outlet boxes of one of the following:

Arrow-Hart Div., Crouse-Hinds Co.
Bell Electric/Square D Co.
Harvey Hubbell, Inc.
O-Z/Gedney Co.
Slater Electric Co.

2.3 JUNCTION PULL BOXES

A. Provide galvanized code-gauge sheet steel junction and pull boxes, with screw-on covers; of types, shapes and sizes, to suit each respective location and installation; with welded seams and equipped with stainless steel nuts, bolts, screws and washers.

B. Manufacturers: Subject to compliance with requirements, provide junction and pull boxes of one of the following:

Adalet-PLM Div., Scott and Fetzer Co.
Appleton Electric Co.
Arrow-Hart Div., Crouse-Hinds Co.
Bell Electric/Square D Co.
GTE Corporation
Keystone Columbia, Inc.
O-Z/Gedney Co.
Slater Electric Co.
Spring City Elect. Mfg. Co.

2.4 CONDUIT BODIES

A. Provide galvanized cast-metal conduit bodies, of types, shapes, and sizes, to suit respective locations and installation, construct with threaded-conduit-entrance ends, removable covers, and corrosion- resistant screws.

B. Manufacturers: Subject to compliance with requirements, provide conduit bodies of one of the following:

Appleton Electric Co.
Crouse-Hinds Co.
Gould, Inc.
Killark Electric Mfg. Co.
O-Z/Gedney Co.
Spring City Electrical Mfg. Co.

2.5 BUSHINGS, KNOCKOUT CLOSURES AND LOCKNUTS

A. Provide corrosion-resistant punched-steel box knockout closures, conduit locknuts and insulated malleable iron conduit bushings, offset connectors, of types and sizes to suit respective uses and installation.

B. Manufacturers: Subject to compliance with requirements, provide bushings, knockout closures, locknuts and connectors of one of the following:

Appleton Electric Co.
Burndy Corp.
Crouse-Hinds Co.
Gould, Inc.
O-Z/Gedney Co.
RACO, Inc.
Steel City/Midland-Ross Corp.
Thomas and Betts Co., Inc.

PART 3 – EXECUTION

3.1 INSTALLATION OF ELECTRICAL BOXES AND FITTINGS

A. Install electrical boxes and fittings, complying with manufacturer's written instructions, applicable requirements of NEC and NECA's "Standard of Installation", and in compliance with recognized industry practices to ensure that products fulfill requirements.

B. Coordinate installation of electrical boxes and fittings with wire/cable and raceway installation work.

C. Provide weatherproof outlets for interior and exterior locations exposed to weather or moisture.

D. Provide knockout closures to cap unused knockout holes where blanks have been removed.

E. Install boxes and conduit bodies in those locations to ensure ready accessibility of electrical wiring.

F. Avoid using round boxes where conduit must enter box through side of box, which would result in difficult and insecure connections when fastened with locknut or bushing on rounded surface.

G. Fasten boxes rigidly to substrates or structural surfaces to which attached, or solidly embed electrical boxes in concrete or masonry.

H. Provide electrical connections for installed boxes.

I. Pull boxes and junction boxes shall be furnished and installed in all conduit runs at intervals not exceeding 100 feet maximum.

J. Identify each circuit in all pull boxes and junction boxes whether the box contains one or more circuits.

END OF SECTION 260135

SECTION 260155

MOTOR STARTERS

PART 1 – GENERAL

1.1 DESCRIPTION OF WORK

A. Extent of motor starter work is indicated by drawings, schedules and specifications.

B. Refer to sections of other divisions of these specifications for driven equipment specified without motor starters. Motor starters for such equipment are the work of this section.

C. Types of motor starters in this section include the following:

Manual.
Magnetic Full Voltage, Non-Reversing.
Combination Disconnect Switch and Magnetic Starter.
Adjustable Frequency Drive (AFD)

1.2 SUBMITTALS

A. Product Data: Submit manufacturer's data on motor starters and accessories.

1.3 COORDINATION

A. The drawings and details there upon are scheme and/or diagrammatic in nature, and indicate the need and intent of the design. These are to be used for general guidance only. It shall be the responsibility of the Electrical Contractor to coordinate with other Division subcontractors, the installation of all motor starters, the need for control devices including the wiring and conduit, to and from the device.

B. This coordination shall be carried out prior to actual installation. This shall be done to eliminate the possibility of conflicts between trades on items such as access, clearances and maintenance issues that may arise after completion of coordination.

C. During the coordination phase of the project, the Electrical Contractor shall consult with Division 1 thru 23 subcontractors with regard to base design equipment characteristics. Any differences from the electrical plans and specifications shall be considered a change. The trade’s contractor making the change at no additional cost to the Owner or delay in project completion shall handle these additional costs.

PART 2 – PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products of one of the following (for each type and rating of motor starter):

Allen-Bradley Co.
Cutler Hammer Products

Furnas Electric Co.
General Electric Co.
Square D Co.
Siemens

2.2 MOTOR STARTERS

A. Provide motor starters and ancillary components; of types, sizes, ratings and electrical characteristics indicated which comply with manufacturer's standard materials, design and construction in accordance with published product information, and as required for complete installations.

B. Fractional HP Manual Motor Starters: Provide manual, single phase, fractional HP motor starters for each motor rated less than 1/2 HP, of types, ratings and electrical characteristics indicated. Equip unit with thermal overload relay for protection of 120 volt AC motors. Provide starters with quick-make, quick-break, trip free toggle mechanisms, selector switches for hand-off-automatic control; mount starter in NEMA Type 1 or Type 4 enclosure as indicated or required by the NEC.

C. Magnetic Motor Starter: Provide magnetic full voltage, non-reversing starters for each motor rated 1/2 HP and more of types, ratings and electrical characteristics indicated; equip with solid state overload relays, control transformers with 120V secondary, with one secondary fuse and one grounded secondary lead, two normally open and two normally closed auxiliary contacts, hand-off- automatic selector switch, red and green pilot lights wired and mounted through front of the enclosure. Mount starter in NEMA Type 1 or Type 4 enclosure as required by the NEC.

D. Combination Disconnect Switch Magnetic Starter: Provide full-voltage, non-reversing, combination non-fused disconnect switch and magnetic starter for each motor rated 1/2 horsepower and more, of types, ratings and electrical characteristics indicated; equip with solid state overload relays, control transformer with 120 volt secondary, one secondary fuse and one grounded secondary lead, two normally open and two normally closed auxiliary contacts, hand-off- automatic switch, red and green pilot lights wired and mounted through the front of the enclosure. Mount starter in NEMA Type 1 or Type 4 enclosure as required by the National Electrical Code (NEC).

E. Three (3) phase, full voltage, non-reversing magnetic motor starters, horsepower rating with minimum NEMA size #0 shall be as follows:

NEMA Size	Continuous Rating	Maximum Horsepower	
		208 Volt	480 Volt
0	18 AMPs	3HP	5HP
1	27 AMPs	7-1/2HP	10HP
2	45 AMPs	10HP	25HP
3	90 AMPs	25HP	50HP

4	135 AMPs	40HP	100HP
5	270 AMPs	75HP	200HP

Motor full-load current shall not exceed continuous ampere rating of starter.

F. Adjustable Frequency Drive (AFD): The AFD shall convert the input AC main power to an adjustable frequency and voltage. The output frequency and voltage of the AFD shall be adjustable to maintain a constant voltage/hertz ratio throughout the operating range. The AFD shall be designed to operate from a 480 volt, three phase, 60 hertz main supply that is within +10% or -10% of nominal line voltage. The AFD control technique shall employ the pulse width modulated (PWM) technology.

1. Ratings:

   a. The AFD shall be capable of supplying 120% of rated full load current for one minute at maximum ambient temperature.

   b. Unit shall be rated for installation in a power system capable of delivering up to 65,000 RMS symmetrical amperes.

   c. Minimum power factor shall be .95 throughout the entire speed range.

   d. The AFD efficiency shall be 98% at full speed.

2. Adjustments:

   a. The acceleration and deceleration ramp rates shall be adjustable from 1 to 60 seconds.

   b. The overload trip shall be adjustable from 0 to 100% of rated output current.

   c. The current limit shall be adjustable from 60 to 120% of rated output current to maximize starting torque.

   d. Voltage boost shall be adjustable from 100 to 400% of nominal voltage/hertz ratio at 1 hertz tapering to 100% at 20 Hertz.

   e. The drive shall provide a control for adjusting the minimum frequency setting up to 45 Hertz and a maximum operating frequency adjustable over a range of 40 to 60 Hertz.

3. Protection:

   a. A non-adjustable instantaneous overcurrent trip shall be set to 250% of rated output current.

   b. AFD protection shall be accomplished with fuseless electronic protective circuits, to protect from the following conditions:

- Short circuit at AFD output.
- Ground fault at AFD output.
- Open circuit at AFD output.
- Input undervoltage.
- DC bus overvoltage.
- Loss of input phase.
- AC line switching transients.
- Instantaneous overload.
- Sustained overload exceeding 100% of rated current.
- Overtemperature.

4. Control:

   a. All the following operator controls shall be mounted to the front panel which is integral to the AFD:

      - Manual speed potentiometer.
      - Hand-Off-Auto (HOA) switch. The AFD shall accept an input signal of 4 to 20 Ma. DC. as an automatic speed reference signal when the AFD is in the automatic mode of operation. The manual speed potentiometer shall control the AFD when the switch is in the manual mode.
      - The AFD shall be furnished with an isolated follower with a setpoint control of 4 to 20 Ma. DC with PI control from an isolated ground signal.

5. Operator Interface:

   a. The AFD shall be furnished with an alphanumeric display and keypad to allow the operator access to drive modes, parameters and status conditions.

   b. Operator control and setup functions shall include the following:

      (1) Frequency setpoint
      (2) Acceleration/Deceleration time
      (3) Minimum/Maximum Output Frequencies
      (4) Proportional Gain
      (5) Integral Gain
      (6) Setpoint
      (7) Drive Reset
      (8) Elapsed Time
      (9) Enable PI (Setpoint) Control
      (10)Auto Reference Source Select

      Operating status information will consist of the following:

      (1) Frequency Output
      (2) Output Current
      (3) Output Voltage
      (4) Accel/Decel Ramp Time
      (5) Forward/Reverse Direction
      (6) Hand/Auto Local Indicator
      (7) Elapsed Time

The diagnostic and fault conditions available via the operator interface will include the following:

(1) Output Frequency
(2) Output Current
(3) Output Voltage
(4) Shutdown Reference Status
(5) Jog Status
(6) Mode of Operation
(7) Input Signal Levels
(8) Faults
(9) Overload Timer Activated
(10) Motor Current Limit

6. Enclosure:

   a. The enclosure shall be NEMA Type 1 with a dead front and back construction with all components and load, line and control terminations fully front accessible. The enclosure shall be self-ventilated and have provisions for top and bottom entry of conduit and wire.

PART 3 – EXECUTION

3.1 INSTALLATION OF MOTOR STARTERS

A. Install motor starters in accordance with manufacture's written instructions, applicable requirements of NEC, NEMA Standards, and NECA's "Standard of Installation", and in compliance with recognized industry practices to ensure that products fulfill requirements.

B. The Electrical Contractor shall consult and cooperate with the Control Contractor in assisting him in making control connections to the automatic position of the selector switch and to the auxiliary contacts.

C. Motor Data: Before installing wiring for motors and starters, the Electrical Contractor shall consult the respective parties furnishing the equipment and obtain from them all data necessary to properly connect the apparatus, and for selection of thermal overload relays in accordance with motor nameplate. Any variance in loads or electrical characteristics from the contract drawings should be reported to the Engineer before proceeding with the work.

D. When packaged equipment is furnished, all unit starters shall be furnished, mounted and wired by the installing contractor. The Electrical Contractor shall furnish and install a disconnect switch, as specified in Section 260170, and wire between unit's main terminal block and the disconnect switch.

E. Provide connections for motor starters.

3.2 ADJUST AND CLEAN

A. Inspect operating mechanisms for malfunctioning and where necessary adjust units for free mechanical movement.

B. Touch-up scratched or marred surfaces to match original finish.

3.3 FIELD QUALITY CONTROL

A. Subsequent to wire/cable hookup, energize motor starters and demonstrate functioning of equipment in accordance with requirements.

END OF SECTION 260155

SECTION 260170

MOTOR AND CIRCUIT DISCONNECTS

PART 1 – GENERAL

1.1 DESCRIPTION OF WORK

A. Extent of motor and circuit disconnect switch work is indicated by drawings and schedules.

B. Types of motor and circuit disconnect switches in this section include the following:

Equipment disconnects.
Appliance disconnects.
Motor-circuit disconnects.

1.2 SUBMITTALS

A. Product Data: Submit manufacturer's data including specifications, installation instructions and general recommendations, for each type of motor and circuit disconnect switch required.

1.3 COORDINATION

A. The drawings are scheme and/or diagrammatic in nature, and indicate the need and intent of the design. These are to be used for general guidance only. It shall be the responsibility of the Electrical Contractor to coordinate, with other Division Subcontractors, the installation of all motor and circuit disconnect switches, supporting hardware, including wiring and conduit, to and from the equipment. This coordination will include conduit layout to allow access to equipment for maintenance.

B. This coordination shall be carried out prior to actual installation; this shall be done to eliminate the possibility of conflicts between trades on items such as access, clearances and maintenance issues that may arise after completion of construction.

C. Should the coordination not be carried out prior to installation, and a conflict exists, the installing contractor shall remove and reinstall the equipment as required to clear the conflict at no additional cost to the Owner and no delay in project completion.

PART 2 – PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Manufacturer: Subject to compliance with requirements, provide products of one of the following (for each type of switch):

Square D Company

2.2 FABRICATED SWITCHES

A. Safety Switches: Safety switches shall be of sizes noted on the drawings, fusible or non-fusible and contained in a general purpose enclosure. All switches shall be type HD

and have quick-make, quick- break operation. All switches shall be of proper horsepower rating as applicable and have dual interlocks designed to interlock the switch box door with the switch operating mechanism. Unit shall be provided with a suitable means of interlock release. An arrangement shall be provided for locking the operating handle in the "ON" or "OFF" position. Safety switches shall have the proper type metal enclosure, i.e., standard, weatherproof, etc., to suit their specific location as required by the National Electrical Code.

B. Fuses: Provide fuses for safety switches, as recommended by switch manufacturer, of classes, types and ratings needed to fulfill electrical requirements for service indicated.

C. When packaged rooftop equipment is furnished, the unit disconnect switch shall be furnished, mounted and wired by the installing contractor.

D. When rooftop exhaust fans rated less than 1/2 HP at 120 volts, single phase, are furnished, except utility sets, the unit disconnect switch shall be furnished, mounted and wired by the installing contractor.

PART 3 – EXECUTION

3.1 INSTALLATION OF MOTOR AND CIRCUIT DISCONNECT SWITCHES

A. Install motor and circuit disconnect switches where indicated, complying with manufacturer's written instructions, applicable requirements of NEC, NEMA, and NECA's "Standard of Installation", and in accordance with recognized industry practices to ensure that products fulfill requirements.

B. Install disconnect switches used with motor-driven appliances, and motors and controllers within sight of controller position unless otherwise indicated.

C. Provide electrical connections for motor and circuit disconnect switches.

END OF SECTION 260170

SECTION 260180

OVERCURRENT PROTECTIVE DEVICES

PART 1 – GENERAL

1.1 DESCRIPTION OF WORK

A. Extent of overcurrent protective device work is indicated by drawing schedules and specifications.

B. Types of overcurrent protective devices in this section include the following:

1. Molded case circuit breaker.

1.2 SUBMITTALS

A. Product Data: Submit manufacturer's data on overcurrent protective devices, including: voltages and current ratings, interrupting ratings, current limitations, internal inductive and non-inductive loads, time-current trip characteristic curves, and mounting requirements.

B. Shop Drawings: Submit layout drawings of overcurrent protective devices, showing spatial relationships of units to associated electrical equipment, and connections to electrical power supplies.

PART 2 – PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, manufacturers offering products which may be incorporated in the work include the following:

1. Circuit-Breakers

Square D Co.

2.2 CIRCUIT BREAKERS

A. Except as otherwise indicated, provide circuit breakers and ancillary components, of types, sizes, ratings and electrical characteristics indicated, which comply with manufacturer's standard design, materials, components, and construction in accordance with published product information, as required for a complete installation.

B. Molded-Case Circuit Breakers: Provide factory assembled, molded-cased circuit breakers of frame size indicated; 120/208 volts, 60 Hertz, one, two, or three poles with a short circuit symmetrical ampere interrupting rating as indicated by the panel schedule and/or as shown by the single line riser diagram. Provide circuit breakers with permanent thermal instantaneous magnetic trips in each pole with ampere ratings as indicated. Construct with overcenter, trip-free, toggle type operating mechanisms with

quick-make, quick- break action and positive handle trip indication. Construct devices for mounting and operating in any physical position and operating in an ambient temperature of 40 degrees C. Provide circuit breakers with mechanical screw type connector lugs, AL/CU rated.

PART 3 – EXECUTION

3.1 INSTALLATION OF OVERCURRENT PROTECTIVE DEVICES

A. Install overcurrent protective devices as indicated in contract documents, in accordance with the manufacturer's written instructions and with recognized industry practices to ensure that protective devices comply with requirements. Comply with NEC Standards for Installation of overcurrent protective devices.

B. Coordinate with other work, including electrical wiring work, as necessary to interface installation of overcurrent protective devices with other work.

C. Fasten circuit breakers without causing mechanical stresses, twisting or misalignment being exerted by clamps, supports, or cabling.

3.2 ADJUST AND CLEAN

A. Inspect circuit-breaker operating mechanisms for malfunctioning and, where necessary, adjust units for free mechanical movement.

3.3 FIELD QUALITY CONTROL

A. Prior to energization of overcurrent protective devices, test devices for continuity of circuitry and for short-circuits. Correct malfunctioning units, and then demonstrate compliance with requirements.

END OF SECTION 260180

SECTION 260190

SUPPORTING DEVICES

PART 1 – GENERAL

1.1 DESCRIPTION OF WORK

A. Types of supports, anchors, sleeves and seals specified in this section include the following:

Hangers.
Riser Clamps.
C-clamps
I-beam clamps.
One-hole conduit straps.
Two-hole conduit straps.
Round steel rods.
Lead expansion anchors.
Toggle bolts.
U-Channel Strut Systems.

PART 2 – PRODUCTS

2.1 MANUFACTURED SUPPORTING DEVICES

A. Provide supporting devices, complying with manufacturer's standard materials, design and construct in accordance with published product information, and as required for a complete installation, and as herein specified.

B. Supports: Provide supporting devices of types, sizes and materials having the following construction features:

Hangers: For supporting EMT conduit, electro-galvanized steel, with 1/4" minimum diameter hole for round steel rod; approximately MSS types 5, 7, 9 or spring steel conduit clips.

Reducing Couplings: Steel rod reducing coupling, 1/4" minimum black steel.

C-Clamps: Black malleable iron, 1/4" minimum rod size.

I-Beam Clamps: Black steel, 1-1/4" x 3/16" stock; 3/8" cross bolt; flange width 2"; approx. 52 pounds per 100 units.

One-Hole Conduit Straps: For supporting EMT conduit, electro- galvanized steel.

Two-Hole Conduit Straps: For supporting EMT conduit, electro-galvanized steel; 3/4" strap width; and 2-1/8" between center of screw holes.

Hexagon Nuts: For 1/4" rod size; galvanized steel.

Round Steel Rod: Black steel; 1/4" min. dia.

Offset Conduit Clamps: For supporting rigid metal conduit; black steel.

C. Anchors: Provide anchors of types, sizes and materials indicated; and having the following construction features:

Lead Expansion Anchors: 1/4" - 20 Minimum .

Toggle Bolts: Springhead; 3/16 x 4".

D. Manufacturer: Subject to compliance with requirements, provide anchors of the following:

Ackerman Johnson Fastening Systems, Inc.
Elcen Metal Products Co.
Ideal Industries, Inc.
Rawlplug Co., Inc.
Star Expansion Co.
U.S. Expansion Bolt Co.
Erico Products, Inc. (Caddy)
Hilti, Inc.

E. U-Channel Strut Systems: Provide U-channel strut system for supporting electrical equipment, 16-gauge hot dip galvanized steel, construct with 9/16" dia. holes, 8" o.c. on top surface, with standard hot dip galvanized finish, and with the following fittings which mate and match with U-channel.
Beam clamps.
Thinwall conduit clamps.
Conduit hangers.
U-bolts.

F. Manufacturers: Subject to compliance with requirements, provide channel systems of one of the following:
B-Line Systems, Inc.
Elcen Metal Products Co.
Power-Strut Div.; Van Huffel Tube Corp.
Unistrut Div.; GTE Products Corp.
Hilti, Inc.

PART 3 – EXECUTION

3.1 INSTALLATION OF SUPPORTING DEVICES

A. Install hangers and anchors in accordance with manufacturer's written instructions and with recognized industry practices to insure supporting devices comply with requirements. Comply with requirements of NECA, NEC and ANSI/NEMA for installation of supporting devices.

B. Install hangers, supports, clamps and attachments to support piping properly from building structure. Arrange for grouping of parallel runs of horizontal conduits to be supported together on trapeze type hangers where possible. Install supports with maximum spacings.

END OF SECTION 260190

SECTION 260452

GROUNDING

PART 1 – GENERAL

1.1 DESCRIPTION OF WORK

A. Types of grounding in this section include the following:

Grounding:

Underground metal piping.
Underground metal water piping.
Grounding rods.
Service equipment.
Enclosures.
Systems.
Equipment.
Building Structural Steel (Bonding)

PART 2 – PRODUCTS

2.1 GROUNDING

A. Except as otherwise indicated, provide each electrical grounding system indicated, with assembly of materials including, but not necessarily limited to, cables/wires, connectors, terminals (solderless lugs), and other items and accessories needed for complete installation. Where materials or components are not otherwise indicated, comply with NEC, NEMA, and established industry standards for applications indicated.

B. Provide conduit, tube, duct, cable and fittings complying with Division 26 Basic Materials and Methods section, "Raceways", in accordance with the following listing:

Rigid steel conduit.
Electrical metallic tubing.
Flexible metal conduit.
Liquid-tight flexible metal conduit.
Rigid metal conduit fittings.
EMT fittings.
Flexible metal conduit fittings.
Liquid-tight flexible metal conduit fittings.

2.2 ELECTRICAL GROUNDING CONDUCTORS

A. Unless otherwise indicated, furnish a green insulated equipment grounding conductor for all feeders and branch circuits, matching power supply wiring materials and sized according to NEC.

2.3 BONDING PLATES, CONNECTIONS, TERMINALS & CLAMPS

A. Provide electrical bonding plates, connectors, terminals and clamps as recommended by bonding plate, connector, terminal and clamp manufacturers for applications.

2.4 GROUND RODS & PLATES

A. Ground Rods: Steel with copper welded exterior, 3/4" dia. x 10'.

PART 3 – EXECUTION

3.1 INSTALLATION OF GROUNDING SYSTEMS

A. Install electrical grounding systems in accordance with manufacturer's written instructions and with recognized industry practices to ensure grounding complies with requirements. Comply with requirements of NEC, NESC, NEMA and UL standards for installation of grounding systems.

B. Coordinate with other electrical work as necessary to interface installation of grounding system with other work.

C. Clamp cable connections to ground rods.

D. Install bonding jumpers with ground clamps on water meter piping to electrically bypass water meter.

E. Install clamp-on connectors only on thoroughly cleaned metal contact surfaces, to ensure electrical conductivity and circuit integrity.

3.2 FIELD QUALITY CONTROL

A. Upon completion of installation of electrical grounding system, test ground resistance with ground resistance tester. Where tests show resistance-to-ground is over 25 ohms, take appropriate action to reduce resistance to 25 ohms or less by driving additional ground rods and/or by chemically treating soil encircling ground rods with sodium chloride, calcium chloride, copper sulphate, or magnesium. Then retest to demonstrate compliance.

END OF SECTION 260452

SECTION 260471

FEEDER CIRCUITS

PART 1 – GENERAL

1.1 DESCRIPTION OF WORK

A. Feeder circuit work is indicated by drawings and schedules.

B. The feeder circuits shall include furnishing and installing a complete wire and conduit system between distribution panelboards and major 3 phase loads, between power panels and 3 phase motor loads.

C. Types of equipment to be furnished and installed in this section include the following:

Rigid Metal Conduit
Electrical Metallic Tubing (EMT)
Intermediate Metal Conduit (IMC)
Wires and Cables
Junction Boxes
Pull Boxes
Conduit Bodies
Bushings
Locknuts
Supporting Devices

PART 2 – PRODUCTS

2.1 FEEDER CIRCUITS

A. Furnish and install each feeder circuit with assembly of materials, including but not necessarily limited to, conduit, wire, pull boxes, junction boxes and other items and accessories needed for a complete installation. Where materials or components are not otherwise indicated, comply with NEC, NEMA and established industry standards for applications indicated.

PART 3 – EXECUTION

3.1 INSTALLATION OF FEEDER CIRCUITS

A. Install feeder circuits, complying with equipment manufacturer's written instructions, applicable requirements of NEC, NEMA and NECA's "Standard of Installation", and in accordance with recognized industry practices.

B. Multiple circuits within a single raceway shall not be permitted under this section.

END OF SECTION 260471

SECTION 260472

BRANCH CIRCUITS

PART 1 – GENERAL

1.1 DESCRIPTION OF WORK

A. Branch circuit work is indicated by drawings.

B. The branch circuits shall include furnishing and installing a complete wire and conduit or cable system between panelboards and lighting fixtures, receptacles, fractional horsepower motors, and small single phase loads.

C. Types of equipment to be furnished and installed in this section include the following:

Rigid Raceways – See Section 260110
Electrical Metallic Tubing (EMT)
Wires and Cables
Junction Boxes
Pull Boxes
Conduit Bodies
Bushings
Locknuts
Supporting Devices

PART 2 – PRODUCTS

2.1 BRANCH CIRCUITS

A. Furnish each branch circuit with an assembly of materials, including but not necessarily limited to, conduit, wire, cable, pull boxes, junction boxes and other items and accessories needed for a complete installation. Where materials or components are not otherwise indicated, comply with NEC, NEMA and established industry standards for applications indicated.

2.2 CONVENIENCE BRANCH CIRCUITS

A. Intent:

1. The intent of this portion of the specifications is to describe the requirements of a convenience circuit as it applies to 120-volt receptacles.

2. All convenience branch circuits may consist of more than one 120 volt receptacle.

B. Convenience Circuit - General: A circuit consisting of a phase and neutral conductor, which may share its neutral with other phase conductors provided that the neutral conductor does not become overloaded due to circuit phase relationship. This type of circuit shall also include an equipment grounding conductor as described under the grounding section of the specifications.

C. Convenience Circuit - Dedicated: A circuit consisting of a phase and neutral conductor which DOES NOT share conductors with any other circuits. This type of circuit shall also include an equipment grounding conductor as described under the grounding section of the specifications.

PART 3 – EXECUTION

3.1 INSTALLATION OF BRANCH CIRCUITS

A. Install branch circuits, complying with equipment manufacturer's written instructions, applicable requirements of NEC, NEMA, and NECA's "Standard of Installation", and in accordance with recognized industry practices.

B. Multiple circuits within a single raceway or cable shall be permitted under this section. It shall be the responsibility of the Electrical Contractor to assure that the neutral conductors do not become overloaded due to circuit phase relationship, and isolated grounds not become voided or compromised due to miswiring or wrong connections.

C. The Electrical Contractor may elect to use metal clad cable in lieu of electrical metallic tubing (EMT) in wall cavities, and/or above tile or dry wall ceilings. In all areas of exposed construction, electrical metallic tubing (EMT) shall be installed.

END OF SECTION 260472