INVITATION FOR BID (IFB)

BLUEBERRY HILL SCHOOL
BOILER REPLACEMENT

TOWN OF LONGMEADOW
MASSACHUSETTS

July 17, 2019

NV5 Delivering Solutions Improving Lives

INVITATION FOR BID (IFB)
BLUEBERRY HILL SCHOOL BOILER REPLACEMENT
TOWN OF LONGMEADOW, MASSACHUSETTS

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INVITATION FOR BID
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LEGAL NOTICE:
INVITATION FOR BID (IFB)
BLUEBERRY HILL SCHOOL BOILER REPLACEMENT

The Town is soliciting bids for the Blueberry Hill School boiler replacement. The consulting engineer is NV5, Hadley, MA. Sealed bids should be labeled with the name and contact information of the bidder and the bid title 'IFB-Blueberry Hill School Boiler Replacement' on the outer envelope. Deliver sealed bids to the Town of Longmeadow, Purchasing Department, Attn: Chad Thompson, Procurement Manager, 735 Longmeadow Street, Suite 101, Longmeadow, MA 01106. Sealed bids will be received until the bid deadline of **11:00am on Wednesday, August 7, 2019**, after which time all bids will be opened and read aloud in the auditorium of the same building. Late bids will be rejected. The project shall be procured in accordance with the provisions of Massachusetts General Laws, Chapter 149, Section 44A through Section 44J, inclusive.

Every General Bid shall be accompanied by a bid bond, cash, certified check, or treasurer's check issued by a responsible bank or trust company, payable to the "Town of Longmeadow", in the amount of five percent (5%) of the bid amount. Bid documents are only available through the Town of Longmeadow, Purchasing Department, Attn: Chad Thompson, Procurement Manager, 735 Longmeadow Street, Suite 101, Longmeadow, MA 01106 (cthompson@longmeadow.org , Phone: 413-565-4185). Bid documents can also be accessed through the Town website, www.longmeadow.org , select 'Government' from the header, then 'Purchasing' department, then select 'Bids & RFPs', then 'Bid & RFP Finder' to access bid documents by title. Bidders are encouraged to register with the Longmeadow Purchasing Department in order to receive updates and addenda. Those that do not register with the Longmeadow Purchasing Department will be required to independently monitor the Longmeadow bid listing service for issued updates and addenda. Failure to acknowledge addenda may result in a bid rejection.

A MANDATORY Pre-Bid Conference is scheduled for Wednesday, July 24, 2019 at 10:00am. Gather at the main entry of Blueberry Hill School,275 Blueberry Hill Rd, Longmeadow, MA 01106. Those that attend the Mandatory Pre-Bid Conference should register on the Registration Form during the conference before the conference concludes. Once the Procurement Manager declares that the Mandatory Pre-Bid Conference is 'Complete and Closed', then no others will be allowed to register their attendance for the Mandatory Pre-Bid Conference. Additional site inspection requests will not be accommodated. Bids received from those that have not registered during the Mandatory Pre-Bid Conference will have their bid rejected.

The successful General Bidder will be required to furnish a 100% performance bond, and 100% labor and materials payment bond as set forth in the specifications; each bond executed in the full amount of the Contract Price. Prevailing Wage Rates to be paid on the work of the project are established by a Schedule issued by the Division of Occupational Safety under the Executive Office of Labor and Workforce development, a copy of which is contained in the Contract Documents, and will be made a part of the Contract. No bid shall be withdrawn for a period of thirty (30) calendar days following the bid deadline without written consent by the Town of Longmeadow.

The Town of Longmeadow acting through the Town Manager, the Awarding Authority, reserves the right to reject any or all bids, waive minor informalities and to award a contract in the best interest of the Town of Longmeadow.

INVITATION FOR BID (IFB)
BLUEBERRY HILL SCHOOL BOILER REPLACEMENT
INVITATION FOR BID

1. The Town is soliciting bids for the Blueberry Hill School boiler replacement. The consulting engineer is NV5, Hadley, MA. Sealed bids should be labeled with the name and contact information of the bidder and the bid title 'IFB-Blueberry Hill School Boiler Replacement' on the outer envelope. Deliver sealed bids to the Town of Longmeadow, Purchasing Department, Attn: Chad Thompson, Procurement Manager, 735 Longmeadow Street, Suite 101, Longmeadow, MA 01106. Sealed bids will be received until the bid deadline of **11:00am on Wednesday, August 7, 2019**, after which time all bids will be opened and read aloud in the auditorium of the same building. Late bids will be rejected. The project shall be procured in accordance with the provisions of Massachusetts General Laws, Chapter 149, Section 44A through Section 44J, inclusive.

2. This is not a DCAMM project.

3. **A MANDATORY Pre-Bid Conference is scheduled for Wednesday, July 24, 2019 at 10:00am. Gather at the main entry of Blueberry Hill School,275 Blueberry Hill Rd, Longmeadow, MA 01106.** Those that attend the Mandatory Pre-Bid Conference should register on the Registration Form during the conference before the conference concludes. Once the Procurement Manager declares that the Mandatory Pre-Bid Conference is 'Complete and Closed', then no others will be allowed to register their attendance for the Mandatory Pre-Bid Conference. Additional site inspection requests will not be accommodated. Bids received from those that have not registered during the Mandatory Pre-Bid Conference will have their bid rejected.

4. Every General Bid shall be accompanied by a bid bond, cash, certified check, or treasurer's check issued by a responsible bank or trust company, payable to the "Town of Longmeadow", in the amount of five percent (5%) of the bid amount. Bid documents are only available through the Town of Longmeadow, Purchasing Department, Attn: Chad Thompson, Procurement Manager, 735 Longmeadow Street, Suite 101, Longmeadow, MA 01106 (cthompson@longmeadow.org , Phone: 413-565-4185). Bid documents can also be accessed through the Town website, www.longmeadow.org , select 'Government' from the header, then 'Purchasing' department, then select 'Bids & RFPs', then 'Bid & RFP Finder' to access bid documents by title. Bidders are encouraged to register with the Longmeadow Purchasing Department in order to receive updates and addenda. Those that do not register with the Longmeadow Purchasing Department will be required to independently monitor the Longmeadow bid listing service for issued updates and addenda. Failure to acknowledge addenda may result in a bid rejection.

5. The successful General Bidder will be required to furnish a 100% performance bond, and 100% labor and materials payment bond as set forth in the specifications; each bond executed in the full amount of the Contract Price. Prevailing Wage Rates to be paid on the work of the project are established by a Schedule issued by the Division of Occupational Safety under the Executive Office of Labor and Workforce development, a copy of which is contained in the Contract Documents, and will be made a part of the Contract. No bid

shall be withdrawn for a period of thirty (30) calendar days following the bid deadline without written consent by the Town of Longmeadow.

6. Bidding procedures shall be in accordance with the provisions of Massachusetts General Laws, Chapter 149, Section 44A through Section 44J, inclusive, and Chapter 30, Section 39M, as amended.

7. Prevailing Wage Rates to be paid on the work of the project are established by a Schedule issued by the Division of Occupational Safety under the Executive Office of Labor and Workforce development, a copy of which is contained in the Contract Documents, and will be made a part of the Contract.

8. No bid shall be withdrawn for a period of thirty (30) days, Saturdays, Sundays and legal holidays excluded, after receipt of award, without written consent by the Town of Longmeadow.

9. A CORI check of all Contractor employees will be required of the successful contractor. The contractor will be responsible for all expenses associated with CORI checks.

10. The Town of Longmeadow is exempt from sales tax, for which reason, bidders should not include sales tax in figuring or in reference to any bid.

11. The Town of Longmeadow acting through the Town Manager, the Awarding Authority, reserves the right to reject any or all bids, waive minor informalities and to award a contract in the best interest of the Town of Longmeadow.

INSTRUCTIONS TO BIDDERS

ARTICLE 1 - BIDDER'S REPRESENTATION

1.1 Each General Bidder (hereinafter called the "Bidder") by making a bid) represents that:

1. The Bidder has carefully read and understands the Contract Documents and the bid is made in accordance therewith.
2. The Bidder has visited the site and is familiar with the local conditions under which the Work has to be performed.

1.2 Failure to so examine the Contract Documents and site will not relieve any Bidder from any obligation under the bid as submitted.

ARTICLE 2 - GENERAL BIDDER'S QUALIFICATIONS

2.1 The General Bidder shall be required to demonstrate that they have experience with the completion of the project Scope of Work with comparable projects of scale completed for other boiler replacement projects.

ARTICLE 3 – N/A

ARTICLE 4 - REQUESTS FOR INTERPRETATION

4.1 By submitting a Bid, the Bidder agrees and warrants that he has carefully examined the site and the Contract Documents, that he is familiar with the conditions and requirements of both or reasonably inferable therefrom, and where they require, in any part of the work, a given result to be produced that the Contract Documents are adequate and that he will produce the required result.

4.2 Bidders shall promptly notify the Longmeadow Purchasing Department of any ambiguity, inconsistency or error which they may discover upon examination of the bid documents and specifications, site, local conditions or reasonably inferable therefrom. The Longmeadow Purchasing Department will work with the Architect and Facilities Department to issue a response and clarifications to any changes in specifications. No claims for additional costs will be considered for such ambiguity, inconsistency or error if discovered or inferable from the Contract Documents or existing conditions of the Project after the submission of Bid.

4.3 Questions? :
Bidders that have questions or require clarification or interpretation of the bid documents shall make a written request to the Longmeadow Purchasing Department only. For the General Bid all questions and inquiries must be received no later than 5:00pm on Wednesday, August 1, 2019. Questions and inquiries received after the deadline for questions may not be provided.

Bidders will have the opportunity to ask questions during the Mandatory Pre-Bid Conference. An Engineer from NV5 Engineers, and the Facilities Director from the Town of Longmeadow will be present to respond to questions and inquires during the

conference. All verbal responses to questions and inquiries that are considered binding will be confirmed by way of addendum and will be posted to the bid listing service that can be accessed through the Town of Longmeadow Purchasing Department page of the website www.longmeadow.org . Bidders show have registered with the Purchasing Department requesting to be added to the bid list will be supplied issued addendum by email.

All other inquiries and questions should be submitted in writing to the Longmeadow Purchasing Department by one of the following methods:

Email: cthompson@longmeadow.org

4.4 Interpretation, correction, or change in the Contract Documents will be made by Addendum which will become part of the Contract and Bid Documents. Neither the Awarding Authority nor the Engineer will be held accountable for any oral instructions.

4.5 Addenda will be posted and accessible online through the Purchasing Department page of the Town website www.longmeadow.org . Addendum will also be issued to those that have requested to be added to the bid list for the named project who have provided their complete contact information (Bidders should supply contact name, mailing address, email, phone and fax number). Those that do not register on the bid list with the Longmeadow Purchasing Department will be responsible for monitoring the bid listing service accessed through the Purchasing Department page of the Town website.

4.6 Failure of a bidder to acknowledge the receipt of issued addendum may result in a bid rejection. Failure of the Awarding Authority to send, or of any Bidder to receive any such interpretation shall not relieve the Bidder from any obligations under his bid as submitted and all Addenda or interpretations shall become part of the Contract as is fully written therein.

4.7 Hard copies of addenda will be made available at the Longmeadow Purchasing Department only.

ARTICLE 5 - PREPARATION AND SUBMISSION OF BIDS

5.1 Bids shall be submitted on the "Form for General Bid", as appropriate, furnished at no cost by the Awarding Authority. The forms enclosed in the Project Manual shall not be extracted or used. Additional forms are available at the location listed in the Advertisement. All bid prices submitted must remain firm for thirty (30) days following the opening of Bids.

5.2 All entries on the Bid Form shall be made by typewriter or in ink.

5.3 Where so indicated on the Bid Form, sums shall be expressed in both words and figures. Where there is a discrepancy between the bid unit pricing expressed in words and the bid unit pricing expressed in figures, the words shall control. Errors based on multiplication, addition, or subtraction shall be correct based on recalculation from bid unit pricing.

5.4 Bid Deposit shall be:

- At least five percent (5%) of the greatest possible bid amount, considering all Alternates; made payable to the Town of Longmeadow
- in the form of:
  - Cash
  - Certified Check, Treasurer's or Cashier's check issued by a responsible bank or trust company
  - A Bid Bond issued by a surety company licensed to do business in the Commonwealth of Massachusetts and listed in U.S. Treasure Circular 570, and shall be conditioned upon faithful performance by the Principal of the agreements contained in the bid.
  - each Bid Bond must be accompanied by a Power of Attorney

Bid deposits of the three (3) lowest responsible and eligible General Bidders and the Sub-Bidders, in each sub-trade, shall be retained until the execution and delivery of the Owner/Contractor Agreement.

5.5 Date and Time for receipt of bids is set forth in the "Advertisement for Bid". All bids must be received in the Town of Longmeadow's Purchasing Department, 735 Longmeadow St., Suite 101, Longmeadow, MA 01106. The clock in the Purchasing Department shall be the sole determining factor of time.

5.6 If at the time of the schedule bid opening, Longmeadow Purchasing Department is closed due to uncontrolled events such as fire, snow, ice, or building evacuation, the bid opening will be postponed until 11:00 A.M. on the next regular business day that town administrative offices is open.

5.7 Timely delivery of a bid to the location designated shall be the full responsibility of the Bidder.

5.8 The submission of a bid will be construed to mean that the bidder is fully informed as to the extent and character of the supplies, materials, or equipment required and a representation that the bidder can furnish the supplies, materials or equipment in complete compliance with the specifications.

ARTICLE 6 – N/A

ARTICLE 7 - WITHDRAWAL OF BIDS

7.1 Before Opening of Bids

7.1.1 Any Bid may be withdrawn prior to the time designated for receipt of bids upon written request. Withdrawal of Bids must be confirmed over the Bidder's signature by written notice post-marked or sent by facsimile on or before the date and time set for receipt of Bids.

7.1.2 Withdrawn bids may be resubmitted up to time designated for the receipt of bids.

7.2 After Opening of Bids

7.2.1 Bidders may withdraw a bid at any time up to the time of Award as defined in Paragraph 9.1, and upon demonstrating, to the satisfaction of the Awarding Authority that a bona fide clerical error was made during the preparation of the bid. Failure to conclusively demonstrate a bona fide clerical error may result in forfeiture of the bid deposit.

ARTICLE 8 - CONTRACT AWARD

8.1 Award means both the determination and selection of the lowest, responsible and eligible bidder, evaluated by the Awarding Authority.

8.2 The Awarding Authority will award the contract to the lowest responsible and eligible bidder within thirty days, Saturdays, Sunday, and legal holidays excluded after the opening of bids in accordance with M.G.L. c149 §44A.

8.3 The award of this Contract is not subject to any other Agency review or approval.

8.4 The Awarding Authority reserves the right to waive any informalities in or to reject any or all Bids if it be in the public interest to do so.

8.5 The Awarding Authority also reserves the right to reject any sub-bid if it determines that such sub-bid does not represent the bid of a person competent to perform the work as specified, or if less than three sub-bids are received for a sub-trade, or if bid prices are not reasonable for acceptance without further competition.

8.6 The Contract will be awarded to the lowest responsible and eligible Bidder, except in the event of substitution as provided under M.G.L. c149 §44E and 44F, in which cases the procedure as required by said sections shall govern the award of the Contract.

8.7 As used herein, the term "lowest responsible and eligible Bidder" shall mean the General Bidder whose bid is the lowest of those Bidders, demonstrably possessing the skill, ability and integrity necessary for the faithful performance of the work, and who meets the requirements for Bidders set forth in M.G.L. c.149 §44A-J and not debarred from bidding under M.G.L. c.149 §44C; and who shall certify that they are able to furnish labor that can work in harmony with all other elements of labor employed or to be employed on the work.

ARTICLE 9 - FORMS REQUIRED AT CONTRACT APPROVAL

9.1 Upon Award, the General Bidder shall complete the following forms to ensure prompt contract validation. These forms will be provided to the General Contractor by the Awarding Authority.

9.2 Owner/Contractor Agreement and Form of Corporate Vote.

9.3 Form of Performance Bond and Form of Payment Bond must be submitted by the

General Contractor on the supplied form, in accordance with Article 11 of the General Conditions. The dates of the bonds must coincide with the Contract date, and a current Power-of-Attorney must be attached to each bond.

9.4 Insurance Certificates for the General Contractor and all Filed Subcontractors are required and must be submitted in accordance with Article 11 of the General Conditions.

9.5 Statement of Management on Internal Accounting Controls and a Statement prepared by a CPA expressing an opinion in the State of Management Controls, as required by M.G.L. c30 §39R, if not otherwise on file with the Division of Capital Asset Management.

.1 This applies to all General Contractors; and applies to any contracts of $100,000. or more.

9.6 No bond will be released by the Town of Longmeadow without a fully executed Release of Lien form by the Contractor to Town of Longmeadow Purchasing Department.

ARTICLE 10 - CONTRACT VALIDATION

10.1 The Owner-Contractor Agreement shall not be valid until signed by the Town Manager, the Awarding Authority for the Town of Longmeadow.

10.2 The Notice-To-Proceed for construction shall not be issued until the Owner/Contractor Agreement has been validated with a completed contract.

10.3 Incomplete or unacceptable submission of the forms required by paragraph 10.2 - 10.5 will delay the validation of the Owner/Contractor Agreement.

ARTICLE 11 - TIME OF COMPLETION

11.1 The Contractor shall commence work under this contract as soon as possible and must obtain Substantial Completion of all Scope of Work for boiler replacement scope of work by **October 11, 2019, the Substantial Completion date**. The Contractor will only be allowed to perform work on school boilers when students are not in session, after regular school hours beginning at 3:00PM with work in the evening (2nd shift). Work can also be performed on weekends and holidays. Loud demolition work cannot be performed when school is in session with attending students.

11.2 Damages for delays in the performance of the Work shall be in accordance with the Longmeadow Contract and will include liquidated damages in the amount of $500.00 per calendar day for Scope of Work that is not completed after the Substantial Complete Date.

ARTICLE 12 – MANDATORY PRE-BID CONFERENCE

12.1 **A MANDATORY Pre-Bid Conference is scheduled for Wednesday, July 24, 2019 at 10:00am. Gather at the main entry of Blueberry Hill School,275 Blueberry Hill Rd, Longmeadow, MA 01106.** Those that attend the Mandatory Pre-Bid Conference should register on the Registration Form during the conference before the conference concludes.

Once the Procurement Manager declares that the Mandatory Pre-Bid Conference is 'Complete and Closed', then no others will be allowed to register their attendance for the Mandatory Pre-Bid Conference. Additional site inspection requests will not be accommodated. Bids received from those that have not registered during the Mandatory Pre-Bid Conference will have their bid rejected

12.2 All Bidders shall review the Contract Documents and visit the site to ascertain the existing conditions of the work prior to submission of their Bid or be responsible for said conditions within their Bid.

ARTICLE 13 - CONDITION OF THE SITE AND PROJECT DOCUMENTS

13.1 All bidders shall visit the site and thoroughly examine all Contract Documents, checking the requirements of the Drawings and Specifications with the existing conditions, before submitting a bid. Inspect and be thoroughly familiar with same and conditions under which work will be carried out. Neither the Owner nor the Engineer will be responsible for errors, omissions and/or charges for extra work arising from General or Subcontractor's failure to familiarize themselves with Contract Documents or existing conditions. By submitting a Bid, the bidder agrees and warrants that he has examined the site and the Contract Documents, that he is familiar with the conditions and requirements of both or reasonably inferable therefrom and where they require, in any part of the work, a given result to be produced that the Contract Documents are adequate and that he will produce the required result.

ARTICLE 14 – COMMONWEALTH OF MASSACHUSETTS REQUIREMENTS

14.1 Attention is directed to Chapter 149 of the General Laws and Amendments thereto regulating competitive bidding in the award of contracts for public building projects, and the selection of sub-bidders, and applicable sections of which by reference become a part of the information for bidders, and to all other statutory or other pertinent law, applicable thereto.

BID FORM

FORM FOR GENERAL BID

TO THE AWARDING AUTHORITY

A. **The undersigned proposes to furnish all labor and materials required for** IFB – BLUEBERRY HILL SCHOOL BOILER REPLACEMENT, **in accordance with the Invitation for Bid documents for the Contract Price specified below, subject to additions and deductions according to the terms of the specifications.**

B. **This Bid includes Addenda number(s) _____, _____, _____, _____, _____, _____.'**

C. **BID PRICING:**

BASE BID:
The proposed Contract Price for Base Bid is:_____
(Base Bid Amount in Numbers)

_____ **dollars**
(Base Bid Amount in Words)

BID ALTERNATE NO.1:
HVAC add alternate to the base bid for the replacement of the existing shot feeder with a combination magnetic filter, side stream filter, and shot feeder unit.

The proposed Contract Price for Bid Alternate No.1 is: _____
(Bid Alternate No.1 Amount in Numbers)

_____ **dollars**
(Bid Alternate No.1 Amount in Words)

BID TOTAL: _____

(Sum of Base Bid, plus Bid Alternate No.1)

D. **The subdivision of the proposed contract price is as follows:**

ITEM 1. The work of the general contractor, being all work other than that covered by ITEM 2.

TOTAL OF ITEM 1 ..... $ _____.

ITEM 2. Sub-bids as follows:

Sub-trade	Name of Sub-Bidder	Amount	Bonds Required indicated by YES or NO	
_____	_____	**$**_____	___	___
_____	_____	**$**_____	___	___

TOTAL OF ITEM 2 $ _____.

E. **The undersigned agrees that each of the above named sub-bidders will be used for the work indicated at the amount stated, unless a substitution is made. The undersigned further agrees to pay the premiums for the Performance and Payment Bonds furnished by sub-bidders as requested herein and that all of the cost of all such premiums is included in the amount set forth in Item 1 of this Bid.**

The Undersigned agrees that, if he is selected as General Contractor, he will promptly confer with

the Awarding Authority on the question of sub-bidders; and that the Awarding Authority may substitute for any sub-bid listed above a sub-bid filed with the Awarding Authority by another sub-bidder for the sub-trade against whose standing and ability the undersigned makes no objection; and that the undersigned will use all such finally selected sub-bidders at the amounts named in their respective sub-bids and be in every way as responsible for them and their work as if they had been originally named in this general bid, the total contract price being adjusted to conform thereto.

F. The undersigned agrees that, if selected General Contractor, he will within five days, Saturdays, Sundays and legal holidays excluded, after presentation thereof, by the Awarding Authority, execute a Contract in accordance with the terms of this Bid and furnish a Performance Bond and also a Labor and Materials or Payment Bond, each of a Surety company qualified to do business under the laws of the Commonwealth and satisfactory to the Awarding Authority and each in the sum of the Contract price, the premiums for which are to be paid by the General Contractor and are included in the Contract price; provided that if there is more than one surety, each surety shall be jointly and severally liable.

The Undersigned hereby certifies that he is able to furnish labor that can work in harmony with all other elements of labor employed or to be employed on the Work and that he will comply with all laws and regulations applicable to awards made subject to Section 44A.

G. The Undersigned hereby certifies, under penalties of perjury, that they have complied with all Laws of the Commonwealth relating to taxes, reporting of employees and Contractors, and withholding and remitting Child Support.

H. The Undersigned hereby certifies, under penalties of perjury, that all employees to be employed at the worksite will have successfully completed a course in construction safety and health approved by the United States Occupational Safety and Health Administration that is at least 10 hours in duration at the time the employee begins work and shall furnish documentation of successful completion of said course with the first certified payroll report for each employee.

I. The Undersigned further certifies under the penalties of perjury that this Bid is in all respects bona fide, fair and made without collusion or fraud with any other person. As used in this subsection the word "person" shall mean natural person, joint venture, partnership, corporation or other business or legal entity. The Undersigned further certifies under penalty of perjury that the said undersigned is not presently debarred from doing public construction work in the Commonwealth of Massachusetts under the provisions of section twenty- nine F of chapter twenty-nine, or any other applicable debarment provisions of any other chapter of the General Laws or any rule or regulation promulgated thereunder.

By:

_____
Name of General Bidder **Date**

_____
Signature Name, and Title of Person Signing Bid

_____
Name, and Title of Person Signing Bid

_____
Business Address

_____
City, State, Zipcode

_____
Email Address **Phone No.**

_____
Corporate Seal, If Applicable

Note: If the Bidder is a corporation, indicate State of incorporation under signature, and affix corporate seal; if a partnership, give full names and residential addresses of all partners, and if an individual, give residential address if different from business address.

BIDDER'S QUALIFICATIONS AND REFERENCES FORM

All questions must be answered, and the data given must be clear and comprehensive. Please type or print legibly. If necessary, add additional sheet for starred items. This information will be utilized by the Town for purposes of determining bidder responsiveness and responsibility with regard to the requirements and specifications of the Contract.

1.FIRM NAME: _____

2.WHEN ORGANIZED: _____

3. INCORPORATED?
_____ YES
_____ NO DATE AND STATE OF INCORPORATION:_____

4. IS YOUR BUSINESS REGISTERED WITH SOMWBA FOR THE FOLLOWING WOMEN AND/OR MINORITY CATEGORIES:

MBE? _____YES _____NO

WBE? _____YES _____NO or

MWBE? _____YES _____NO

5.LIST ALL CONTRACTS CURRENTLY ON HAND, SHOWING CONTRACT AMOUNT AND ANTICIPATED DATE OF COMPLETION:
_____
_____
_____
_____
_____

6.HAVE YOU EVER FAILED TO COMPLETE A CONTRACT AWARDED TO YOU?
_____ YES
_____ NO
IF YES, WHERE AND WHY?
_____
_____

7.HAVE YOU EVER DEFAULTED ON A CONTRACT? _____ YES _____ NO
IF YES, PROVIDE DETAILS.
_____
_____

8.
LIST YOUR VEHICLES/EQUIPMENT AVAILABLE FOR THIS CONTRACT:
_____
_____
_____
_____
_____
_____

9.
IN THE SPACES FOLLOWING, PROVIDE INFORMATION REGARDING **CONTRACTS COMPLETED BY YOUR FIRM LISTING <u>ONLY PROJECTS OF SIMILAR NATURE</u> TO THE PROJECT BEING BID**. A MINIMUM OF TWO (S) CONTRACTS SHALL BE LISTED. PUBLICLY BID CONTRACTS ARE PREFERRED.

PROJECT NAME: _____
OWNER: _____
CITY/STATE: _____
DOLLAR AMOUNT: $ _____ DATE COMPLETED: _____
PUBLICLY BID? _____YES_____ NO
TYPE OF WORK?: _____
CONTACT PERSON: _____ TELEPHONE #: (____)_____
CONTACT PERSON'S RELATION TO PROJECT?: _____
(i.e., contract manager, purchasing agent, etc.)
_____

PROJECT NAME: _____
OWNER: _____
CITY/STATE: _____
DOLLAR AMOUNT: $ _____ DATE COMPLETED: _____
PUBLICLY BID? _____YES_____ NO
TYPE OF WORK?: _____
CONTACT PERSON: _____TELEPHONE #: (____)_____
CONTACT PERSON'S RELATION TO PROJECT?: _____
(i.e., contract manager, purchasing agent, etc.)
_____

PROJECT NAME: _____
OWNER: _____
CITY/STATE: _____
DOLLAR AMOUNT: $ _____ DATE COMPLETED: _____
PUBLICLY BID? _____YES_____ NO
TYPE OF WORK?: _____
CONTACT PERSON:_____ TELEPHONE #: (____)_____
CONTACT PERSON'S RELATION TO PROJECT?:_____
(i.e., contract manager, purchasing agent, etc.)

PROJECTNAME: _____
OWNER: _____
CITY/STATE: _____
DOLLAR AMOUNT: $ _____ DATE COMPLETED: _____
PUBLICLY BID? _____YES_____ NO
TYPE OF WORK?: _____
CONTACT PERSON: _____ TELEPHONE #:(____)_____
CONTACT PERSON'S RELATION TO PROJECT?: _____
(i.e., contract manager, purchasing agent, etc.)

10.
The undersigned certifies that the information contained herein is complete and accurate and here by authorizes and requests any person, firm, or corporation to furnish any information requested by the Town in verification of the recitals comprising this statement of Bidder's qualifications and experience.
DATE: _____
BIDDER: _____
SIGNATURE: _____
PRINTED NAME: _____ TITLE: _____

(End Bid Submission Form)

SPECIFICATIONS

TABLE OF CONTENTS

SECTION 22 00 00

PLUMBING

PART 1 - GENERAL

1.0 GENERAL PROVISIONS

A. The GENERAL REQUIREMENTS, DIVISION 01, and BIDDING AND CONTRACT REQUIREMENTS, DIVISION 00, are hereby made a part of this Specification Section.

B. Examine all Drawings and all Sections of the Specifications and requirements and provisions affecting the work of this Section.

1.1 SCOPE OF WORK

A. This project consists of the replacement of one (1) of the two (2) cast iron boilers located at the Blueberry Hill Elementary School in Longmeadow, MA. Plumbing scope of work includes demolition of existing gas piping and installation of new gas piping to accommodate the boiler replacement.

B. The building is to be commissioned. Provide all labor required to fully test and demonstrate that all systems operate as designed.

C. The work under this Section shall include the furnishing of all materials, labor, equipment and supplies and the performance of all operations to provide complete working systems. In general, the following items are specified under this section:

D. Compressed Gas Systems:

1. Natural gas piping.
2. Extend all gas train vents to atmosphere.
3. Gas Flue Piping: this contractor is responsible for supervision, licensure and permitting of gas flues ≥ 400,000 BTU/hr. this includes all gas flues, listed chimney linings, metal and factory built chimney's, ventilation hoods used for exhausting combustion by-products and F-Vent systems. Refer to HVAC drawings and specifications.
4. Final connection to all gas fired equipment includes valves, regulators, drip and dirt pockets, unions and necessary appurtenances.

E. General:

1. Testing and Cleaning of all piping systems
2. Valves.
3. Fittings unions, flanges and couplings.
4. Hangers, plates and inserts.
5. All supplementary steel for piping and equipment support.
6. Drilling for installation of inserts.
7. Shop Drawings

8. Record (As-Built) Drawings

F. Work of this Section is generally shown on the Plumbing Drawings.

1.2 RELATED WORK

A. Principal classes of Work related to the Work of this Section are listed in the Specification Table of Contents, and are specified to be performed under the indicated Sections of the Specifications. Refer to the indicated Sections for description of the extent and nature of the indicated Work, and for coordination with related trades. This listing may not include all related Work items. Coordinate and schedule the Work of this Section with that of all other trades.

B. The following work is not included in this Section and will be provided under other Sections:

1. Concrete work including concrete housekeeping pads.
2. Painting, except as specified herein.
3. Electrical power wiring for all equipment.
4. Temporary light, power, water, heat, gas and sanitary facilities for use during construction and testing. Refer to Division 01, General Conditions.

1.3 DEFINITIONS

A. As used in this Section, the following items are understood to have the following meaning:

1. "***Contractor or Subcontractor"***, unless otherwise qualified, shall mean the installer of the work specified under this Section.
2. "***Furnish"*** shall mean purchase and deliver to the project site, complete with every necessary appurtenance.
3. ***"Install"*** shall mean unload at the delivery point at the site and perform all work necessary to establish secure mounting and proper operation at the proper location in the project.
4. ***"Provide"*** shall mean "Furnish" and "Install".
5. ***"Work"*** shall mean all labor, materials, equipment, apparatus, controls, accessories and all other items required for a proper and complete installation.
6. ***"Concealed"*** shall mean hidden from sight in chases, furred-in spaces, shafts, hung ceilings, embedded in construction or in a crawl space. Areas to be concealed as part of tenant alterations to the building shall also be considered in this definition.
7. ***"Exposed"*** shall mean not installed underground or concealed as defined above.
8. ***"Furnished by others"*** shall mean materials or equipment purchased under other sections of the general contract and installed by this section of the specifications by this trade Contractor.
9. ***"Owners Representative"*** shall be the party responsible to make decisions regarding all contractual obligations in reference to the Scope of Work for the Owner.

10. ***"Date of Substantial Completion"*** shall indicate the date where the work has been formally accepted as evidenced by completed final punch list or where the work has reached the stage that the Owner obtains beneficial use and commences utilization of the installed systems for business or occupancy purposes. The GENERAL REQUIREMENTS, DIVISION 01, shall supercede this definition where specifically defined.

11. ***"Piping"*** shall mean, in addition to pipe or tubing, all fittings, flanges, unions, valves, strainers, drains, hangers and other accessories relative to such piping.

1.4 CODES, REFERENCES AND PERMITS

A. Materials, installation of systems and equipment provided under this section shall be done in strict accordance with Massachusetts Department of Public Safety Codes, Massachusetts Department of Environmental Protection, Massachusetts State Building Code 780 CMR and any other Codes and Regulations having jurisdiction including but not limited to:

1. Massachusetts State Plumbing Code (248 CMR 10.00)
2. Massachusetts Fuel Gas Code (248 CMR 3.00, 4.00, 5.00 and 7.00)
3. State and Local Building Codes and Presiding State Energy Code
4. All applicable NFPA Standards
5. Occupational Safety and Health Administration (OSHA)
6. Underwriters' Laboratories, Inc. (UL)

B. Unless otherwise specified or indicated, materials, workmanship and equipment performance shall conform with the latest governing edition of the following standards, codes, specifications, requirements, and regulations, except when more rigid requirements are specified or are required by applicable codes but not limited to:

1. American National Standards Institute (ANSI)
2. American Society of Mechanical Engineers (ASME)
3. American Society of Testing and Materials (ASTM)
4. American Water Works Association (AWWA)
5. Factory Mutual System (FM)
6. Institute of Electrical and Electronic Engineers (IEEE)
7. Cast Iron Soil Pipe Institute (CISPI)
    a. All cast iron soil pipe and fittings shall be marked with the collective trademark of the Cast Iron Soil Pipe Institute (CISPI) and be listed by NSF International.
    b. Standard, Stainless-Steel Shielded, Couplings: Standard Couplings shall conform to CISPI 310 and ASTM C 1277. Shield Assemblies shall consist of a stainless steel bi-directional corrugated shield; stainless-steel bands and tightening devices; and an ASTM C 564, rubber sleeve. Couplings shall bear the NSF Trademark, and be manufactured in the USA.
8. Plumbing and Drainage Institute (PDI)
9. National Association of Plumbing-Heating Cooling Contractors (NAPHCC)
10. National Electrical Manufacturer's Association (NEMA)

11. National Fire Protection Association (NFPA)
12. National Sanitation Foundation (NSF)
13. Plastic Pipe and Fittings Associations (PPFA)

C. All pressure vessels shall conform to ASME and Massachusetts Codes and Regulations.

D. All pipe and fittings shall be manufactured in the United States.

E. Codes, laws and standards provide a basis for the minimum installation criteria acceptable. The drawings and specifications illustrate the scope required for this project, which may exceed minimum codes, laws and standards.

F. Give all notices, file all plans, obtain all permits and licenses, and obtain all necessary approvals from authorities having jurisdiction. Deliver all certificates of inspection to the authorities having jurisdiction. No work shall be covered before examination and approval by the Owner's Representative, inspectors, and authorities having jurisdiction. Replace imperfect or condemned work to conform to requirements, satisfactory to Owner's Representative, and without extra cost to the Owner. If work is covered before inspection and approval, this Contractor shall pay costs of uncovering and reinstalling the covering, whether it meets contract requirements or not.

1.5 OBTAINING INFORMATION

A. Obtain from the manufacturer the proper method of installation and connection of all equipment that is to be furnished and installed. Obtain all information that is necessary to facilitate the work and to complete the project.

B. Prior to performing any new work, uncover, locate and determine the routing, size, material and direction of slope of all existing piping system to which connection is to be made. The invert elevation of the existing drains and sewers must be established prior to any slab cutting for new piping systems.

1.6 MATERIAL AND EQUIPMENT STANDARDS

A. Where equipment or materials are specified with the name of a manufacturer, such specification shall be deemed to be used for the purpose of establishing a standard for that particular item. No equipment or material shall be used unless previously approved by the Owner's Representative.

B. Substitutions may be offered for review provided the material, equipment or process offered for consideration is equal in every respect to that indicated or specified. The request for each substitution must be accompanied by complete specifications together with drawings or samples to properly appraise the materials, equipment or process. Highlight and list all applicable specification requirements, which the substituted material deviates from.

C. If a substitution of materials or equipment in whole or in part is made, bear the cost of any changes necessitated by any other trade as a result of said substitution.

D. All materials, equipment and accessories provided under this section shall be new and unused products of recognized manufacturers as approved.

E. All material, equipment and accessories provided under this section must be listed on the Massachusetts Board of Registration of Plumbers and Gas Fitters accepted Plumbing Products System.

1.7 SUBMITTALS

A. Conform to the requirements of Division 01, General Conditions, for schedule and form of all submittals unless specifically noted otherwise in this Section. Coordinate this submittal with submittals for all other finishes. Shop drawings and design layouts shall be prepared by licensed installing Contractors and shall note the name(s), license number(s) and license expiration dates(s) of the Contractor(s) installing the Plumbing work.

B. Definitions:

1. Shop Drawings are information prepared by the Contractor to illustrate portions of the work in more detail than indicated in the Contract Documents.

2. Acceptable Manufacturers: The mechanical design for each product is based on the single manufacturer listed in the schedule or shown on the drawings. In Part 2 of the specifications, certain Alternate Manufacturers are listed as being acceptable. In addition, the MATERIAL AND EQUIPMENT STANDARDS paragraph potentially allows for substitutions as being acceptable. These are acceptable only if, as a minimum, they:

a. Meet all performance criteria listed in the schedules and outlined in the specifications.

b. Fit within the available space it was designed for, including space for maintenance and component removal, with no modification to either the space or the product. Clearances to walls, ceilings, and other equipment will be at least equal to those shown on the design drawings. The fact that a manufacturer's name appears as acceptable shall not be taken to mean the Engineer has determined that the manufacturer's products will fit within the available space – this determination is solely the responsibility of the Contractor.

c. Products must adhere to all architectural considerations including, but not limited to; being of the same color as the product scheduled or specified and fitting within the architectural enclosures and details.

C. Submittal Procedures, Format and Requirements

1. Review submittal packages for compliance with Contract Documents and then submit to Owner's Representative for review. Submit enough sets of shop drawings such that, after review, two sets will be kept by the reviewer, with only the remaining sets returned with reviewer's marks and comments.

2. Each Shop Drawing shall indicate in title block, and each Product Data package shall indicate on cover sheet, the following information:

a. Title

b. Equipment number

c. Name and location of project

d. Names of Owner, Engineer and Seller

e. Names of manufacturers, suppliers, vendors, etc.

f. Date of submittal

g. Whether original submittal or resubmitted

3. Shop Drawings showing manufacturer's product data shall contain detailed dimensional drawings (minimum ¼" = 1' scale) including plans and sections (where physical clearance could be an issue). Provide larger scale details as necessary.

4. Submit accurate and complete description of materials of construction, manufacturer's published performance characteristics, sizes, weights, capacity ratings (performance data, alone, is not acceptable), electrical requirements, starting characteristics, wiring diagrams, and acoustical performance for complete assemblies. Drawings shall clearly indicate location (terminal block or wire number), voltage and function for all field terminations, and other information necessary to demonstrate compliance with all requirements of Contract Documents.

5. Provide Shop Drawings showing details of piping connections to all equipment. If connection details are not submitted and connections are found to be installed incorrectly, this Contractor shall reinstall them within the original contract price.

6. Provide complete data for all auxiliary services and utilities required by submitted equipment.

7. Provide a complete description of all controls and instrumentation required including electrical power connection drawing for all components and interconnection wiring to starters, detailed information on starters, control diagrams, termination diagrams, and all control interfaces with a central control system.

8. Provide installation and erection information including; lifting requirements, and any special rigging or installation requirements for all equipment.

9. The Owner's Representative shall approve all materials before commitment for materials is made.

D. Specifications and Schedule Compliance Statement

1. The manufacturer shall submit a point by point statement of compliance with each specification criteria listed in each paragraph for those submittals listed in Paragraph E: Product Data that are noted with an asterisk (*).

2. The statement of compliance shall consist of a list of all paragraphs (line by line) identified in Part 2 and applicable Part 3 of the specification for which the submitted product in the opinion of the manufacturer complies, deviates, or does not meet.

3. Where the proposed submittal complies fully, the word "comply" shall be placed opposite the paragraph number.

4. Where the proposed submittal does not comply, or accomplishes the stated function in a manner different from that described, a full description of the deviation shall be provided.

5. Verify each field of the associated schedule where associated technical data is presented on the drawings. Where the submitted material does not 'comply" provide the value the submitted equipment will achieve based upon the specified conditions.

6. Where a full description of a deviation is not provided, it shall be assumed that the proposed system does not comply with the paragraph in question and the product will be rejected.

7. Submissions which do not include a point by point statement of compliance as specified shall be disapproved.

E. Product Data: Submit complete manufacturer's product description and technical information including:

1. Piping – General. A submittal is required for each pipe class listed in these specifications.

2. Unions and Flanges

3. Pipe Joint Materials

4. Hangers, Inserts and Supports

5. Valves

6. Identification, labels and tags.

7. For welded systems, submit weld coupons

F. Submit shop drawings and product data grouped to include complete submittals of related systems, products and accessories in a single submittal.

1. Do not submit multiple product information in a single bound manual.

2. Three-ring binders shall not be accepted.

G. Deviations

1. Concerning deviations other than substitutions, proposed deviations from Contract Documents shall be requested individually in writing whether deviations result from field conditions, standard shop practice, or other cause. Submit letter with transmittal of Shop Drawings which flags the deviation to the attention of the Owner's Representative.

2. Without letters flagging the deviation to the Owner's Representative, it is possible that the Engineer may not notice such deviation or may not realize its ramifications. Therefore, if such letters are not submitted to the Owner's Representative, the Seller shall hold the Engineers, his consultants and the Owner harmless for any and all adverse consequences resulting from the deviations being implemented. This shall apply regardless of whether the Engineer has reviewed or approved shop drawings containing the deviation, and will be strictly enforced.

3. Approval of proposed deviations, if any, will be made at discretion of Engineer.

H. Schedule: Incorporate shop drawing review period into construction schedule so that Work is not delayed. This Contractor shall assume full responsibility for delays caused by not incorporating the following shop drawing review time requirements into his project schedule. Allow at least 10 working days, exclusive of transmittal time, for review each time shop drawing is submitted or resubmitted with the exception that 20 working days, exclusive of transmittal time are required when more than five shop drawings of a single trade are received in one calendar week.

I. Responsibility

1. Intent of Submittal review is to check for capacity, rating, and certain construction features. Ensure that work meets requirements of Contract Documents regarding information that pertains to fabrication processes or means, methods, techniques, sequences and procedures of construction; and for coordination of work of this and other Sections. Work shall comply with approved submittals to extent that they agree with Contract Documents. Submittal review shall not diminish responsibility under this Contract for dimensional coordination, quantities, installation, wiring, supports and access for service, nor the shop drawing errors or deviations from requirements of Contract Documents. The Engineer's noting of some errors while overlooking others will not excuse the Plumbing Contractor from proceeding in error. Contract Documents requirements are not limited, waived nor superseded in any way by review.

2. Inform Contractors, manufacturers, suppliers, etc. of scope and limited nature of review process and enforce compliance with contract documents.

J. In the event that the Shop Drawings for any of the products specified herein are not provided:

1. Furnish and install all materials and equipment herein specified in complete accordance with these Specifications.

2. If materials and/or equipment are installed that are not in complete accordance with these specifications, remove this material and/or equipment. Replace material and/or equipment with material and/or equipment that are in complete accordance with these specifications, at the direction of the Owner’s Representative.

3. Removal and replacement of materials and/or equipment that is not in complete compliance with these Specifications shall be done at no extra cost to the Owner.

4. Removal and replacement of materials and/or equipment that is not in complete compliance with these Specifications shall not be allowed as a basis for a claim of delay of completion of the Work.

K. Mark dimensions and values in units to match those specified.

L. Submit Material Safety Data Sheets (MSD) on each applicable product with submittal.

1.8 RECORD DRAWINGS

A. Refer to DIVISION 01, General Conditions, for record drawings and procedures to be provided under this section, unless specifically noted otherwise in this section.

B. Record Drawings (red-line drawings) will be updated daily for review with the monthly requisition. The record drawing shall be an accurate depiction of the systems as completed, including dimensions (vertical/horizontal of concealed components off fixed building elements.

C. Maintain complete and separate set of prints of Contract Drawings at job site at all times and record work completed and all changes from original Contract Drawings clearly and accurately including work installed as a modification or addition to the original design.

D. At completion of work prepare a complete set of record drawings on AutoCAD showing all systems as actually installed. The architectural background AutoCAD files will be made available for the Contractor’s copying, at his expense, to serve as backgrounds for the

drawings. Transfer changes from field drawings onto AutoCAD drawings and submit copy of files and three sets of prints to Owner's Representative for comments as to compliance with this section. CAD layering as established by the A&E design team shall be maintained with any and all changes done by the Contractor.

E. The Architect and Engineer are not granting to the Contractor any ownership or property interest in the CADD Drawings by the delivery of the CADD Disks to the Contractor. The Contractor's rights to use the CADD disks and the CADD Drawings are limited to use for the sole purpose of assisting in the Contractor's performance of its contractual obligations under its contract with respect to the Project. The Architect and Engineer are granting no further rights. Any reuse or other use by the Contractor will be at the Contractor's sole risk and without liability to the Architect and Engineer. The Contractor hereby waives and releases any losses, claims, damages, liabilities of any nature whatsoever, and costs (including attorney fees) arising out of, resulting from, or otherwise related to the use of the CADD Disks and CADD Drawings by the Contractor. The Contractor, to the maximum extent permitted by law, hereby agrees to indemnify, defend and hold the Architect and Engineer harmless from all loses, claims, damages, liabilities, and costs (including attorney fees) arising out of, resulting from, or otherwise related to the use of the CADD Disks and CADD Drawings by the Contractor.

F. Record Drawings, shall show "as-built" condition of details, sections, riser diagrams, control changes and corrections to schedules. Schedules shall show actual manufacturer and model numbers of final equipment installation.

G. Submit the record set for approval by the engineer a minimum of four weeks prior to seeking the permanent certificate of occupancy.

1.9 WARRANTIES

A. Submit manufacturer's standard replacement warranties for material and equipment furnished under this Section. Such warranties shall be in addition to and not in lieu of all liabilities which the manufacturer and the Contractor may have by law or by provisions of the Contract Documents.

B. All materials, equipment and work furnished under this Section shall be guaranteed against all defects in materials and workmanship for a minimum period of one-year (1) commencing with the Date of Substantial Completion. Any failure due to defective material, equipment or workmanship which may develop, shall be corrected at no expense to the Owner including all damage to areas, materials and other systems resulting from such failures.

C. Guarantee that all elements of each system meet the specified performance requirements as set forth herein or as indicated on the Drawings.

D. Upon receipt of notice from the Owner of the failure of any part of the systems during the warranty period, the affected parts shall be replaced. Any equipment requiring excessive service shall be considered defective and shall be replaced.

1.10 COORDINATION

A. Refer to **DIVISION 01, GENERAL CONDITIONS**, for record drawings and procedures to be provided under this Section, unless specifically noted otherwise in this Section.

B. Materials and apparatus shall be installed as fast as conditions of the building will permit and must be installed promptly when and as required.

C. Confer with all other trades relative to location of all apparatus and equipment to be installed and select locations so as not to conflict with work of other Sections. Any conflicts shall be referred immediately to the Owner's Representative for decision to prevent delay in installation of work. All work and materials placed in violation of this clause shall be readjusted to the Owner's Representative's satisfaction at no expense to the Owner.

D. Where work of this section will be installed in close proximity to work of other sections or where there is evidence that the work of this section may interfere with work of other sections, assist in working out space conditions to make satisfactory adjustment. Prepare and submit for approval 3/8" scale or larger working drawings and sections, clearly showing how the work is to be installed in relation to the work of other sections. If the work of this section is installed before coordinating with other trades or so as to cause interference with work of other trades, make changes necessary to protect conditions without extra charge.

E. Keep fully informed as to the shape, size and position of all openings required for all apparatus, pipes, sleeves, etc., and give information in advance to allow construction of required openings. Furnish all sleeves, pockets, supports and incidentals, and coordinate with the General Contractor for the proper setting of same.

F. All distribution systems which require pitch or slope such as condensate drains and water piping shall have the right of way over those which do not. Confer with other trades as to the location of pipes, ducts, lights and apparatus and install work to avoid interferences.

G. Make reasonable modifications in the work as required by structural interferences, interference with work of other trades, or for proper execution of the work without extra charge.

1.11 INTERPRETATION OF DRAWINGS AND SPECIFICATIONS

A. It is the intention of the Specifications and Drawings to call for complete, finished work, tested and ready for continuous operation. Any apparatus, appliance, material or work not shown on the Drawings, but mentioned in the Specifications or vice-versa, or any incidental accessories necessary to make the work complete in all respects and ready for operation, even if not particularly specified, shall be provided without additional expense to the Owner.

B. The Drawings are generally diagrammatic. The locations of all items that are not definitely fixed by dimensions are approximate only. The exact locations must be determined at the project and shall have the approval of the Owner's Representative before being installed. Follow Drawings, including his shop drawings, in laying out work and shall check the Drawings of other trades to verify spaces in which work will be installed. Maintain maximum headroom and space conditions. Where space conditions appear inadequate, notify the Owner's Representative before proceeding with the installation. Without extra charge, make reasonable modifications in the layout as needed to prevent conflict with work of other trades or for proper execution of the work.

C. Any requests for information (RFI) for resolving an apparent conflict or unclarity, or a request for additional detail, shall include a sketch or equivalent description of proposed solution.

D. Size of pipes and methods of running them are shown, but it is not intended to show every offset and fitting, nor every structural difficulty that may be encountered. To carry out the true intent and purpose of the Drawings, all necessary parts to make complete approved working systems ready for use, shall be furnished without extra charge. All work shall be installed in an approved workmanlike manner.

1.12 INSPECTION OF SITE CONDITIONS

A. Prior to submission of bid, visit the site and review the related construction documents to determine the conditions under which the Work has to be performed. Report, in writing, to the Owner's Representative, any conditions which might adversely affect his work.

1.13 SURVEY AND MEASUREMENTS

A. Base all required measurements, horizontal and vertical, from referenced points established WITH the Owner's Representative and be responsible for correctly laying out the Work required under this Section of the Specification.

B. In the event of discrepancy between actual measurements and those indicated, notify the Owner's Representative in writing and do not proceed with the related work until instructions have been issued.

1.14 DELIVERY, STORAGE AND HANDLING

A. No materials shall be delivered or stored on site until corresponding Shop Drawings have been approved.

B. All manufactured materials shall be delivered to the site in original packages or containers bearing the manufacturers labels and product identification.

C. Protect materials against dampness. Store off floors, under cover and adequately protected from damage.

D. Inspect all plumbing equipment and materials, upon receipt at the job site, for damage and conformance to approved shop drawings.

1.15 PROTECTION OF WORK AND PROPERTY

A. Be responsible for the care and protection of all work included under this Section until the completion and final acceptance of this Contract.

B. Protect all equipment and materials from damage from all causes including, but not limited to, fire, vandalism and theft. All materials and equipment damaged or stolen shall be repaired or replaced with equal material or equipment at no additional cost to the Owner.

C. Protect all equipment, outlets and openings with temporary plugs, caps and covers. Protect work and materials of other trades from damage that might be caused by work or workmen under this Section and make good damage thus caused.

D. Damaged materials are to be removed from the site; no site storage of damaged materials will be allowed.

1.16 SUPERVISION

A. Supply the service of a competent Supervisor with a minimum of 5 years experience in Plumbing Construction Supervision who shall be in charge of the Plumbing work at the site.

1.17 SAFETY PRECAUTIONS

A. Life safety and accident prevention shall be a primary consideration. Comply with all of the safety requirements of the Owner and OSHA throughout the entire construction period of the project.

B. Furnish, place and maintain proper guards and any other necessary construction required to secure safety of life and/or property.

1.18 SCHEDULE

A. Construct work in sequence under provisions of Division 01 and as coordinated with the Owner's Representative.

1.19 HOISTING, SCAFFOLDING AND PLANKING

A. The work to be done under this Section of the Specifications shall include the furnishing, set-up and maintenance of all derricks, hoisting machinery, cranes, helicopters, scaffolds, staging and planking as required for the work.

1.20 SLEEVES, INSERTS AND ANCHOR BOLTS

A. Coordinate with other trades the location of and maintaining in proper positions, sleeves, inserts and anchor bolts to be supplied and/or set in place under this section of the specifications. In the event of incorrectly located preset sleeves, inserts and anchor bolts, etc., all required cutting and patching of finished work shall be done under this section of the specifications.

B. Field drilling (core drilling), when required, shall be performed under this section of the specifications, after receipt of approval by the Owner's Representative.

1. When coring cannot be avoided, provide ¼ inch pilot hole prior to coring. When coring through floor or slab, verify location of core on floor below and protect and piping, ductwork, wiring, furniture, personnel, etc., below the location of the core.

1.21 SUPPLEMENTARY STEEL, CHANNELS AND SUPPORTS

A. Provide all supplementary steel, factory fabricated channels and supports required for the proper installation, mounting and support of all Plumbing equipment, piping, etc., required by the Specifications.

B. Supplementary steel and factory fabricated channels shall be firmly connected to building construction in a manner approved by the Owner's Representative as shown on the drawings or herein specified.

C. The type and size of the supporting channels and supplementary steel shall be determined by the Contractor and shall be of sufficient strength and size to allow only a minimum deflection in conformance with the manufacturer's requirements for loading.

D. All supplementary steel and factory fabricated channels shall be installed in a neat and workmanlike manner parallel to the walls, floors and ceiling construction. All turns shall be made with 90 degree and 45 degree fittings, as required to suit the construction and installation conditions.

E. All supplementary steel including factory fabricated channels, supports and fittings shall be approved, shall be galvanized steel, aluminum or stainless steel where exposed or subject to rust producing atmosphere and shall be manufactured by Unistrut, H-strut, Powerstrut or approved equal.

1.22 HAZARDOUS MATERIALS

A. Dispose of all hazardous materials in accordance with Federal and State laws. All handling shall conform to EPA requirements. A uniform hazardous waste manifest shall be prepared for all disposals and returned with all applicable signoffs prior to application for final payment. Provide breakout cost for this scope.

B. Removed equipment or fluids containing any hazardous materials such as ethylene glycol, or oil shall be recycled by a licensed facility approved by the Owner's Representative.

C. Where it has been identified that asbestos-containing material exists within the scope limits, refer to the Asbestos Abatement specification section for requirements. Where insulation is removed, provide new insulation (type and thickness as specified in this section). Where scope is not defined, provide unit prices with bid for all pipe and sizes involved.

1.23 ACCESSIBILITY

A. All work provided under this Section of the Specification shall be installed so that parts requiring periodic inspection, maintenance and repair are accessible. Work of this trade shall not infringe upon clearances required by equipment of other trades, especially code required clearances to electrical gear. Minor deviations from the drawings may be made to accomplish this, but changes of substantial magnitude shall not be made prior to written approval from the Owner's Representative.

1.24 WELDING QUALIFICATIONS

A. [Piping shall be welded in accordance with qualified procedures using performance qualified welders and welding operators.] Procedures and welders shall be qualified in accordance with ASME BPV IX. Welding procedures qualified by others, and welders and welding operators qualified by another employer, may be accepted as permitted by ASME B31.1. The Owner's Representative shall be notified 24 hours in advance of tests, and the tests shall be performed at the work site if practicable. Welders or welding operators shall apply their assigned symbols near each weld they make as a permanent record. Structural members shall be welded in accordance with Section 05055 WELDING STRUCTURAL.

B. A fire watchman with an approved fire extinguisher shall be posted at the site of the welding work, during that work, and for a minimum of 30 minutes after the work is completed, to see that sparks or drops of hot metal do not start fires.

1.25 PROJECT CLOSEOUT

A. Construction Observations By The Engineer

1. The engineer shall make progress site visits during construction, and one substantial completion (punch list) site visit for determining substantial completion.

2. The Trade Contractors and the General Contractor are required to inspect their own work and make any corrections to the work to comply with the specifications and the contract documents. It is not the responsibility of the engineer to develop lists of incomplete work items.

3. Progress Site Visits

a. The purpose of the progress site visit by the engineer is to observe if the work is proceeding in accordance with the contract documents.

b. The engineer will prepare a field report which will note in general the work completed since the last observation visit, work found not to be in accordance with the contract documents and work not corrected since the previous observation visit.

B. Substantial Completion

1. When the Work under this Section is substantially complete, submit written notice with a detailed list of items remaining to be completed or corrected and a schedule of when each remaining work item will be completed. Should the engineer determine the list of remaining work does not constitute substantial completion the engineer will notify the Architect and/or Owner and he will not make a substantial completion site visit.

2. The following items shall be completed prior to the written request for substantial completion site visit:

a. Certification of successful operation of all systems.

b. Training of the Owner's personnel in the operation of the systems.

c. Record Drawings in accordance with the contract specifications.

d. Operation and Maintenance manuals.

e. Testing reports.

f. Balancing reports.

g. Manufacturers certificates of approvals.

h. Emergency contact list for reporting of malfunctioning equipment during the warrantee period.

i. Contractors Project Completion certificate in accordance with the building code requirements.

3. Should the Engineer, during the substantial completion visit, observe that the Work is substantially complete, s/he will provide a written listing of the observed deficiencies referred herein as the Punch List. The Punch List will provide for a place for the Contractor and general Contractor to sign off and date each item individually indicating that the observed deficiency item has been corrected.

4. Should the Engineer, during the substantial completion site visit, observe that the Work is not substantially complete, s/he will provide, a written list of the major deficiencies and a reason for the work not being considered substantially complete.

5. If the work is found not to be substantially complete then the engineer shall be reimbursed for his time to reobserve the work. A reobservation fee shall be charged to the Contractor through the contractual agreement for any further observations by the engineer.

6. Remedy all deficiencies listed in the punch list within the time frame required by the contract.

C. Engineers Construction Completion Certification

1. Where required by the applicable code, the Engineers Construction Completion Certification will be issued by NV5 when all life safety and health related issues are complete, all required functional tests are complete and all reports are complete. The following is a minimum listing of the required systems to be tested with reports generated indicating they are complete and ready for use:

a. Gas Distribution Pressure Test

2. There shall be NO outstanding items identified on the punch list for scope within any of these categories.

D. Final Completion

1. The following items shall be submitted prior to the written request for Final completion:

a. Revised Substantial Completion items to be resubmitted in accordance with the review process comments.

b. Warranties commencing the date of Substantial completion

c. Individual Signed and dated Punch List acknowledging completion of all punch list items

2. When all of the punch list work items are complete and resolved and the work is ready for final observation site visit. The signature lines for completion of each punch list item shall be signed by the Contractor indicating the work is complete and signed by the General Contractor indicating s/he has inspected the work and found it to be complete. Should the Engineer find the work to be finally complete and all Punch List items are complete the Engineer will make a recommendation to the Architect or Owner. If the Engineer has found the punch list work to be

incomplete during final inspection a written listing of the observed deficiencies will be prepared by the Engineer.

3. If the work is not fully complete then the engineer shall be reimbursed for his time to reobserve the work. A reobservation fee shall be charged to the Contractor through the contractual agreement for any reobservations by the engineer.

E. Re-observation Fees

1. The re-observation fee shall be $1200.00 per visit.

F. Contractor's Project Completion Certificate

1. Upon completion of work and prior to request for Certificate of Occupancy, each Trade Contractor and the General Contractor shall issue a certificate stating that work has been installed generally consistent with construction documents and all applicable codes. NV5 can furnish a blank Contractor's certificate form upon request. The certificate shall certify:

   a. Execution of all work has been installed in accordance with the approved construction documents.

   b. Execution and control of all methods of construction was in a safe and satisfactory manner in accordance with all applicable local, state and federal statutes and regulations.

2. The certificate shall include the following information:

   a. Project.

   b. Permit Number.

   c. Location.

   d. Construction Documents.

   e. Date on Plans and Specifications submitted for approval and issuance of the Building Permit.

   f. Addendum(a) and Revision Dates.

3. The certificate shall be signed by the Contractor and include the following:

   a. Signature.

   b. Date.

   c. Company.

   d. License Number.

   e. License Expiration Date.

PART 2 - PRODUCTS

2.0 RESERVED

2.1 PIPE, FITTINGS AND JOINTS - GENERAL

A. PIPE MATERIALS SPEC INDEX

SERVICE	CODE	MAXIMUM SERVICE OPERATING LIMITS		PIPE CLASS	PIPE MATERIAL
		(psig)	TEMPERATURE (°F)		
Gas (Natural)	G	50	70	A11	C. Steel
Gas Vent	GV	50	70	A11	C. Steel

General Pipe Spec Notes:

1. Each valve type shall be the product of a single manufacturer. Each system shall be provided with valves as required by code and shown on the dwgs. And shall be installed to facilitate operation, replacement and repair.
2. Provide access panels for concealed valves behind non-removable ceilings or walls.
3. Provide shut-off valves on supply piping to individual pieces of equipment.
4. Provide pipe dope, teflon tape, wax rings, neoprene gaskets and other jointing compounds as required by best standard practice and only on service as recommended by manufacturer.
5. Apply putties and jointing compounds for plumbing fixtures and trim as recommended by manufacturers.

PIPE CLASS A11	**Gas Piping**	
ITEM	**2" AND SMALLER**	**2½" AND LARGER**
Pipe	Schedule 40 Carbon Steel ASTM A53 Grade B, A106 Grade A Or ASTM A120.	Schedule 40 Carbon Steel ASTM A53 Grade B, ASTM A106 Grade A Or ASTM A120.
Fittings	Screwed Malleable Iron 150 PSI. Mechanical Press Connect Fittings: Viega MegaPress G ½-inch through 2-inch with HNBR sealing element shall conform to ANSI LC4-2012 /CSA 6.32-2012 2nd Edition. Installation must be in accordance to manufacturer's instructions and specifications utilizing manufacturers approved tooling. All installers shall hold a manufacturers credential card confirming individual has been trained by manufacturer.	Butt Weld Carbon Steel Schedule 40, ASTM A234.
Unions	Screwed 150# Malleable Iron ASTM A197 Grade II.	Use Flanges.
Flanges	150# Raised Face, Screwed, ASTM A197.	150# Raised Face Weld Neck ASTM A105
Valves - note: all valves used for gas shall be Plumbing Board approved for use.		
Plug/Gas Cock	Apollo 70-100-07 series.	Watts FBV3C-IPS, or flanged ball valve for sizes up to 4" Valves larger than 4", Iron Body, Greasable and Lubricated Tapered Plug, rectangular port, regular opening, Flanged End, Valve shall be equal to R&M Energy Systems Inc. Resun Model #1431 200 psi WOG, 125 psi SWP. The valve shall be approved for use by the state fuel gas code. other acceptable manufacturers are Nordstrom, or Serck Audco
Ball	Bottom Loaded Pressure Stem. Valve Rated At 600 psi WOG. Watts B-6000-UL-Mass. Apollo 70 series, or Equal.	Approved valves shall be 2-piece full port design constructed of a forged brass body and end adapter. Seats and stem packing shall be virgin PTFE. Stem shall be bottom loaded, blowout proof design with fluo-rocarbon elastomer O-ring to prevent stem leaks. Valve shall have chrome plated brass ball and adjustable packing gland. Valve sizes 21/2" – 4" (65 – 100mm) threaded, shall be rated to 400psi (27.5 bar) WOG non-shock and 125psi (8.6 bar) WSP. Valve shall be a Watts Regulator Company Series FBV-3C

PIPE CLASS A11	Gas Piping	
ITEM	**2" AND SMALLER**	**2½" AND LARGER**
		(threaded) or equal.
Pressure Regulator Inlet Pressure Up to 2 psig	Provide a CSA design certified lever acting line pressure regulator where shown on plans. The regulator shall be in compliance with ANSI Z21.80, be a self-aligning valve with lever action for dead end lockup, and have an outlet pressure range of 7-11 inches W.C. The regulator shall be constructed of an aluminum casting with corrosion resistant internal parts and a nitrile rubber valve. The regulator shall be Maxitrol or equal by Equimeter or Fisher Controls.	
Gaskets	1/16" Red Rubber, Wire Inserted. 150# Raised Face and 125# Flatface Gasket.	

Notes:

1. Provide Two Wrenches For Each Gas Cock Size.
2. The Contractor, At His Option, May Weld Piping Down To 1-1/4 If Permitted By Local Codes.
3. All Welders For Gas Piping Must Be Certified Per The Requirements Of Section 22 00 00.

2.2 PIPING AND MATERIAL SUNDRIES

A. Materials and equipment shall be of the best quality manufactured, new, unused and free from all defects. Piping and fittings shall conform to the latest ANSI, ASTM, and NFPA and AWWA Standards including latest amendments and shall be in conformance with state and local plumbing codes, material standards.

B. Each length of pipe, each pipe fitting, trap, materials and/or device used in the respective system shall have cast, stamped or indelibly marked on it, the maker's name or mark, weight and quality of the product when such marking is required by the approved standard that applies.

C. Unions and Flanges

1. Unless otherwise specified herein, unions for copper and brass piping two inches and smaller shall be 125 pounds (steam working pressure) brass ground joint type. Larger than 2 inches in diameter shall be 150 pounds flat faced brass

flanges conforming to ANSI Standard B16.24. Flanges shall have copper clad steel bolts and nuts and 1/16-inch minimum thickness red rubber full faced gaskets.

2. Where brass flanges and ferrous flanges are to be joined, ferrous flanges shall be full faced.

3. Mating of ferrous and non-ferrous flanges shall be separated with rubber gaskets (1/16-inch minimum thickness) and Teflon liners installed in the boltholes. Boltholes shall be drilled to receive the Teflon liners. Physical contact between the ferrous and non-ferrous flanges including the bolts, nuts, and washers will not be permitted.

D. Nipples

1. Close and shoulder nipples shall be of corresponding materials as specified for the respective piping system and shall be extra heavy.

2.3 HANGERS AND SUPPORTS

A. Hangers shall be installed, as required, to meet code compliance as to location/spacing and Manufacturer's Standardization Society (MSS) Standard Practice Bulletins SP-58 & 69.

B. Hanger material shall be compatible with piping materials with which it comes into contact.

C. Hangers shall be installed, in addition to the above, at all changes of direction (horizontal and vertical), valves and equipment connections. Hangers shall be located so that their removal is not required to service, assemble or remove equipment.

D. Horizontal runs may use band hangers up to 4" size. Piping larger than 4" shall be provided with Clevis type.

E. Where three or more pipes are running parallel to each other, factory fabricated gang pipe hangers with pipe saddle clips or rollers may be used in lieu of the hereinbefore specified hangers. These hangers shall be sized to provide for insulation protectors as hereinafter specified. Pipe saddle clips shall be not less than 16 gauge metal and shall be copper when installed with uninsulated copper piping. Where pipe rollers are provided for insulated copper piping, insulation protectors shall be provided at each set of rollers and filled with a section of heavy density fiberglass pipe covering.

F. Exposed rods, clamps, hangers, and shields shall be electrogalvanized coated.

G. Upper Attachments to Building Structure:

1. Existing Reinforced Concrete Construction: Upper attachment welded or clamped to steel clip angles that are expansion-bolted to the concrete. Expansion bolting shall be located so that piping loads place bolts in shear. Submit details for approval.

2. Structural Steel Framing: Upper attachments welded or clamped to structural steel members. Additional steel members may be necessary in some support locations where piping locations differ from that known on contract drawings. Submit details for approval.

3. Structural Wood Framing: Submit details for approval.

4. Expansion Fasteners and Power Set Fasteners: In existing concrete slab construction, expansion fasteners may be used for hanger loads up to one-third the manufacturer's rated strength of the expansion fastener. Power set fasteners may be used for loads up to one-fourth of rated load. When greater hanger loads are encountered, additional fasteners may be used and interconnected with steel members combining to support the hanger.

H. All inserts in new concrete construction shall be capable of developing the full strength of the rod or bolt used in them and shall be either continuous insert type or malleable iron concrete inserts for rod sizes 3/8 inch to 7/8 inch. Continuous inserts shall have anchors every 4 inches and shall extend 1-1/2 inches above the back of the insert and shall hook to provide anchor. All inserts shall be tied into the reinforcing steel rods with wire and properly sized reinforcing rods shall be inserted through the special holes, hooks, or brackets provided in or on the inserts to securely anchor insert to the structure.

I. Valve and piping supports, from the floor, shall be adjustable pipe support and complete with pipe standard and flange, anchored to floor.

1. Supports shall be installed at each control valve, riser tee or elbow and where any unsupported section exceeds 4'-0" in length measured along piping centerline and within 4’-0” off floor.

PART 3 - EXECUTION

3.0 DEMOLITION

A. The existing facility will continue to operate during all phases of the demolition work and subsequent construction. No interruption of the plumbing systems will be permitted without prior approval of the Owner’s Representative. Work at the Center Elementary School and Blueberry Hill Elementary School is to be performed only during unoccupied hours.

B. Submit proposed methods and sequence of operations for the selective demolition work to the Owner’s Representative for review prior to the start of the work.

C. Perform all demolition while ensuring minimum interference with adjacent occupied areas.

D. Where sections of a system are to be removed and the system serves other areas of the building that are outside the scope of the work, perform the following:

1. Coordinate the temporary shutdown of the system with the Owner's representative.

2. Install supports in the remaining active sections of the system as required by the removal of nearby supports associated with the demolition.

3. Isolate the system.

4. Cap the remaining system section, leaving the remainder of the system active.

E. Provide temporary shoring or bracing during the demolition work to prevent movement, settlement, or collapse of the system or adjacent systems due to the work.

F. Promptly repair any damage caused to adjacent facilities or areas that are designated to remain at no additional cost to the Owner.

G. Equipment:

1. Coordinate with the Contractor and Subcontractors to provide disconnection prior to equipment removal.

2. Remove equipment by unfastening at the supports or attachments. Then remove the attachments from the building, leaving no component of the original installation.

3. The Owner shall choose to take possession of the equipment or not. If the Owner chooses not to take possession of the equipment, the Subcontractor shall remove the equipment and dispose of the equipment in accordance with Paragraph H specified below.

4. Exercise care with equipment that is to be relocated or turned over to the Owner, examine the equipment before removal in the presence of the Owner's representative to determine its condition.

5. Install relocated equipment to ensure no damage.

6. Equipment to be turned over to the Owner: Deliver to an on-site location designated by the Owner, and obtain acknowledgment of receipt in good condition.

H. All equipment, etc., not turned over to the Owner shall be become the property of the General Contractor, and shall be removed from the site and be properly disposed of.

3.1 IDENTIFICATION

A. General

1. All piping, equipment, control panels, and valves furnished and/or installed under this Section of the Specifications and shall be marked for ease of identification.

2. Marking shall be done using self-adhering (screw or rivets for equipment) labels applied to clean, smooth surfaces. All lettering shall have sharply contrasting background for ease of identification. Colors shall be in accordance with ANSI A13.1 Standards. Samples of stickers together with color schedules shall be submitted for approval.

B. Pipe Identification

Provide color-coded pipe identification markers on all piping in the building installed under this section.

1. All pipe markers shall be as manufactured by W.H. Brady, Westline Products, Seton Nameplate Company or approved equal. Stenciling of the piping will not be permitted. Pipe markers, bands and flow arrows shall be pressure adhesive, snap-on, acrylic or vinyl type.

2. Furnish and affix approved adhesive bands identifying the service and direction of flow of each piping system installed under this Section of the Specifications.

3. Name of the service, taken from drawing legend, shall be printed in black letters, not less than 1 ¼ inches high for piping, including covering, 3 inches and larger and ¾ inch in height for piping 2-1/2 inches and smaller.

4. Arrows and color band background shall conform to State Plumbing Code for all domestic and protected water systems. Legends, arrows and colors shall conform to ANSI Standard A13.1 covering “Identification of Piping Systems” for all other systems.

5. Identification shall be provided on all piping that is exposed as well as all in concealed locations such as shafts, and above removable ceilings in which piping may be viewed.

6. Each set shall consist of one band on which the name of the service is printed and one band on which is printed a black directional arrow.

7. Bands shall be applied where they can be easily read from the finished floor below, with their long dimension parallel to the axis of the pipe.

8. Bands shall be applied only after any finish painting is completed.

9. In general, the piping of each system shall be identified in the following locations and the piping designation shall be taken from the legend as indicated on the drawings.

   a. Pipe mains and branches – every 25 feet in all accessible open areas and ten feet apart in congested areas.

   b. At each side of valves and pipe tees.

   c. Each wall penetration (both sides).

   d. At each piece of equipment.

   e. At each floor, above and below ceilings, on exposed risers and drops.

10. The following color coding shall be used with names in black letters on backgrounds indicated:

SCHEDULE OF PIPING IDENTIFICATION		
Service	**Legend**	**Background Color**
Gas	Natural Gas	Yellow

C. Valve Tags

1. All valves on pipes of every description shall have numbering tags. The valve numbers shall correspond with numbers indicated for valves and controls on two-printed Valve Lists prepared using electronic database by the HVAC subcontractor. These printed lists shall state the numbers and locations of each valve and the fixture or group of fixtures which it controls, and other necessary information, such as requiring the opening or closing of another valve when one valve is to be opened or closed.

2. Provide flow diagrams showing all valves. Use the Valve List for callouts of all valves on the flow diagrams, prepared in a form to meet the approval of the Architect. Include this info in the operating and maintenance (O&M) manuals, and, for all mechanical rooms, provide the information laminated, mounted and framed under glass at the direction of the Owner. All valve interior diameters shall be shown in the O&M manuals and on the final Record Drawings.

3. Valve tags shall have neat circular black and white laminated fibre-engraved white showing through tags of at least 1 ½" in diameter, attached with a brass hook to each valve stem. Stamp on these valves tags in letters, as large as practical, the number of the valve and the service such as indicated on the "Valve List". The numbers on each service shall be consecutive. All valves on tanks and pumps shall be numbered by 3" black and white laminated fibre-engraved white showing through discs with white numbers 2" secured to stem of valves by means of brass hooks or small solid link brass chain.

3.2 TESTING

A. General

1. All labor, materials, instruments, devices and power required for testing shall be provided by this Contractor. The tests shall be performed in the presence and to the satisfaction of the Architect and such other parties, as may have legal jurisdiction. No piping in any location shall be closed up, furred in, or covered before testing.
2. Where portions of piping systems are to be covered or concealed before completion of the project, those portions shall be tested separately in the manner specified herein for the respective entire system.
3. Any piping or equipment that has been left unprotected and subject to mechanical or other injury in the opinion of the Engineer shall be retested in part or in whole as directed.
4. The Engineer retains the right to request a recheck or resetting of any pump or instrument by this Contractor during the guarantee period at no additional cost to the Contractor.
5. Repair, or if directed by the Engineer, replace any defective work with new work without extra charge to the Contract. Repeat tests as directed, until the work is proven to meet the requirements specified herein.
6. Restore to its finished condition any work, damaged or disturbed, provided by other Contractors and engage the original Contractor to do the work of restoration to the damaged or disturbed work.
7. The fixtures shall be tested for stability of support and satisfactory operation. The piping shall be tested when directed by the Engineer for stability.
8. After the fixtures are set and connected, and the piping systems to same have been tested, this Contractor shall turn water onto the fixtures, and equipment, fill the traps, etc., and the proper operation of all items shall be demonstrated by him in the presence of and to the satisfaction of the Engineer or their designated representatives.
9. Caulking of screwed joints or holes in piping will not be acceptable.
10. Notify the Engineer and any inspectors having jurisdiction, a minimum of 48 hours in advance of making any required tests so that arrangements may be made for their presence to witness the scheduled tests.

B. Specific:

1. Gas Systems

a. Before any system of gas piping is put into service, it shall be carefully tested in the presence of, and with the approval of, the gas inspector to insure that it is gastight. Where any part of the system is to be enclosed or concealed, this test shall precede the work of closing in the piping. The test medium shall be air or inert gas (e.g. nitrogen, carbon dioxide). Oxygen shall never be used.

b. Gas piping systems, not in excess of ½ psig or 14 inches water column, extending from the outlet of the meter set assembly to the closed shutoff valve of each appliance, shall withstand a pressure of at least six inches mercury or three pounds gauge for a period of not less than 10 minutes without showing any drop in pressure. Pressure shall be measured with a mercury manometer or slope gauge, or an equivalent device so calibrated as to be read in increments of not greater than 1/10 pound. The source of pressure shall be isolated before the pressure tests are made.

c. After the test of piping for tightness as described herein, gas may be turned on and appliances tested at normal operating pressure by means of a soap bubble test, or other non-corrosive foaming agent test.

3.3 SPECIAL TOOLS

A. Provide any and all special tools, recommended by the manufacturer of items furnished, noted as not being commonly available.

3.4 CERTIFICATES OF APPROVAL

A. Upon completion of the work, furnish to the Owner through the Engineer, in duplicate, certificates of inspection and/or approval from state and local inspection authorities having jurisdiction indicating the installed systems compliance to their requirements.

3.5 QUIET OPERATION

A. All work provided under this Section of the Specifications shall operate under conditions of load without sound or vibration, which is abnormally objectionable for such equipment in the opinion of the Engineer. In case of moving machinery, sound or vibration noticeable outside of the room in which it is installed, or annoyingly noticeable inside its own room will be considered objectionable shall be corrected in an approved manner by this Contractor at no change in Contract amount.

3.6 SYSTEMS

A. Natural Gas Systems

1. All piping shall be cut accurately to measurements obtained at the site and shall be installed without springing or forcing due to inaccurate measurements or improper hanger installation

2. Every branch line from a main shall be furnished with a branch valve (no exceptions) and shall be taken off the top of main using such fittings as may be required by structural obstructions or other installation conditions. All service

pipes, fittings, and valves shall be kept at sufficient distance from other work to permit not less than 1 inch between finished coverings on other service piping.

3. All piping shall be supported independently and securely fastened to the building structure with appropriate anchors and pipe hangers. In general, all lines shall be installed above ceilings in finished spaces.

4. All piping shall be cut true and threaded or welded. Cap all open ends of piping to prevent the entrance of debris when work on this system is complete or the work day has ended.

5. All pipes shall be run parallel and graded evenly to low points. A serviceable drip leg of at least six inches in length shall be provided at each low point, at every connection to a piece of equipment, and at the base of each riser.

6. Provide valved pressure gauge assemblies at each main gas service entrance, at each water heater, boiler, emergency or standby generator, incinerators, HVAC rooftop units and all other major pieces of equipment utilizing gas. Each pressure gauge assembly shall be individually valved, include a snubber and shall have a dial range that would locate the system pressure as close to the approximate mid-point on the dial range as possible. Assembly shall be similar to TRERICE Model 760B, 2-1/2 inch diameter gauge, 735-2 valve and 872-1 snubber.

7. Piping system shall be purged with 100 psi compressed air to remove dirt and debris.

8. Pressure test gas piping system with air, carbon dioxide or nitrogen pressure test at not less than 10 psi gage for a period of 24 hours with no decrease in pressure. For welded piping and for piping carrying gas at pressures exceeding 14-inches of water column pressure, the test pressure shall be at least 60 psig for a period of 24 hours with no decrease in pressure. If a decrease in pressure is detected, soap or bubble test joints for leaks, repair or replace as required, and retest.

9. Gas piping connections to all equipment shall include a gas shutoff valve, drip leg, union fitting and pressure gauge as well as a swing joint consisting of at least two 90 degree elbows at all HVAC equipment.

3.7 PATCHING, REPLACEMENT AND MODIFICATION OF EXISTING WORK

A. After installation of pipe lines, neatly patch, repair, and replace existing work where damaged, removed or altered for pipe line installation. This work shall be similar and equal in quality to the work removed or damaged, unless otherwise shown or specified. Such work shall include replacement of existing lines at points of connections to new lines, patching of masonry work, and wherever any such patching work is indicated on drawings or otherwise required.

3.8 GENERAL INSTALLATION REQUIREMENTS

A. Piping Installation

1. Install piping approximately as shown on the drawings and as directed during installation by the General Contractor or the Engineer.

2. Piping shall be installed as straight and direct as possible forming right angles or parallel lines with building walls, other piping and neatly spaced.

3. The horizontal runs of piping, except where concealed in partitions, shall be installed as high as possible.

4. Piping or other apparatus shall not be installed in such a manner so as to interfere with the full swing of the doors and access to other equipment.

5. The arrangement, positions and connections of pipes, fixtures, drains, valves, and the like, indicated on the drawings shall be followed as closely as possible, but the right is reserved by the General Contractor or the Engineer to change locations and elevations to accommodate the work, without additional compensation for such change.

6. It shall be possible to drain the water from all sections of each sprinkler cold, and hot water piping system. Pitch piping back to drain valves.

7. Screwed piping of brass or chrome plated brass shall be made up with special care to avoid marring or damaging pipe and fitting exterior and interior surfaces.

8. Small fittings shall be screwed up close to the shoulders of male threads. Lampwick, cord, wool, or any other similar material shall not be used to make up thread joints.

9. Screwed pipe and copper tubing shall be reamed smooth before installation.

10. All exposed piping in connection with fixtures and where exposed on finished walls or to view, shall be chrome plated. Where chrome plated piping is installed, cut and thread pipe so that no unplated pipe threads are visible when the work is completed.

11. Reducing fittings, unless otherwise approved in special cases, shall be provided in making reduction in size of pipe. Bushings will not be allowed unless specifically approved.

12. Remove and replace with new materials, any copper or brass piping (chrome plated or unplated) and valves showing visible tool marks.

13. Vertical risers shall be firmly supported by riser clamps, properly installed to relieve all weight from the fittings.

14. Any piece of pipe six inches or less in length shall be considered a nipple.

15. All water service piping shall be kept a sufficient distance from other work to permit finished covering to be not less than 1 inch from other work.

16. The pipe and fittings shall be manufactured in the United States of America and in accordance with the Commercial Standards, American National Standards Institute and American Society of Testing Materials.

3.9 GAS SERVICE, METER, VENTS AND PIPING

A. Piping shall be done by licensed gas fitter (as required by Code).

B. Gas piping shall pitch to drain and shall have drip pockets at least 6" long with removable caps at low points. Branch connections shall be taken from top or side of horizontal running main. Provide gas cock or valve on connections to fixtures or equipment.

C. Provide pressure reducing valve between meter and building piping, as required by Gas Company, piped and vented to outside of building.

D. Provide individual vents from regulators, pressure switches and reliefs on factory packaged equipment gas trains at all equipment located on this system. It is this contractor's responsibility to extend all vents to atmosphere terminal at a safe location in conjunction with the fuel gas code.

E. Gas piping and safety devices shall meet requirements of NFPA No. 54 and shall be subject to inspection and approval of State Gas Regulatory Board.

F. Special Note: Provide aluminum check valves on all gas pipes that enter rooms where compressed air is installed or when both compressed air and gas piping connect to the same piece of equipment. This is required in all areas where gas and air are present.

G. Provide a gas cock valve at each branch run out from main or riser serving gas outlets. This shall include all branches from the gas main and further branches from gas sub-mains. These requirements will be strictly enforced by the local plumbing inspector. This requirement shall take precedent over general arrangement drawings. Therefore the following is called for:

1. Provide a gas shutoff valve at each Tee on both outlets of the Tee in a run of piping
2. Provide a gas shutoff valve at each piece of equipment
3. Gas valves or cocks shall not be concealed and shall be readily accessible for inspection and repair
4. Provide union connection between shut-off cock and equipment to permit disconnection of equipment

H. Piping shall be securely fastened, separately hung and shall not support any other weight or piping. Piping dropping in concrete block walls shall be factory wrapped for corrosion protection.

I. Welded piping shall conform to the latest requirements of the Massachusetts Fuel Gas Code.

3.10 HANGER AND SUPPORT INSTALLATION

A. Comply with requirements for seismic-restraint devices in General Specification sections for Vibration and Seismic Controls for Plumbing Piping and Equipment

B. Comply with requirements for pipe hanger, support products, and installation.

1. Vertical Piping: MSS Type 8 or 42, clamps.
2. Individual, Straight, Horizontal Piping Runs:
   a. 100 Feet and Less: MSS Type 1, adjustable, steel clevis hangers.
   b. Longer Than 100 Feet: MSS Type 43, adjustable roller hangers.
   c. Longer Than 100 Feet if Indicated: MSS Type 49, spring cushion rolls.
3. Multiple, Straight, Horizontal Piping Runs 100 Feet or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
4. Base of Vertical Piping: MSS Type 52, spring hangers.

C. Support vertical piping and tubing at base and at each floor.

D. Rod diameter may be reduced one size for double-rod hangers, to a minimum of 3/8 inch.

E. Support piping and tubing not listed in this article according to MSS SP-69 and manufacturer's written instructions.

F. Hanger Installation

1. All piping shall be supported from the building structure by means of approved hangers and supports, to maintain proper grading and pitching of lines, to prevent vibration and to secure piping in place, and shall be so arranged as to provide for expansion and contraction.

2. Maximum spacing of hangers on runs of pipe (vertical and horizontal) having no concentration of weight shall be as follows:

S C H E D U L E	
MATERIAL	**Steel**
Pipe Size (Inches)	**Hanger Spacing in Feet/Pipe**
.50	6
.75	8
1.00	10
1.25	10
1.50	10
2.00	10
2.50	10
3.00	10
3.50	10
4.00	10
5.00	10
6.00	10
8.00	10

3. Provide hangers at a maximum distance of two feet from both sides of all changes in direction (horizontal and vertical), on both sides of concentrated loads (equipment) and at valves.

4. Hangers, in general, for all horizontal piping shall be A Band type hangers for piping up to 4" size and Clevis type for piping 5" and larger. These hangers shall be sized to fit the outside diameter of the pipe insulation protectors (sheet metal shields) specified herein. Gang type hangers may be used for supply piping up to

3" size where applicable and in conformance with manufacturer's recommendations.

5. All vertical drops and runouts including insulated pipes shall be supported by split ring hangers with extension rods and wall plates or stamped type up to 2" size only.

6. Provide on all horizontal insulated lines, pipe covering protectors (shields) at each hanger. Each protector shall be sized to fit the outside diameter of the Pipe insulation.

7. Lock nuts or retaining straps shall be provided with all beam clamps.

8. All supplementary steel including factory fabricated channels and associated accessories, including 12 inch long sheet metal shields, throughout both suspended and floor mounted shall be provided by this Contractor and shall be subject to the approval of the Engineer.

9. Hangers shall not pierce the insulation on any insulated pipe except when prior approval is given.

10. Wire, tape or wood fastenings for shims or support of any pipe or tubing shall not be used.

11. Remove all rust from the ferrous hanger equipment (hangers, rods, and bolts) and apply one coat of red lead immediately after erection.

12. Piping at all equipment and each control valve shall be supported to prevent strains or distortions in the connected equipment and control valves. Piping and equipment shall be supported to allow for removal of equipment, valves and accessories with a minimum of dismantling and without requiring additional support after these items are removed.

13. All piping shall be independently supported from the building structure and not from the piping, ductwork, conduit or ceiling suspension systems of other systems.

14. Installation of hangers which permit wide lateral motion of any pipe will not be acceptable.

15. All hangers in contact with uninsulated piping shall be compatible with piping material.

3.11 FINAL DOCUMENTATION (DRAFT FOR MA PROJECTS)

A. Upon completion of work and prior to request for Certificate of Occupancy, issue a certificate stating that work has been installed generally consistent with construction documents in accordance with 780 CMR, 9th Edition. All submittals, as-builts, O&M manuals, and balancing reports are to be provided for engineer's review, prior to request for engineer's completion certificates. In addition, and also prior to request for completion certificates, all punch list items must be completed to the satisfaction of the engineer. Verify that all sequences of operations and controls have been incorporated and all systems and equipment are working per the sequences of operations as dictated by 780 CMR, Chapter 13. A blank Contractor's certificate form can be furnished by NV5 upon request.

END OF SECTION

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SECTION 23 00 00

HEATING, VENTILATING AND AIR CONDITIONING

PART 1 - GENERAL

1.0 GENERAL PROVISIONS

A. The GENERAL REQUIREMENTS, DIVISION 01, and BIDDING AND CONTRACT REQUIREMENTS, and DIVISION 00 are hereby made a part of this Specification Section.

B. Examine all Drawings and all Sections of the Specifications and requirements and provisions affecting the work of this Section.

1.1 SCOPE OF WORK

A. This project consists of the replacement of one (1) of the two (2) cast iron boilers located at the Blueberry Hill Elementary School in Longmeadow, MA. Scope of work includes demolition of existing boiler, hydronic piping, and flue, as required for boiler removal and installation of new cast iron boiler, associated piping, and flues, and integration of new boiler into existing BAS. Fuel oil piping, fuel oil transfer pump skid, and related components are to be demolished and piping to fuel oil tank is to be capped liquid tight. All provisions required to maintain operation of existing hot and chilled water systems during construction shall be made by the contractor. An alternate to the base HVAC bid consisting of the integration of a slipstream water filtration and treatment device in to the existing piping distribution system is to be provided, this will be referred to herein and on drawings as “HVAC Alternate #1”.

Prior to the demolition of the oil transfer pump skid, the contractor shall drain and properly dispose of approximately 10,000 gallons of remaining #2 fuel oil located in the existing fuel oil storage tank.

B. Contractor to coordinate work hours with building owner. Refer to general notes on drawings for acceptable work hours.

C. The work under this Section shall include the furnishing of all materials, labor, equipment and supplies and the performance of all operations to provide complete working systems, in general, to include the following items:

1. Piping and Fittings (all systems and types) including submitting sizing where called for on the drawings or in these specifications
2. Pipe Hangers and Supports
3. Identification
4. Valves and Accessories (all types)
5. Boiler/Burner Units
6. Equipment Nameplates
7. Factory Tests

8. Insulation
9. Chimneys, Stacks, and Flues
10. Relocation of existing HVAC components that interfere with new construction and removal and disposal of obsolete components.
11. Operating and maintenance instructions and manuals
12. Cleaning, Testing, and Adjusting Piped Systems and Equipment
13. HVAC Control Systems
14. Training of Owners Personnel on Equipment, Systems, and Controls

D. The work to be done under this section is generally shown on the Mechanical HVAC Drawings.

1.2 RELATED WORK

A. Principal classes of Work related to the Work of this Section are listed below, and are specified to be performed under the indicated Sections of these Specifications. Refer to the indicated Sections for description of the extent and nature of the indicated Work, and for coordination with related trades. This listing may not include all related Work items. It is the responsibility of the Contractor to coordinate the Work of this Section with that of all other trades.

B. The following work is not included in this section and will be provided under other sections, except as specified herein:

1. Electrical power wiring for all HVAC equipment and to junction box(es) in mechanical areas. Power wiring from these box(es) to all control equipment (control panels, etc.) and all controls/interlock wiring shall be provided by the controls Contractor. Control wiring shall be from standby power source (if available).
2. Starters and variable speed drives that are not integral to equipment, unless specified otherwise.
3. Structural supports necessary to distribute loading from equipment to roof or floor.
4. Temporary light, power, water, heat, gas and sanitary facilities for use during construction and testing. Refer to Division 01, General Conditions.
5. Concrete work including concrete housekeeping pads and blocks for vibrating and rotating equipment, and cast-in-place manholes.

1.3 DEFINITIONS

A. As used in this Section, the following terms shall be understood to have the following meaning:

1. “**Contractor**,” or “**Subcontractor**,” unless otherwise qualified, shall mean the installer of the work specified under this Section, and shall be responsible for coordination of this work with the work of the ATC Contractor.

2. "**Furnish**" shall mean purchase and deliver to the project site, complete with every necessary appurtenance and product support.
3. "**Install**" shall mean unload at the delivery point at the site and perform all work necessary to establish secure mounting and proper operation at the proper location in the project.
4. "**Provide**" shall mean furnish and install.
5. **"Work"** shall mean all labor, materials, equipment, apparatus, controls, accessories and all other items required for a proper and complete installation.
6. "**Concealed**" shall mean hidden from sight in chases, furred in spaces, shafts, embedded in construction, in a crawl space, and above hung ceilings.
7. "**Exposed**" shall mean not installed underground or concealed as defined above.
8. "**Furnished by others**" shall mean materials or equipment purchased under other sections of the general contract and installed by this section of the specifications by this trade Contractor.
9. "**Owner's Representative**" shall be the party responsible to make decisions regarding all contractual obligations in reference to the Scope of Work for the Owner.
10. "**Date of Substantial Completion**" shall indicate the date where the work has been formally accepted as evidenced by completed final punch list or where the work has reached the stage that the Owner obtains beneficial use and commences utilization of the installed systems for business or occupancy purposes. The GENERAL REQUIREMENTS, DIVISION 01, shall supersede this definition where specifically defined.
11. "**Piping**" shall mean, in addition to pipe or tubing, all fittings, flanges, unions, valves, strainers, drains, hangers and other accessories relative to such piping.
12. "**ATC**" shall mean Automatic Temperature Controls, and shall be interchangeable with "**BAS**" (Building Automation System) and with "BMS" (Building Management System).

1.4 CODES, REFERENCES AND PERMITS

A. Materials, installation of systems and equipment provided under this section shall be done in strict accordance with the latest governing edition of the following standards, codes, specifications, requirements, and regulations, and any other Codes and Regulations having jurisdiction including but not limited to:

1. All Applicable NFPA Standards
2. State and Local Building Mechanical, Electrical, and Energy Codes
3. American Society of Mechanical Engineers (ASME)
4. American Society of Testing and Materials (ASTM)
5. American National Standards Institute (ANSI)
6. Underwriters' Laboratories, Inc. (UL)
7. Occupational Safety and Health Administration (OSHA)
8. Any other local codes or authorities having jurisdiction.

B. Heating, pumping, process piping and refrigeration systems shall be installed by Contractors and personnel appropriately licensed in the State (Installing Contractor).

C. All pressure vessels shall conform to ASME and State codes and regulations.

D. All equipment shall meet the more efficient requirement:

1. As shown on bid documents,
2. Minimum efficiencies state in ASHRAE 90.1-2007, or
3. Minimum efficiencies stated in the governing Energy Code.

E. Unless otherwise specified or indicated, materials, workmanship and equipment performance shall conform with the latest governing edition of the following standards, codes, specifications, requirements, and regulations, except when more rigid requirements are specified or are required by applicable codes but not limited to:

1. Air Conditioning and Refrigeration Institute (ARI)
2. Air Diffusion Council (ADC)
3. Air Movement and Control Association (AMCA)
4. American Boiler Manufacturers Association (ABMA)
5. American National Standards Institute (ANSI)
6. American Petroleum Institute (API)
7. American Society of Heating, Refrigeration and Air Conditioning (ASHRAE)
8. American Society of Mechanical Engineers (ASME)
9. American Society of Testing and Materials (ASTM)
10. American Welding Society, Inc. (AWS)
11. Associated Air Balance Council (AABC)
12. Certified Ballast Manufacturers (CME)
13. Copper Development Association (CDA)
14. Factory Mutual System (FM)
15. Insulated Cable Engineers Association (ICEA)
16. Manufacturer's Standardization Society of the Valve & Fitting Industry (MSS)
17. National Electric Manufacturers Association (NEMA)
18. National Environmental Balancing Bureau (NEBB)
19. North American Insulation Manufacturer's Association (NAIMA)
20. Sheet Metal and Air Conditioning Contractor's National Association, Inc. (SMACNA)
21. The Hydronics Institute (HI)
22. Thermal Insulation Manufacturer’s Association (TIMA)

F. Codes, laws and standards provide a basis for the minimum installation criteria acceptable. The drawings and specifications illustrate the scope required for this project, which may exceed minimum codes, laws and standards.

G. The date of the code or standard is that in effect at the Bid date.

H. Give all notices, file all plans, obtain all permits and licenses, and obtain all necessary approvals from authorities having jurisdiction. Deliver all certificates of inspection to the authorities having jurisdiction. No work shall be covered before examination and approval by the Owner's Representative, inspectors, and authorities having jurisdiction. Replace imperfect or condemned work to conform to requirements, satisfactory to Owner's Representative, and without extra cost to the Owner. If work is covered before inspection and approval, this Contractor shall pay costs of uncovering and reinstalling the covering, whether it meets contract requirements or not.

1.5 GENERAL REQUIREMENTS

A. Nameplates

1. Each item of equipment shall have a nameplate bearing the manufacturer's name, address, type or style, model number, catalog number, and serial number securely affixed in a conspicuous place; the nameplate of the distributing agent will not be acceptable.

B. Maintenance Information

1. Systems and equipment which require periodic maintenance to maintain efficient operation shall be furnished with complete necessary maintenance information. Required routine maintenance actions, as specified by the manufacturer, shall be stated clearly and incorporated on a readily accessible label on the equipment. Such label may be limited to identifying, by title or publication number, the operation and maintenance manual for that particular model and type of product.

C. Equipment Guards

1. Belts, pulleys, chains, gears, couplings, projecting setscrews, keys, and other rotating parts so located that any person may come in close proximity thereto shall be completely enclosed or guarded. High-temperature equipment and piping so located as to endanger personnel or create a fire hazard shall be guarded or covered with insulation of type specified for service.

1.6 MATERIAL AND EQUIPMENT STANDARDS

A. Where equipment or materials are specified with the name of a manufacturer, such specification shall be deemed to be used for the purpose of establishing a standard for that particular item. No equipment or material shall be used unless previously approved by the Owner's Representative.

B. Substitutions (approved equals) may be offered for review provided the material, equipment or process offered for consideration is equal in every respect to that indicated or specified. In order for Requests for substitution to be considered, all must be submitted for pre-approval of manufacturer within 30 days of award of contract. All requests must be

accompanied by a list of minimum 5-year-old successful installations of similar scope (with Owner contact and phone number), complete specifications together with drawings or samples to properly appraise the materials, equipment or process. Allow 30 days for Owner's Representative's review.

C. If a substitution of materials or equipment in whole or in part is made, this Contractor shall bear the cost of any changes necessitated by any other trade as a result of said substitution.

D. All materials, equipment and accessories provided under this section shall be new and unused products of recognized manufacturers as approved.

1.7 SUBMITTALS

A. Conform to the requirements of Division 01, General Conditions, for schedule and form of all submittals unless specifically noted otherwise in this section. Coordinate this submittal with submittals for all other finishes. Shop drawings and design layouts shall be prepared by licensed installing Contractors and shall note the name(s), license number(s) and license expiration date(s) of the Contractor(s) installing the heating.

B. Definitions:

1. Shop Drawings are information prepared by the Contractor to illustrate portions of the work in more detail than indicated in the Contract Documents.

2. Acceptable Manufacturers: The mechanical design for each product is based on the single manufacturer listed in the schedule or shown on the drawings. In Part 2 of the specifications certain Alternate Manufacturers are listed as being acceptable. In addition, the MATERIAL AND EQUIPMENT STANDARDS paragraph potentially allows for substitutions as being acceptable. These are acceptable only if, as a minimum, they:

a. Meet all performance criteria listed in the schedules and outlined in the specifications. For example, to be acceptable, an air handling unit must deliver equal CFM against equal external static pressure (with the allowed pressure drop of dirty filters) using equal or less horsepower as the air handler listed in the schedules.

b. Fit within the available space it was designed for, including space for maintenance and component removal, with no modification to either the space or the product. Clearances to walls, ceilings, and other equipment will be at least equal to those shown on the design drawings. The fact that a manufacturer's name appears as acceptable shall not be taken to mean the Engineer has determined that the manufacturer's products will fit within the available space – this determination is solely the responsibility of the Contractor.

c. Products must adhere to all architectural considerations including, but not limited to: being of the same color as the product scheduled or specified, fitting within the architectural enclosures and details.

C. Submittal Procedures, Format and Requirements

1. Review submittal packages for compliance with Contract Documents and then submit to Owner's Representative for review. Submit enough sets of shop

drawings such that, after review, two sets will be kept by the reviewer, with only the remaining sets returned with reviewer's marks and comments.

2. Each Shop Drawing shall indicate in title block, and each Product Data package shall indicate on cover sheet, the following information:
   a. Title.
   b. Equipment number.
   c. Name and location of project.
   d. Names of Owner, Engineer and Seller.
   e. Names of manufacturers, suppliers, vendors, etc.
   f. Date of submittal.
   g. Whether original submittal or resubmitted.
3. Shop drawings showing manufacturer's product data shall contain detailed dimensional drawings (minimum ¼" = 1' scale) including plans and sections (where physical clearance could be an issue). Provide larger scale details as necessary. Sheet metal drawings shall show elements of reflected ceiling plan, exposed ductwork, walls and partitions (highlighting fire walls and smoke partitions), diffusers, registers, grilles, all dampers (fire, smoke, balancing, backdraft, and control dampers), sleeves and other aspects of construction as necessary for coordination.
4. Submit accurate and complete description of materials of construction, manufacturer's published performance characteristics, sizes, weights, capacity ratings (performance data, alone, is not acceptable), electrical requirements, starting characteristics, wiring diagrams, and acoustical performance for complete assemblies. Drawings shall clearly indicate location (terminal block or wire number), voltage and function for all field terminations, and other information necessary to demonstrate compliance with all requirements of Contract Documents.
5. Provide shop drawings showing details of piping connections to all equipment. If connection details are not submitted and connections are found to be installed incorrectly, this Contractor shall reinstall them within the original contract price.
   a. Alternate pipe joining methods such as grooved and permanent push-to-connect systems shall be shown on drawings and product submittals, and be specifically identified with the applicable manufacturer's style or series number. Installation shall include any additional hangers required for the alternate system.
6. Provide complete data for all auxiliary services and utilities required by submitted equipment. This shall include power, cooling water and compressed air requirements and points of connection.
7. Provide a complete description of all controls and instrumentation required including electrical power connection drawing for all components and interconnection wiring to starters, detailed information on starters, control diagrams, termination diagrams, and all control interfaces with a central control system.
8. Provide installation and erection information including; lifting requirements, and any special rigging or installation requirements for all equipment.

9. The Owner's Representative shall approve all materials before commitment for materials is made.

D. Specifications, Schedule, and Control Sequence Compliance Statement

1. The manufacturer shall submit a point by point statement of compliance with each specification criteria listed in each paragraph for those submittals listed in Paragraph E: Product Data that are noted with an asterisk (*).
2. The statement of compliance shall consist of a list of all paragraphs (line by line) identified in Part 2 and applicable Part 3 of the specification and that the unit controls will provide all manufacturer's portions of the control sequences shown on the drawings for which the submitted product in the opinion of the manufacturer complies, deviates, or does not meet.
3. Where the proposed submittal complies fully, the word "comply" shall be placed opposite the paragraph number.
4. Where the proposed submittal does not comply, or accomplishes the stated function in a manner different from that described, a full description of the deviation shall be provided.
5. Verify each field of the associated schedule where associated technical data is presented and sequences are shown on the drawings. Where the submitted material does not 'comply" provide the value the submitted equipment will achieve based upon the specified conditions.
6. Where a full description of a deviation is not provided, it shall be assumed that the proposed system does not comply with the paragraph in question and the product will be rejected.
7. Submissions which do not include a point by point statement of compliance as specified shall be disapproved.

E. Product Data: Submit complete manufacturer's product description and technical information including:

1. Piping and Fittings (all services, types, and joining methods)
2. Pipe Hangers and Supports
3. Identification
4. Valves and Accessories (all types)
5. Pressure Gauges, Thermometers, Accessories
6. Electric Motors and Starters
7. Boiler/Burner Units (*)
8. Factory Tests
9. Insulation
10. Chimneys, Stacks, and Flues
11. Operating and maintenance instructions and manuals
12. Testing, Adjusting, & Balancing Qualifications, Plan, and Reports
13. Slipstream Water Filtration and Treatment Device (HVAC Alternate #1 on Drawings)

14. HVAC Control Systems (*)
15. Identification, labels and tags
16. O&M manual table of contents
17. O&M manual

F. Submit shop drawings and product data grouped to include complete submittals of related systems, products and accessories in an individual (combined) submittal.

1. Access panel shop drawings shall be submitted to the Construction Supervisor for approval.
2. Do not submit multiple product information in a single bound manual.
3. Three-ring binders shall not be accepted.

G. Deviations

1. Concerning deviations other than substitutions, proposed deviations from Contract Documents shall be requested individually in writing whether deviations result from field conditions, standard shop practice, or other cause. Submit letter with transmittal of Shop Drawings which flags the deviation to the attention of the Owner's Representative.
2. Without letters flagging the deviation to the Owner's Representative, it is possible that the Engineer may not notice such deviation or may not realize its ramifications. Therefore, if such letters are not submitted to the Owner's Representative, the Seller shall hold the Engineers, his consultants and the Owner harmless for any and all adverse consequences resulting from the deviations being implemented. This shall apply regardless of whether the Engineer has reviewed or approved shop drawings containing the deviation, and will be strictly enforced.
3. Approval of proposed deviations, if any, will be made at discretion of Engineer.

H. Schedule: Incorporate shop drawing review period into construction schedule so that Work is not delayed. This Contractor shall assume full responsibility for delays caused by not incorporating the following shop drawing review time requirements into his project schedule: Allow at least 10 working days, exclusive of transmittal time, for review each time shop drawing is submitted or resubmitted with the exception that 20 working days, exclusive of transmittal time are required for the following:

1. O&M manuals
2. If more than five shop drawings of a single trade are received in one calendar week.

I. Responsibility

1. Intent of Submittal review is to check for capacity, rating, and certain construction features. HVAC Contractor shall ensure that work meets requirements of Contract Documents regarding information that pertains to fabrication processes or means, methods, techniques, sequences and procedures of construction; and for coordination of work of this and other Sections. Work shall comply with approved submittals to extent that they agree with Contract Documents. Submittal review shall not diminish responsibility under this Contract for dimensional coordination, quantities, installation, wiring, supports and access for service, nor the shop drawing errors or deviations from requirements of Contract Documents. The

Engineer's noting of some errors while overlooking others will not excuse the HVAC Contractor from proceeding in error and will not absolve the Contractor from meeting the full design intent of the associated system(s). Contract Documents requirements are not limited, waived nor superseded in any way by review.

2. Inform Contractors, manufacturers, suppliers, etc. of scope and limited nature of review process and enforce compliance with contract documents.

J. In the event that the HVAC Subcontractor fails to provide Shop Drawings for any of the products specified herein:

1. The HVAC Subcontractor shall furnish and install all materials and equipment herein specified in complete accordance with these Specifications.

2. If the HVAC Subcontractor furnishes and installs material and/or equipment that is not in complete accordance with these Specifications, he shall be responsible for the removal of this material and/or equipment. He shall also be responsible for the replacement of this material and/or equipment with material and/or equipment that is in complete accordance with these Specifications, at the direction of the Owner's Representative.

3. Removal and replacement of materials and/or equipment that is not in complete compliance with these Specifications shall be done at no extra cost to the Owner.

4. Removal and replacement of materials and/or equipment that is not in complete compliance with these Specifications shall not be allowed as a basis for a claim of delay of completion of the Work.

K. Mark dimensions and values in units to match those specified.

L. Submit Material Safety Data Sheets (MSD) on each applicable product with submittal.

1.8 OPERATION AND MAINTENANCE DATA

A. Commence preparation of the Operating and Maintenance (O&M) Manuals immediately upon receipt of "Approved" or "Approved as Noted" shop drawings and submit each section within one month. The final submission shall be no later than two months prior to the projected date of Substantial Completion of the Project.

B. Each O&M document shall include the manufacturer's web address for equipment -specific O&M information for Internet access by the Owner.

C. The manual shall consist of (3) sets of manuals and include (3) sets of CDs, which shall contain the scanned content of the entire manual. The manual shall highlight the actual equipment used and not be a master catalog of all similar products of the manufacturer. The manual shall be submitted for review prior to creation of the CDs.

D. The Manual shall contain the following:

1. Operations Manual

a. Systems description including all relevant information needed for day-to-day operations and management including:

1) Start-up requirements and procedures, including Water Treatment systems.

2) Shut-down requirements and procedures, including Water Treatment systems.

3) Trouble-shooting checklist (i.e., common alarms with possible cause & effect, etc.).

b. Wiring diagrams, schematics, logic diagrams and sequence of operations that accurately depict the controls system.

c. Depiction of each interface screen where programmable logic and visual displays are provided. Descriptors shall be provided to define displayed data, alarms, etc.

d. A single sheet (for ease of removal) of all access codes and passwords necessary to access all levels of control and programming.

2. Maintenance Manual

a. Define all maintenance activities required to ensure system operation within manufacturers specified parameters. Maintenance documentation shall include:

1) Data retrieval sheet

2) Special instructions (i.e., lockout/tag-out, etc.)

3) Special tools (i.e., key, allen wrench, etc.)

4) Tasks

5) Frequency

6) Required materials, lubricants, etc.

b. Provide table of all required activities plotted vs. interval with adequate fill-in-space for “activity completion date” and “comments”. Where multiple instrument readings are required, provide data sheet formatted to accommodate activity.

c. Provide as part of each package, a valve and system chart that corresponds to the valve tags. Provide directions for normal positions and positions for equipment failure modes.

d. The HVAC Subcontractor shall furnish spare-parts data for each different item of equipment furnished. The data shall include a complete list of: parts and supplies, with current unit prices, lead time, and source of supply; a list of parts and supplies that are either normally furnished at no extra cost with the purchase of the equipment, or specified hereinafter to be furnished as part of the contract; and a list of additional items recommended by the manufacturer to assure efficient operation for a period of 360 days at the particular installation. The foregoing shall not relieve the HVAC Subcontractor of any responsibilities under the guarantees specified herein.

e. Provide copy of all warranty information including extended warrantees where specified with associated date of substantial completion (commencement of warranty) and end date of coverage. Define all components/subsystems specifically included and excluded.

E. Provide O&M manuals for each of the following as a minimum:

1. Valves and Accessories (all types, including charts for all balancing valves)
2. Boiler/Burner Units
3. HVAC Control Systems
4. Hydronic system water filtration (HVAC Alternate #1)

1.9 RECORD DRAWINGS

A. Refer to DIVISION 01, General Conditions, for record drawings and procedures to be provided under this section, unless specifically noted otherwise in this section.

B. Record Drawings (red-line drawings) will be updated by this Contractor daily for review with the monthly requisition. The record drawing shall be an accurate depiction of the systems as completed, including dimensions (vertical/horizontal) of concealed components off fixed building elements.

C. The HVAC Foreman shall maintain complete and separate set of prints of Contract Drawings at job site at all times and shall record work completed and all changes from original Contract Drawings clearly and accurately including work installed as a modification or addition to the original design.

D. At completion of work the HVAC Contractor shall prepare a complete set of record drawings on AutoCAD showing all systems as actually installed. The Architectural background AutoCAD files will be made available for the Contractor's copying, at his expense, to serve as backgrounds for the drawings. The HVAC Contractor shall transfer changes from field drawings onto AutoCAD drawings and submit copy of files and three sets of prints to Owner's Representative for comments as to compliance with this section. CADD layering as established by the design team shall be maintained with any and all changes done by the Contractor.

E. The Engineer is not granting to the Contractor any Ownership or property interest in the CADD Drawings by the delivery of the CADD Disks to the Contractor. The Contractor's rights to use the CADD disks and the CADD Drawings are limited to use for the sole purpose of assisting in the Contractor's performance of its contractual obligations under its contract with respect to the Project. The Engineer is granting no further rights. Any reuse or other use by the Contractor will be at the Contractor's sole risk and without liability to the Engineer. The Contractor hereby waives and releases any losses, claims, damages, liabilities of any nature whatsoever, and costs (including attorney fees) arising out of, resulting from, or otherwise related to the use of the CADD Disks and CADD Drawings by the Contractor. The Contractor, to the maximum extent permitted by law, hereby agrees to indemnify, defend and hold the Engineer harmless from all loses, claims, damages, liabilities, and costs (including attorney fees) arising out of, resulting from, or otherwise related to the use of the CADD Disks and CADD Drawings by the Contractor.

F. Record Drawings, shall show "as-built" condition of all plans, mechanical room part plans, details, sections, piping diagrams, control diagram and sequence changes and corrections to schedules. Schedules shall show actual manufacturer model numbers and capacities of final installed equipment.

G. The HVAC Contractor shall submit the record set for approval a minimum of three weeks prior to seeking the permanent certificate of occupancy.

1.10 WARRANTIES

A. Submit manufacturer's standard replacement warranties for material and equipment furnished under this Section. Such warranties shall be in addition to and not in lieu of all liabilities which the manufacturer and the HVAC Subcontractor may have by law or by provisions of the Contract Documents.

B. All materials, equipment and work furnished under this Section shall be guaranteed against all defects in materials and workmanship for a minimum period of one year commencing with the Date of Substantial Completion. Where individual equipment sections specify longer warrantees, provide the longer warrantee. Any failure due to defective material, equipment or workmanship which may develop, shall be corrected at no expense to the Owner including all damage to areas, materials and other systems resulting from such failures.

C. Guarantee that all elements of each system meet the specified performance requirements as set forth herein or as indicated on the Drawings.

D. Upon receipt of notice from the Owner of the failure of any part of the systems during the guarantee period, the affected parts shall be replaced. Any equipment requiring excessive service shall be considered defective and shall be replaced.

1.11 COORDINATION

A. Refer to DIVISION 01, General Conditions, for record drawings and procedures to be provided under this section, unless specifically noted otherwise in this section.

B. Materials and apparatus shall be installed as fast as conditions of the building will permit and must be installed promptly when and as required.

C. Confer with all other trades relative to location of all apparatus and equipment to be installed and select locations so as not to conflict with work of other Sections. Any conflicts shall be referred immediately to the Owner’s Representative for decision to prevent delay in installation of work. All work and materials placed in violation of this clause shall be readjusted to the Owner’s Representative's satisfaction at no expense to the Owner.

D. Where work of this section will be installed in close proximity to work of other sections or where there is evidence that the work of this section may interfere with work of other sections, assist in working out space conditions to make satisfactory adjustment. Prepare and submit for approval 3/8" scale or larger working drawings and sections, clearly showing how the work is to be installed in relation to the work of other sections. If the work of this section is installed before coordinating with other trades or so as to cause interference with work of other trades, make changes necessary to protect conditions without extra charge.

E. Keep fully informed as to the shape, size and position of all openings required for all apparatus, piping, ductwork, etc., and give information in advance to build openings into the work. Furnish all sleeves, pockets, supports and incidentals, and coordinate with the Owner’s Representative for the proper setting of same.

F. All distribution systems which require pitch or slope such as condensate drains and water piping shall have the right of way over those which do not.

G. Make reasonable modifications in the work as required by structural interferences, interference with work of other trades, or for proper execution of the work without extra charge.

H. Keep fully informed as to the size, shape and location of all openings required for the work of this Section and give full information to all Subcontractors and the Owner's Representative.

1.12 INTERPRETATION OF DRAWINGS AND SPECIFICATIONS

A. It is the intention of the Specifications and Drawings to call for complete, finished work, tested and ready for continuous operation. Any apparatus, appliance, material or work not shown on the Drawings, but mentioned in the Specifications or vice versa, or any incidental accessories necessary to make the work complete in all respects and ready for operation, even if not particularly specified, shall be provided by the HVAC Subcontractor or his/her Sub Subcontractors, without additional expense to the Owner.

B. The Drawings are generally diagrammatic. The locations of all items that are not definitely fixed by dimensions are approximate only. The exact locations must be determined at the site and shall have the approval of the Owner before being installed. The HVAC Subcontractor shall follow Drawings, including shop drawings, in laying out work and shall check the Drawings of other trades to verify spaces in which work will be installed. Maintain maximum headroom and space conditions. Where space conditions appear inadequate, notify the Engineer before proceeding with the installation. The HVAC Subcontractor shall, without extra charge, make reasonable modifications in the layout as needed to prevent conflict with work of other trades or for proper execution of the work.

C. Any requests for information (RFI) for resolving an apparent conflict or unclarity, or a request for additional detail, shall include a sketch or equivalent description of Contractors proposed solution.

D. Sizes of ducts and pipes and routing are shown, but it is not intended to show every offset and fitting, nor every structural difficulty that may be encountered. To carry out the intent and purpose of the Drawings, all necessary parts to make complete approved working systems ready for use, shall be furnished without extra charge.

1.13 INSPECTION OF SITE CONDITIONS

A. Prior to submission of bid, visit the site and review the related construction documents to determine the conditions under which the Work has to be performed. Send a report, in writing, to the Owner's Representative, noting any conditions which might adversely affect the Work of this Section of the Specifications.

1.14 SURVEY AND MEASUREMENTS

A. Base all required measurements, horizontal and vertical, from referenced points established with the Owner's Representative and be responsible for correctly laying out the Work required under this Section of the Specification.

B. In the event of discrepancy between actual measurements and those indicated, notify the Owner's Representative in writing and do not proceed with the related work until instructions have been issued.

1.15 DELIVERY, STORAGE AND HANDLING

A. No materials shall be delivered or stored on site until Shop Drawings have been approved.

B. All manufactured materials shall delivered to the site in original packages or containers bearing the manufacturer's labels and product identification.

C. Protect materials against dampness. Store off floors, under cover, and adequately protected from damage.

D. Inspect all equipment and materials, upon receipt at the job site, for damage and conformance to approved shop drawings.

1.16 PROTECTION OF WORK AND PROPERTY

A. This Contractor shall be responsible for the care and protection of all work included under this Section until the completion and final acceptance of this Contract.

B. Protect all equipment and materials from damage from all causes including, but not limited to, fire, vandalism and theft. All materials and equipment damaged or stolen shall be repaired or replaced with equal material or equipment at no additional cost to the Owner.

C. Protect all equipment, outlets and openings with temporary plugs, caps and covers. Protect work and materials of other trades from damage that might be caused by work or workmen under this Section and make good damage thus caused.

D. Damaged materials are to be removed from the site; no site storage of damaged materials will be allowed.

1.17 SUPERVISION

A. Provide a competent Supervisor with a minimum of 5 years of experience in HVAC Construction Supervision who shall be in charge of the HVAC work at the site.

1.18 SAFETY PRECAUTIONS

A. Life safety and accident prevention shall be a primary consideration. Comply with all of the safety requirements of the Owner and OSHA throughout the entire construction period of the project.

B. Furnish, place and maintain proper guards and any other necessary construction required to secure safety of life and property.

1.19 SCHEDULE

A. Construct work in sequence under provisions of Division 01 and as coordinated with the Owner's Representative.

1.20 HOISTING, SCAFFOLDING AND PLANKING

A. The work to be done under this Section of the Specifications shall include the furnishing, set-up and maintenance of all derricks, hoisting machinery, cranes, helicopters, scaffolds, staging and planking as required for the work.

1.21 CUTTING AND PATCHING

A. Include all coring, cutting, patching, and fireproofing necessary for the execution of the work of this Section. Structural elements shall not be cut without written approval of the Owner. This Contractor shall be responsible for taking all precautions required to identify hidden piping, conduits, etc. before any core drilling and/or cutting of slabs commences, including X-raying the affected slabs. Provide fire stopping to maintain the fire rating of the fire resistance-rated assembly. All penetrations and associated fire stopping shall be installed in accordance with the fire stopping manufacturer's listed installation details and be listed by UL or FM.

B. All work shall be fully coordinated with all phases of construction, in order to minimize the requirements for cutting and patching.

C. Form all chases or openings for the installation of the work of this Section of the specifications, or cut the same in existing work and see that all sleeves or forms are in the work and properly set in ample time to prevent delays. Be responsible that all such chases, openings, and sleeves are located accurately and are of the proper size and shape and consult with the Owner's Representative and all trades concerned in reference to this work. Confine the cutting to the smallest extent possible consistent with the work to be done. In no case shall piers or structural members be cut without the approval of the Owner's Representative.

D. Fit around, close up, repair, patch, and point around the work specified herein to match the existing adjacent surfaces and to the satisfaction of the Owner's Representative.

E. Fill and patch all openings or holes left in the existing structures by the removal of existing equipment that is part of this Section of the Specifications.

F. All of this work shall be carefully done by workmen qualified to do such work and with the proper and smallest tools applicable.

G. Any cost caused by defective or ill-timed work required by this Section of the specifications shall be borne by the Subcontractor.

H. When, in order to accommodate the work required under this Section of the specifications, finished materials of other trades must be cut or fitted, furnish the necessary drawings and information to the trades whose materials must be cut or fitted.

1.22 SUPPLEMENTARY STEEL, CHANNELS AND SUPPORTS

A. Provide all supplementary steel, factory fabricated channels and supports required for proper installation, mounting and support of all equipment and systems provided under this section of the specification.

B. Supplementary steel and factory fabricated channels shall be firmly connected to building construction in a manner approved by the Owner's Representative, as shown on the drawings, or hereinafter specified.

C. The type and size of the supporting channels and supplementary steel provided under this section of the specifications shall be determined by the Subcontractor and shall be of sufficient strength and size to allow only a minimum deflection in conformance with the manufacturer's requirements for loading.

D. All supplementary steel and factory fabricated channels shall be installed in a neat and workmanlike manner parallel to the walls, floors and ceiling construction. All turns shall be made with 90 degree and 45 degree fittings, as required to suit the construction and installation conditions.

E. All supplementary steel including factory fabricated channels, supports and fittings shall be galvanized steel, aluminum, or stainless steel where exposed or subject to rust producing atmosphere and shall be manufactured by Unistrut, H-strut, Powerstrut, ERICO or approved equal.

1.23 HAZARDOUS MATERIALS

A. Dispose of all hazardous materials in accordance with Federal and State laws. All handling shall conform to EPA requirements. A uniform hazardous waste manifest shall be prepared for all disposals and returned with all applicable signoffs prior to application for final payment. Provide breakout cost for this scope.

B. Removed equipment or fluids containing any hazardous materials such as ethylene glycol, oil, mercury or chromate shall be recycled by a licensed facility approved by the Owner's Representative.

C. Where it has been identified that asbestos-containing material exists within the scope limits, refer to the Asbestos Abatement specification section for requirements. Where insulation is removed, provide new insulation (types and thicknesses as specified in this section). Where scope is not defined, provide unit prices with bid for all pipe and duct sizes involved.

1.24 ACCESSIBILITY

A. All work provided under this Section of the Specification shall be installed so that parts requiring periodic inspection, maintenance and repair are readily accessible. Work of this trade shall not infringe upon clearances required by equipment of other trades, especially code required clearances to electrical gear. Minor deviations from the drawings may be made to accomplish this, but changes of substantial magnitude shall not be made prior to written approval from the Owner's Representative.

1.25 WELDING QUALIFICATIONS

A. Piping shall be welded in accordance with qualified procedures using performance qualified welders and welding operators. Procedures and welders shall be qualified in accordance with ASME BPV IX. Welding procedures qualified by others, and welders and welding operators qualified by another employer may be accepted as permitted by ASME B31.9 (or B31.1 for steam boiler piping over 15 psig and all steam and condensate piping over 150 psig). The Owner's Representative shall be notified 24 hours in advance of tests and the tests shall be performed at the work site if practicable. The welder or welding operator shall apply his assigned symbol near each weld he makes as a permanent record. Structural members shall be welded in accordance with Division 01.

B. A fire watchman with an approved fire extinguisher shall be posted at the site of the welding work, during that work, and for a minimum of 30 minutes after the work is completed, to see that sparks or drops of hot metal do not start fires.

1.26 ELECTRICAL WORK

A. All electrical apparatus and controls furnished, and the installation thereof, as a part of the HVAC work, equipment, and controls shall conform to applicable requirements under DIVISION 26 - ELECTRICAL.

1.27 PROJECT CLOSEOUT

A. Certificates Of Approval

1. Upon completion of all work, provide certificates of inspections from the following equipment manufacturers stating that the authorized factory representatives have inspected and tested the operation of their respective equipment and found the equipment to be in satisfactory operating condition and installed per the manufacturers installation instructions and requirements.

a. Automatic Temperature Controls

b. Boilers

B. Construction Observations By The Engineer

1. The engineer shall make progress site visits during construction and one substantial completion (punch list) site visit for determining substantial completion.

2. The Trade Contractors and the General Contractor are required to inspect their own work and make any corrections to the work to comply with the specifications and the contract documents. It is not the responsibility of the engineer to develop lists of incomplete work items.

3. Progress Site Visits

a. The purpose of the progress site visit by the engineer is to observe if the work is proceeding in accordance with the contract documents.

b. The engineer will prepare a field report which will note in general the work completed since the last observation visit, work found not to be in accordance with the contract documents and work not corrected since the previous observation visit.

C. Substantial Completion

1. When the Contractor considers the Work under this Section is substantially complete, the Contractor shall submit written notice, through the General Contractor, with a detailed list of items remaining to be completed or corrected and a schedule of when each remaining work item will be completed. Should the engineer determine the list of remaining work does not constitute substantial completion the engineer will notify the Owner and he will not make a substantial completion site visit.

2. The following items shall be completed prior to the written request for substantial completion site visit:

   a. Certification of successful operation of all systems.

   b. Training of the Owner's personnel in the operation of the systems.

   c. Record Drawings in accordance with the contract specifications.

   d. Operation and Maintenance manuals.

   e. Testing reports.

   f. Manufacturers certificates of approvals.

   g. Emergency contact list for reporting of malfunctioning equipment during the warrantee period.

   h. Contractors Project Completion certificate in accordance with the building code requirements.

3. Should the Engineer, during the substantial completion visit, observe that the Work is substantially complete, s/he will provide a written listing of the observed deficiencies referred herein as the Punch List. The Punch List will provide for a place for the Contractor and general Contractor to sign off and date each item individually indicating that the observed deficiency item has been corrected.

4. Should the Engineer, during the substantial completion site visit, observe that the Work is not substantially complete, s/he will provide, a written list of the major deficiencies and a reason for the work not being considered substantially complete.

5. If the work is found not to be substantially complete then the engineer shall be reimbursed for his time to re-observe the work. A re-observation fee shall be charged to the Contractor through the contractual agreement for any further observations by the engineer.

6. The Contractor shall remedy all deficiencies listed in the punch list within the time frame required by the contract.

D. Engineers Construction Completion Certification

1. Where required by the applicable code, the Engineers Construction Completion Certification will be issued by NV5 when all life safety and health related issues are complete, all required functional tests are complete and all reports are complete. The following is a minimum listing of the required systems to be tested with reports generated indicating they are complete and ready for use:

   a. Boiler Plant Start Up

   b. Pipe Pressure Tests

c. Commissioning of Systems

2. There shall be NO outstanding items identified on the punch list for scope within any of these categories.

E. Final Completion

1. The following items shall be submitted prior to the written request for Final completion:

   a. Revised Substantial Completion items to be resubmitted in accordance with the review process comments.

   b. Warranties commencing the date of Substantial completion

   c. Individual Signed and dated Punch List acknowledging completion of all punch list items

2. When the Contractor considers all of the punch list work items complete, the Contractor shall submit written notice through the General Contractor that all Punch List items are complete and resolved and the work is ready for final observation site visit. The signature lines for completion of each punch list item shall be signed by the Contractor indicating the work is complete and signed by the General Contractor indicating s/he has inspected the work and found it to be complete. Should the Engineer find the work to be finally complete and all Punch List items are complete the Engineer will make a recommendation to the Owner. If the Engineer has found the punch list work to be incomplete during final inspection a written listing of the observed deficiencies will be prepared by the Engineer.

3. If the work is not fully complete then the engineer shall be reimbursed for his time to re-observe the work. A re-observation fee shall be charged to the Contractor through the contractual agreement for any re-observations by the engineer.

F. Re-observation Fees

1. The re-observation fee shall be $1200.00 per visit.

G. Contractor's Project Completion Certificate

1. Upon completion of work and prior to request for Certificate of Occupancy, each Trade Contractor and the General Contractor shall issue a certificate stating that work has been installed generally consistent with construction documents and all applicable codes. NV5 can furnish a blank Contractor's certificate form upon request. The certificate shall certify:

   a. Execution of all work has been installed in accordance with the approved construction documents.

   b. Execution and control of all methods of construction was in a safe and satisfactory manner in accordance with all applicable local, state and federal statutes and regulations.

2. The certificate shall include the following information:

   a. Project.

   b. Permit Number.

   c. Location.

d. Construction Documents.

e. Date on Plans and Specifications submitted for approval and issuance of the Building Permit.

f. Addendum(a) and Revision Dates.

3. The certificate shall be signed by the Contractor and include the following:

a. Signature.

b. Date.

c. Company.

d. License Number.

e. License Expiration Date.

PART 2 - PRODUCTS

2.0 PIPING AND FITTINGS

A. General Requirements for Pipe

1. Pipe material shall be indicated in the Schedule of Pipe and Fittings for each type of service.

2. Steel pipe shall conform to ASTM A53 Grade B or ASTM A106 Grade B (A106 is required for systems with temperatures that could go over 750 degrees F) black steel. Pipe thickness (schedule) shall be as specified for the service.

3. Stainless steel pipe shall be grade 304, 304L, 316 or 316L and shall conform to ASTM A312, seamless. Pipe thickness (schedule) shall be as specified for the service.

4. Copper tubing shall conform to ASTM B75 or ASTM B88, seamless. Thickness (type) shall be as required for the service with a minimum safety factor of 4:1. Tubing for compressed air tubing shall conform to ASTM B251.

5. Polyethylene tubing shall be fire-resistant (FR), low-density virgin polyethylene conforming to ASTM D 1248, Type I, Category 5, Class B or C.

B. General Requirements for Fittings

1. Pipe fittings shall be indicated in the Schedule of Pipe and Fittings for each type of service. Fittings shall be rated to match the larger of the pipe pressure rating in the Schedule or the valve rating listed in the valve tables in the Part 2 Valve and Strainer section of this specification.

2. All fittings shall be installed per code requirements and the manufacturer’s best recommendations.

3. Malleable iron pipe fittings shall conform to ASME B16.3, type required to match adjacent piping.

4. Cast iron (CI) pipe fittings shall conform to ASME B16.1 or ASME B16.4 type required to match adjacent piping.

5. Steel pipe fittings shall have the manufacturer's trademark affixed in accordance with MSS SP-25 so as to permanently identify the manufacturer. For 90° elbows,

provide long radius fitting unless they will not physically fit, in which case short radius may be used. Flanges shall be flat faced weld neck up to Class 125 and raised face weld neck type for Class 150 and above.

6. The steel pipe joining methods below are only allowed when they are specifically listed in the Schedule of Pipe and Fittings:

   a. Type S1: Welded fittings shall conform to ASTM A234 with WPA marking. Butt-welded fittings shall conform to ASME B16.9, and socket welded fittings shall conform to ASME B16.11. Make fusion welded joints as required by ANSI/ASME B31.1.

   b. Type S2: Steel flanged fittings including flanges, bolts, nuts, bolt patterns, etc. shall be in accordance with ASME B16.5 for the class required (Class 150 minimum). Flange material shall conform to ASTM A53 Grade B. Blind flange material shall conform to ASTM A516 for cold service and ASTM A515 for hot service. Bolts shall be high strength or intermediate (Class 150 only) strength with material conforming to ASTM A193.

   c. Type S3: Cast Iron (CI) flanged fittings shall be of malleable cast iron conforming to ASTM A47, Grade 32510. Bolts shall be high strength or intermediate (Class 125 only) strength with material conforming to ASTM A193. Class 125 iron flanges shall be limited to 175 psig / 230^{o}F (up to 12”) and 125 psig / 230^{o}F (14” – 24”). Class 250 iron flanges shall be limited to 400 psig / 250^{o}F (up to 12”) and 250 psig / 250^{o}F (14” – 24”).

   d. Type S4: Ductile iron (DI) flanged fittings shall conform to ASTM A536, Grade 65-45-12. Bolts shall be high strength or intermediate (Class 150 only) strength with material conforming to ASTM A193. Class 150 ductile iron flanges shall be limited to 225 psig / 230^{o}F. Class 300 ductile iron flanges shall be limited to 425 psig / 450^{o}F.

   e. Type S5: Threaded joints: For use up to 2” pipe size. Pipe threads shall conform to ASME B1.20.1. Nipples shall conform to ASTM A733 or ASTM B687. Class 125 iron threaded fittings shall be limited to 150 psig / 250^{o}F or 125 psi at 350^{o}F. Class 250 iron threaded fittings shall be limited to 340 psig / 250^{o}F. Class 150 ductile iron threaded fittings shall be limited to 185 psig / 250^{o}F or 150 psig / 300^{o}F (maximum temperature). Class 300 ductile iron threaded fittings shall be limited to 1200 psig / 250^{o}F or 600 psig / 450^{o}F (maximum temperature).

   f. Type S6: Malleable iron pipe press fittings equal to IMS Fastlock may be used (in exposed, accessible areas only) and shall be NSF-61-4 certified, approved by the state where it will be installed, and be IAPMO approved. Sealing elements for press fittings shall be EPDM gasket and 316L stainless steel ring. System shall be suitable for, and limited to, water systems up to 2” pipe size with operating temperatures up to 210ºF and maximum pressure rating up to 200 psig. Press ends shall have a design feature to assure leakage of liquids and/or gases from inside the system past the sealing element of an un-pressed connection with a 10 psig air pressure test. The function of this feature is to provide the installer quick and easy identification of connections which have not been pressed prior to putting the system into operation.

      1) Do <u>not</u> use on steam systems or hot water systems that use steam heat exchangers. Exception: Press fitting joints may be used on hot water systems below 210º generated by low pressure steam

providing the steam control valves fail closed, the hot water piping has minimum 3 foot thermal traps at the heat exchanger (both supply and return), and the first grooved joint is a minimum of 25 feet away from the heat exchanger's thermal pipes.

g. Type S7: For use over 2" pipe size. Standard grooved mechanical pipe joints shall conform to ANSI/AWWA C606. Use is limited to low temperature water systems below 210°F and 250 psig in easily accessible locations. Couplings shall be designed for not less than 250 psi service and shall provide a water-tight joint.

1) Do not use on steam systems or hot water systems that use steam heat exchangers. Exception: Grooved joints may be used on hot water systems below 210° generated by low pressure steam providing the steam control valves fail closed, the hot water piping has minimum 3 foot thermal traps at the heat exchanger (both supply and return), and the first grooved joint is a minimum of 25 feet away from the heat exchanger's thermal pipes.

2) Grooved mechanical joint fittings shall be full flow factory manufactured forged or fabricated steel fittings or cast ductile iron fittings. Mechanical pipe couplings shall be of the bolted type and shall consist of a housing fabricated in two parts, a synthetic rubber gasket, and nuts and bolts to secure unit together. Housings shall be of ductile iron conforming to ASTM A536, Grade 65-45-12. Coupling nuts and bolts shall be of heat treated carbon steel, zinc electroplated to ASTM B-633 and conform to ASTM A-183 and A-449, minimum 110,000 PSI tensile strength. Gaskets shall be of molded synthetic rubber, Type EPDM (for water service) with central cavity, pressure responsive configuration, rated for a temperature range of -30ºF to +230ºF, and shall conform to ASTM D-2000 (Gaskets shall be verified as suitable for the intended service prior to installation).

3) Rigid grooved joints shall incorporate an angle bolt pad design which maintains metal-to-metal contact of housings upon installation to insure positive rigid clamping of the pipe. Rigid grooved pipe couplings shall be used with grooved end pipes, fittings, valves and strainers. Rigid segmentally welded elbows shall not be used. Standard rigid coupling (2"-12") housings shall be Victaulic Style 107, 07, or Grinnell Style 772, (over 12" shall be 2 piece housings equal to Victaulic AGS) and shall provide system rigidity equal to welded steel with supports and hanging requirements corresponding to ANSI B-31.1 Power Piping and ANSI B-31.9 Building Services Codes (same spacing as steel pipe).

4) Flexible grooved joints will not be permitted, except as vibration isolators adjacent to mechanical equipment other than pumps.

5) Grooves shall be prepared in accordance with the coupling manufacturer's latest published standards. Grooving shall be performed by qualified grooving operators having demonstrated proper grooving procedures in accordance with the tool manufacturer's recommendations. The Owner's Representative shall be notified 24 hours in advance of test to demonstrate

operator's capability, and the test shall be performed at the work site, if practical, or at a site agreed upon. The operator shall demonstrate the ability to properly adjust the grooving tool, groove the pipe, and verify the groove dimensions in accordance with the coupling manufacturer's specifications.

7. Fittings for copper tubing shall be wrought copper and bronze fittings conforming to ASME B16.22 and ASTM B75 or cast copper alloy fittings conforming to ASME B16.18. Copper may be used up to 2" tubing size. Adapters may be used for connecting tubing to flanges and threaded ends of valves and equipment. The copper tubing/pipe joining methods below are only allowed when they are specifically listed in the Schedule of Pipe and Fittings:

   a. Type C1: Soldered copper fittings shall use either 95/5 (Tin/Antimony), silver solder (for systems up to 250 degrees F and 175 psi), or shall be brazed (for higher temperature/pressure systems – Contractor shall submit brazing material and pressure/temperature rating of joint). Solder shall conform to ASTM B32. Solder and flux shall be lead free. Silver solder shall conform to FS QQ-B-654. Brazing alloys shall be B-Ag alloy (or equivalent strength alloy) having a melting point above 1000 degrees F.

   b. Type C2: Copper and copper alloy press fittings equal to Viega ProPress may be used (in exposed, accessible areas only) and 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 and shall be suitable for, and limited to, water systems with operating temperatures up to 210ºF and maximum pressure rating up to 200 psig. Press ends shall have a design feature to assure leakage of liquids and/or gases from inside the system past the sealing element of an un-pressed connection. The function of this feature is to provide the installer quick and easy identification of connections which have not been pressed prior to putting the system into operation.

   c. Type C3: Grooved joints (copper tube sized) fittings (rated and limited for systems up to +210 degrees F and maximum pressure rating of 300 psi) equal to Victaulic Style 607 may be used for water systems (in exposed, accessible areas only).

8. Type SC1: Vic-Press 304™ fittings and couplings or ProPress® Stainless joints with Schedule 5 stainless steel pipe may be used for up to 2" water piping (in exposed, accessible areas only) in lieu of other copper or steel joining methods to a maximum operating temperature of +210 degrees F and maximum pressure rating of 200 psi. Pipe shall be ASTM A312 Schedule 5, stainless steel. Fittings shall be stainless steel with EPDM O-ring seals.

   a. Do <u>not</u> use on steam systems or hot water systems that use steam heat exchangers. Exception: Press fitting joints may be used on hot water systems below 210º generated by low pressure steam <u>providing</u> the steam control valves fail closed, the hot water piping has minimum 3 foot thermal traps at the heat exchanger (both supply and return), <u>and</u> the first grooved joint is a minimum of 25 feet away from the heat exchanger's thermal pipes.

9. Composition gaskets for flanges shall conform to ASME B16.21. Gaskets shall be non-asbestos compressed material in accordance with ASME B16.21, 1/16 inch thickness, full face or self-centering flat ring type. Gaskets shall contain aramid fibers bonded with styrene butadiene rubber (SBR) or nitrile butadiene rubber (NBR). NBR binder shall be used for hydrocarbon service. Gaskets shall be suitable for pressure and temperatures of piping system.

10. Unions shall conform to FS WW-U-531 or FS WW-U-516, type to match adjacent piping.

11. Adapters for copper tubing shall be brass or bronze for soldered and brazed fittings.

12. Dielectric Waterway fittings equal to PPP Clearflow shall be used where dissimilar pipe materials (such as steel and copper) in any water or glycol system are joined. Fittings shall conform to the tensile strength and dimensional requirements specified in FS WW-U-531. Waterways shall have metal connections on both ends to match adjacent piping. Metal parts of dielectric Waterways shall be fully separated by NSF/FDA listed thermoplastic lining so that the electrical current is well below 1 percent of the galvanic current that would exist upon metal-to-metal contact. Fittings shall be rated for 300 psig and 225°F. Galvanized pipe, dielectric unions, or insulated couplings shall not be used.

13. Flexible pipe connectors shall be as specified in Vibration Isolation paragraph.

C. Schedules of Pipe and Fittings

1. As used in the pipe and fitting schedule tables, closed loop systems have expansion tanks and are not open to the atmosphere, examples are chilled, hot, dual temperature and closed heat pump condenser water systems. Open loop systems are open to the atmosphere with open condenser water system being the most common.

2. Relief valve piping shall have the same pressure/temperature ratings as the fluid being relieved. Exposed outdoor piping shall be stainless steel.

WATER AND GLYCOL SERVICES:
UP TO 230 PSIG AT 250ºF, OR 275 PSIG AT 100ºF
(Some joint types or materials may have lower pressure and/or temperature limits and Contractor shall ensure they are only used where those limits will NOT be exceeded.)

Service	Pipe Material & Schedule or Type	Joint Types Allowed	Fitting Material	Min. Pressure Class (psig) & / or Schedule
Closed loop piping up to 2”	Copper / Type L	C1, C2, C3, or SC1	Copper, Bronze	150
Closed loop piping up to 2”	Steel / Schedule 40	S5, S6, or SC1	CI, DI	250 / Standard Weight
Closed loop piping 2.5”-24”	Steel / Standard Weight	S1, S2, S3, S4, or S7	Steel, CI, DI	150 / Standard Weight
Cold water make-up	Copper / Type L	C1 (silver soldered or brazed only), C2, C3, or SC1	Copper, Bronze	150

D. Diesel and Fuel Oil Piping and Fittings

1. Indoor Above Grade - Single Wall:

a. Piping: Seamless steel A53, A105, A120 or ERW A53E. Threaded joints shall be Schedule 80, welded joints shall be Schedule 40. Cast iron fittings must not be used on fuel systems.

b. Fittings: Steel, beveled butt-weld ends, ASTM A234, ANSI B169, same schedule as adjoining pipe, all elbows long radius, all interior surfaces smoothly contoured. Threaded fittings shall be malleable iron, 300 PSI Class, ASTM A47, or forged or rolled steel, ASTM A234.

c. Unions: Malleable iron, 300 PSI Class, brass seat, ANSI B16.39, or 2,000 pound forged steel, ASTM A105.

d. Joints: Welded for piping 2-1/2 inches and above, threaded or butt-welded for pipe 2 inches and below.

e. Flanges shall be forged steel welding neck type with flanges, bolts, nuts, bolt patterns, etc. being in accordance with ASME B16.5 for the class required (Class 150 minimum). Flange material shall conform to ASTM A53 Grade B. Bolts shall be high strength or intermediate (Class 150 only) strength with material conforming to ASTM A193.

2.1 PIPE HANGERS AND SUPPORTS

A. Hangers shall be as manufactured by Carpenter & Patterson, Inc., Grinnell Corporation, B-Line Systems, ERICO, or equal. Hangers shall transmit the load exclusively to the structure of the building. All hangers and supports to conform to MSS standards SP-58 and SP-69 and ANSI B 31.1.

B. Hangers for all piping 4 inches and above shall be adjustable roll type. Hangers for piping below 4 inches shall be clevis type. Hangers for piping in tunnels on strut support frames shall be roller type, similar to Fig. B379 by B-Line Systems. Additionally, the first five (5) pipe hangers on both sides of all pump piping (suction and discharge) to be precompressed spring and double-deflection neoprene style, with 30° hanging rod swing capability, similar and equal in all respects to Mason Industries Model PC 30N, selected by manufacturer for anticipated loading and deflection.

C. Provide all additional structural steel required for proper installation of hangers, anchors, guides and supports; hangers shall be arranged to maintain the required grading and pitch of piping, to prevent vibration and to provide for expansion and contraction.

D. Maximum spacing of hangers and supports for steel pipe:

Pipe Size (inches)	Horizontal	Vertical
Up to 1	6 feet	10 feet
1¼-2½	9 feet	15 feet
3-and up	12 feet	15 feet

E. Reduce Steel pipe spacing to a maximum of 10', regardless of pipe, as necessary for fittings, valves, and other concentrated loads.

F. Horizontal copper tubing shall have maximum hanger spacing of 5' for tubing up to 1-¼" and 8' for 1½" and larger. Vertical copper tubing shall have maximum hanger and support spacing of 10 feet. Maximum spacing for PVC pipe hangers and supports shall be 4' (horizontal), and 10' (vertical) with mid-story guides.

G. Steel or stainless steel tubing shall have maximum hanger and support spacing of 8 feet (horizontal) or 10 feet (vertical).

H. If any other piping material is used, the maximum hanger and support spacing shall be the lesser of manufacturers recommendation or the listed spacing in the mechanical code (currently IMC-2009 Table 305.4).

I. Branch piping and runouts of over 5 feet shall have at least one hanger or support.

J. At all copper piping, provide pipe supports with copper finish to eliminate the possibility of galvanic action.

K. Furnish additional hangers or supports at vertical or horizontal changes of direction and at locations of concentrated loads due to valves, fittings, strainers, and accessories.

L. Hangers and supports shall provide for 2" of vertical adjustments.

M. Hanger rods shall be steel, threaded and furnished with two removable nuts at each end of positioning rod and hanger and locking each in place.

N. Except as otherwise noted, hanger rods shall be of the following sizes:

SCHEDULE OF PIPE HANGER ROD SIZES		
Pipe sizes (inches)	**Single rod diameter (inches)**	**Double rod diameter (inches)**
½-2	3/8	3/8
2½-3	½	3/8
4 & 5	5/8	½
6	¾	5/8
8 – 12	N/A	7/8
14 – 18	N/A	1
20	N/A	1¼
24	N/A	1-½

O. Pipe covering protection saddles shall not be loaded to more than 80% of maximum loading as rated by the manufacturer.

P. Insulated piping insulation shields:

1. Up to 3" pipe size: 18 gauge galvanized steel, located outside the vapor barrier, minimum 180° arc, 12" long, or pipe covering protection saddles.

2. 4" pipe size and larger: pipe covering protection saddles.

Q. Vertical support shall be by means of riser clamps (anchors with split ring type allowable up to 2" size only) and adjustable pipe support with flange anchored to floor or supplementary steel.

R. Rods, clamps and hangers shall be electro-galvanized coated.

S. Valve and piping supports, from the floor, shall be equal to Carpenter & Paterson, Inc. Figure 101, adjustable pipe support and complete with pipe standard and flange, anchored to floor.

1. Supports shall be installed at each control valve, riser, tee or elbow and where any unsupported section exceeds 4'-0" in length measured along piping centerline.

T. Upper Attachments to Building Structure:

1. Existing Reinforced Concrete Construction: Upper attachment welded or clamped to steel clip angles that are expansion-bolted to the concrete. Expansion bolting shall be located so that piping loads place bolts in shear. Submit details for approval.

2. Structural Steel Framing: Upper attachments welded or clamped to structural steel members. Additional steel members may be necessary in some support locations where piping locations differ from that known on contract drawings. Submit details for approval.

3. Structural Wood Framing: Submit details for approval.

4. Expansion Fasteners and Power Set Fasteners: In existing concrete slab construction, expansion fasteners may be used for hanger loads up to one-third the manufacturer's rated strength of the expansion fastener. Power set fasteners may be used for loads up to one-fourth of rated load. When greater hanger loads are encountered, additional fasteners may be used and interconnected with steel members combining to support the hanger.

U. All hangers and shields exposed to the exterior shall be galvanized steel and PVC coated to manufacturer's standard thickness.

V. In grooved piping systems, rigid type grooved joint mechanical couplings may be used on IPS steel piping systems, which meet the support and hanging requirements of these specifications and ASME B31.1 and B31.9. Adequate numbers of flexible type couplings may also be used to compensate for thermal expansion and contraction, settling of the pipe, vibration, noise or other piping system movement. Maximum hanger spacing for flexible couplings shall be in accordance with either manufacturer’s published guidelines or the requirements of Item D of this section; whichever is more stringent.

2.2 VALVES AND STRAINERS

A. General:

1. Valves and strainers shall be constructed of the materials shown in the tables for each system and be rated by the manufacturer for the appropriate pressure class

required for the listed pressure and temperature limits and for the fluid used and per the valve tables.

2. The manufacturers and model numbers indicated below are to be used as a means of identifying the type, quality, materials and workmanship required. Note that some of the manufacturers listed for a type of valve do not make valves for all pressure/temperature limits and/or all sizes. All valves of each type (400 psig ball, 150 psig globe, etc.) for the project shall be by the same manufacturer.

3. All valves shall be located and oriented as to valve stem direction to permit proper and easy operation, and access to valve for maintenance of packing, seat and disc. Valve stems shall not be tilted down unless approved by the manufacturer. Where valves are more than seven feet above the floor, stems shall be horizontal and all valves 2-1/2" and above shall have chain wheel and "endless link" style chain for operation from floor; where impact wheel is required, it shall be provided. Packing and gaskets shall not contain asbestos. Provide unions adjacent to equipment end of all threaded and soldered or permanent push-to-connect end valves. Provide grooved joint couplings adjacent to equipment end of all grooved end valves.

B. Service:

1. Shutoff or Isolation Valves shall be provided in all branch connections to mains and where shown on piping diagrams.

   a. In general, for 2½" and larger piping use flanged valves or grooved-ended valves in grooved water systems; butterfly valves for water and glycol systems or gate valves for steam and condensate systems.

   b. In general, for piping smaller than 2½" use threaded, sweat, permanent push-to-connect or press/crimped water system connections; full port ball valves for water, fuel oil, and glycol systems or gate valves for steam and condensate systems.

2. Balancing Valves

   a. No balancing valves are required where Pressure Independent Automatic Control Valves (PIACV) are used for a single coil. Where multiple coils are served by a single PIACV, each coil shall have a combination balancing and shut-off valve to provide proportional balancing. When non-PIACVs are used, provide automatic flow limiting valves or combination balancing and shut-off valves as shown on drawings and details for water and glycol systems and globe valves for steam and condensate. Triple duty valves (balancing with flow measurement, shut-off, and check valve) or equivalent tri-service assemblies (in grooved piping systems) can be used where shown on the drawings and allowed in the tables on pump discharges.

3. Check Valves

   a. For pump discharge use silent check valves (where allowed in the tables and where triple duty valves are not used). All others shall be swing-check type.

4. Drain Valves and Manual Vent Valves

   a. Globe with plug-type disc or ball valves (as shown on drawings).

5. Vacuum Breakers

a. Vacuum breakers shall be of stainless steel and brass construction rated for a minimum of 200 psig saturated steam and be equal to Spriax Sarco Model VB-14. Provide at least one vacuum breaker for each steam coil and heat exchanger.

C. Swing Check Valves: Bronze valves shall conform to MSS SP-80, of the type required for the pressure class and body connection type listed in the tables. Iron valves shall conform to MSS SP-71, of the type required for the pressure class and body connection type listed in the tables. Steel valves shall conform to ASME B16.34, of the type required for the pressure class and body connection type listed in the tables. Valves shall be as manufactured by Stockham, Milwaukee, Crane, Nibco, Victaulic (grooved), Grinnell (grooved), or Hammond.

D. Silent Check Valves: Silent check valves for use on pump discharge shall be of the materials and pressure/temperature ratings shown in the tables. Minimum open area through valve shall be at least 100% of the pipe area. Valves shall be as manufactured by Mueller, Nibco, Metraflex, APCO, Victaulic (grooved), Grinnell (grooved), or SF Equipment.

E. Globe Valves (including angle valves): Bronze valves shall conform to MSS SP-80, of the type required for the pressure class and body connection type listed in the tables. Iron valves shall conform to MSS SP-85, of the type required for the pressure class and body connection type listed in the tables. Steel valves shall conform to ASME B16.34, of the type required for the pressure class and body connection type listed in the tables. Maximum seat leakage for manual valves shall be no more than 10 cc/hr per inch of diameter. Control valves leakage shall be no more than that allowed by ANSI seat leakage Class IV (0.01% of full open valve capacity). Valves shall be as manufactured by Stockham, Milwaukee, Crane, Nibco, or Hammond. For areas where clearances are restricted, non-rising stems may be used – Contractor shall indicate locations on submittal.

F. Gate Valves: Bronze valves shall conform to MSS SP-80, of the type required for the pressure class and body connection type listed in the tables. Iron valves shall conform to MSS SP-70, of the type required for the pressure class and body connection type listed in the tables. Steel valves shall conform to ASME B16.34, of the type required for the pressure class and body connection type listed in the tables. Maximum seat leakage shall be no more than 10 cc/hr per inch of diameter. Valves shall be as manufactured by Stockham, Milwaukee, Crane, Nibco, or Hammond. For areas where clearances are restricted, non-rising stems may be used – Contractor shall indicate locations on submittal.

G. Ball Valves: Valves shall meet FS WW-V-35C, Type II, and have the appropriate trim to meet the required pressure/temperature ratings listed in the tables. Valves shall have locking handles to allow servicing and removal of piping or equipment. Valves on insulated piping shall have stem extension assemblies equal to the insulation thickness. Valves shall have 100% tight shut-off (no seat leakage). Valves used for isolation (all 2-position applications) shall be full port. Valves shall be as manufactured by Conbraco Industries (Apollo), Watts, Stockham, Nibco, Hammond, or Milwaukee. Ball valves for modulating control service may be reduced port andshall have characterized disc where available to provide equal percentage flow characteristics and extended rangeability. Modulating ball valves shall be Bray VCB series or Belimo B series.

H. Butterfly Valves: Provide butterfly valves of the type and materials listed in the tables. Valve necks shall allow a minimum of 2” insulation. Valves shall have the trim required to meet the listed pressures and temperatures listed in the tables. Valves shall have visual position indication. Valve seats shall have zero or near zero (bubble-tight) bi-directional seat

leakage. Valves 6" and larger and all steam valves shall be gear operated. Non-steam valves under 6" shall be lever operated with balance stops.

1. General Service: Standard lug or grooved (in grooved systems) type with ductile or cast iron body, resilient EPDM seats, bronze, nickel, PPS (Polyphenylene Sulfide), Nylon 11 or EPDM coated ductile iron disc and 416 stainless steel stem. Valves shall comply with MSS SP-25, MSS SP-67, and API-609. Valves shall be as manufactured by Mueller, Centerline, DeZurik, Milwaukee, Nibco, Hammond, Keystone, Bray Model 31H, Victaulic Masterseal (grooved), Grinnell Model B302 (grooved), or SF Equipment.
2. High Performance: Valves shall have lug-style carbon steel body, 316 stainless steel eccentric disc, offset 17-4 PH stainless steel shaft, and filled PTFE soft seat. Valves shall comply with ANSI B16.5, ANSI B16.34, MSS SP-25, MSS SP-61 (zero leakage), MSS SP-58, and API-609. Valves shall be as manufactured by Flowseal (Crane), Neles-Jamesbury, DeZurik, Posi-Seal, Milwaukee, Hammond or Bray/McCannalok.

I. Automatic Flow Limiting Valves: Valves shall be pressure flow limiting independent type with spring loading to provide the required opening to maintain constant flow across the entire control pressure range. Valve flow selection shall be adjustable on the valve assembly with a minimum range of +50% above the design flow. Valves whose flow rate can't be field selected (fixed flow) shall be selected within in the range of -5% to +10% of the design flow and be provided with replacement flow cartridges as required by the balancing Contractor or engineer. The valves shall be provided with a permanent nameplate or tag carrying a record of the factory-determined flow rate, flow range and flow control pressure ranges. Valves shall be certified to control the flow within 5 percent of the flow set per the tag's listed flow and control pressure range. Unless shown otherwise, the minimum control pressure range shall be 2 to 32 psid. Valves shall be of materials suitable for the maximum operating pressure and temperature listed in the table for the intended service. Valves up to 2-inches shall be threaded or solder-end. Valves over 2-inches shall be flanged. Each valve shall have a pressure fitting with quick disconnect valve located on both sides of the valve. Provide deluxe meter kit in carrying case. Provide molded insulation kit. Valves shall be as manufactured by Griswold, Flow Design/Autoflow, Macon, Hays or Nexus.

J. Strainers

1. Strainer-body connections shall be the same size as the pipe lines in which the connections are installed. The bodies shall have arrows clearly cast on the sides to indicate the direction of flow. Each strainer shall be equipped with an easily removable cover and sediment basket. The body or bottom opening shall be equipped with a tapped blowdown opening. Provide full size nipple and appropriate type of valve for blowdown. The basket shall be of stainless steel with small perforations of sufficient number to provide a net free area through the basket of at least 5 times that of the entering pipe. The flow shall be into the basket and out through the perforations. Bronze strainers shall conform to MSS SP-80, of the type required for the pressure class and body connection type listed in the tables. Iron strainers shall conform to MSS SP-71, of the type required for the pressure class and body connection type listed in the tables. Steel strainers shall conform to ASME B16.34, of the type required for the pressure class and body connection type listed in the tables. Y-type strainers are listed in the tables, provide basket type strainers of same construction where shown on drawings. Strainers shall be as manufactured by Mueller, Sarco, Watts, Armstrong, Keckley, or Yarway.

2. Strainers for grooved end piping systems shall be of the same size as the pipe lines in which the connections are installed. The bodies shall have arrows clearly cast on the sides to indicate the direction of flow. Each strainer shall be equipped with an easily removable cover and sediment basket. The body or bottom opening shall be equipped with a tapped blowdown opening:

   a. Y-pattern, 2" through 12" sizes, 300 psi maximum pressure rating. Suitable for services up to 210°F, ductile iron body, Type 304 stainless steel perforated metal removable baskets, blowdown port with pipe plug and grooved ends.

   b. T-pattern, 2" through 12" sizes, 300 psi maximum pressure rating. Suitable for services up to 210°F, ductile iron body, Type 304 stainless steel frame and mesh removable basket, removable access coupling/cap for strainer maintenance, and grooved ends.

   c. T-pattern, 14" through 24" sizes, 300 psi maximum pressure rating. Suitable for services up to 210°F, carbon steel body, Type 304 stainless steel frame and mesh removable basket, carbon steel T-bolt hinged closure/cap for strainer maintenance, and grooved ends.

K. Pressure Relief Valves and Accessories

1. Pressure relief valves shall be provided where shown on the drawings in accordance with ASME BPV VIII Division 01. Relief valves shall be constructed for the maximum pressure the system can operate at. The aggregate relieving capacity of the relief valves shall be not less than that required by the above code. Provide at least one relief valve for each closed loop piping system. Discharge from water relief valves shall be to indirect drain. Pipe chiller refrigerant relief and steam relief valves to a safe location outdoors. Valves shall be as manufactured by Watts, Kunkle, Lonergan, or Lunkenheimer.

2. For steam relief valves that are piped outdoors, provide steam exhaust heads where shown on drawings. Exhaust heads shall be low pressure drop cyclone design with drains as manufactured by Bryan Steam HEH Series (rated at 7,000 fpn) or equal by, Crane (Cochrane), Penn Separator, Watson McDaniel, Anderson or Hayward (Wright-Austin). Pipe drains as required. Exhaust heads shall remove at least 99% of liquids and solids larger than 10 microns and be fabricated of cast iron or carbon steel (with high heat and rust resistant aluminum paint) with stainless steel separating elements. Contractor shall verify that the exhaust head's steam capacity is equal to or greater than the associated relief valves capacity and provide any required pipe increases

L. Air Vents: Provide air vents at all high points in the piping systems meeting the pressure and temperature limits shown on the table for each system.

1. Automatic: Normal Capacity – Float operated with bronze or steel body and stainless steel internals, ball-check valve type with materials as required for the pressure/temperature listed in the table for the system. Provide each vent with safe drainage piping for venting air/water to drain.

2. Manual: For low pressure/temperature water and glycol systems, provide 1/8-in. brass body, chrome plated with two-detachable keys. For higher pressure/ temperature systems, provide globe valves with plug-type disc or ball valves with materials, as required and allowed in the table for the system.

M. Drain Valves: Drain valves shall be one of the type listed for isolation in the table for each piping system. Provide drain connections at all equipment and all low points in the piping systems to allow for complete drainage. Drain connections shall have full size threaded hose end connections with cap/plug. For piping up to 4", provide minimum ¾" valves. For piping between 4" and 10", provide minimum 1½" valves. For piping larger than 10", provide minimum 2" valves. Provide 50' of premium grade hose for each size drain.

N. Valve Lubrication: Furnish a lubrication gun in the mechanical equipment room with extra lubricant sticks sufficient to repack each valve. Guns shall be extra heavy, lever type hydraulic hand type with automatic shutoff, 1500 psi gauge and 12" long connecting hose. Lubricant shall be as required by valve manufacturer for the service intended.

WATER AND FUEL OIL SERVICES:
Maximum 150 psig at 120°F (CHW, CW, FO)

Valve Type	Size	Type	Application	Body/Trim Body/Seat	Type of Connection	Minimum Pressure Rating/Class
Ball	To 2"	2 or 3 piece	Isolation or ATC Modulation (with characterized disc)	Brass or Bronze/RTFE	Sweat (3-piece only) or Threaded (2 or 3-piece)	400 psig CWP (Cold Working Pressure)

WATER SERVICES:
Maximum 150 psig at 250°F (Heating & Dual Temperature Systems), or 275 psig at 120°F (CHW & CW)

Valve Type	Size	Type	Application	Body/Trim Body/Seat	Type of Connection	Minimum Pressure Rating/Class
Ball	To 2"	2 or 3 piece	Isolation or ATC Modulation (with characterized disc)	Brass or Bronze/RTFE	Sweat (3-piece only) or Threaded (2 or 3-piece)	400 psig CWP (Cold Working Pressure) or ANSI Class 150
Butterfly	2½" - 12"	General Service	Isolation or ATC 2-Position	Iron/EPDM	Flanged	200 psig CWP, Bi-directional, dead end service.
Balancing /Shutoff	To 2"	Flow Indication	Isolation and balancing	Bronze or Brass/Brass	Threaded	ANSI Class 125 or 300 psig CWP
Balancing /Shutoff	2½" -12"	Flow Indication	Isolation and balancing	Iron or Steel/Brass	Flanged	ANSI Class 125 for 150 psig or 300 psig CWP for 275 psig
Check	To 2"	Swing	Piping	Bronze/Bronze	Threaded	ANSI Class 125 for 150 psig or Class 200 for 275 psig

WATER SERVICES:
Maximum 150 psig at 250ºF (Heating & Dual Temperature Systems), or 275 psig at 120ºF (CHW & CW)

Valve Type	Size	Type	Application	Body/Trim Body/Seat	Type of Connection	Minimum Pressure Rating/Class
Check	2½" - 12"	Swing	Piping	Iron or Steel /Bronze or 13 Cr steel	Flanged	ANSI Class 125 for 150 psig or Class 250 or 150 Steel for 275 psig
Strainer	To 2"	Y-type	ACVs, P&F HXs	Bronze/Stainless 1/16" screen	Threaded	ANSI Class 125 for 150 psig or Class 200 for 275 psig
Strainer	2½" – 4"	Y-type	ACVs, P&F HXs	Iron or Steel /Stainless 1/16" screen	Flanged	ANSI Class 125 for 150 psig or Class 250 or 150 Stl for 275 psig
Strainer	5" – 12"	Y-type	ACVs, P&F HXs	Iron or Steel/Stainless 1/8" screen	Flanged	ANSI Class 125 for 150 psig or Class 250 or 150 Steel for 275 psig
Strainer	To 16"	Suction Diffuser	Pump Inlet (non-reducing)	Cast or Ductile Iron /Stainless 5/32" screen	Threaded (to 2") or Flanged	300 psig CWP or ANSI Class 125

ALTERNATE PIPING METHOD (GROOVED JOINT) FOR WATER SERVICES:
Maximum Service Rating of 230F; with pressure as required for the systems (see standard valve tables)

Valve Type	Size	Type	Application	Body/Trim Body/Seat	Type of Connection	Pressure Rating/Maximum System Rating
Ball	1½"-6	2-piece	Isolation or ATC 2-Position	DI (ASTM A-536)/Cr.-plated stem, ball TFE seats	Grooved	800 PSI/600 PSI
Ball	2"	1-piece	Diverting (3-port) or ATC 2-Position	DI (ASTM A-395)/SS TFE	Grooved	600 PSI/450 PSI
Butterfly	2"-12"	General Service	Isolation or ATC 2-Position	DI (ASTM A-536 or 395) DI/EPDM	Grooved	300 PSI (dead-end to full rating of valve)/230 PSI

ALTERNATE PIPING METHOD (GROOVED JOINT) FOR WATER SERVICES:
Maximum Service Rating of 230F; with pressure as required for the systems (see standard valve tables)

Valve Type	Size	Type	Application	Body/Trim Body/Seat	Type of Connection	Pressure Rating/Maximum System Rating
Butterfly, 3-way	2”-12”	General Service	Diverting	DI (ASTM A-536 or 395)/ DI/EPDM	Grooved	300 PSI (dead-end to full rating of valve)/230 PSI
Butterfly	14”-24”	General Service	Isolation	DI (ASTM A-395) SS/EPDM	Grooved	175 PSI (dead-end to full rating of valve)/150 PSI
Butterfly	14”-24”	General Service	Isolation	DI (ASTM A-395 or 536) DI/EPDM	Grooved	300 PSI (dead-end to full rating of valve)/230 PSI
Balancing /Shutoff	To 2”	Flow Indication	Isolation and balancing	Ametal® Brass-Copper Alloy/EPDM	Sweat or Threaded	300 PSI/230 PSI
Balancing /Shutoff	2½”-12”	Flow Indication	Isolation and balancing	DI (ASTM A-536)/EPDM	Flanged or Grooved	300 PSI/230 PSI
Tri-Service	2½”-12”	Flow Indication	Pump discharge isolation, check and balancing	DI (ASTM A-536) DI/EPDM	Grooved	300 PSI/230 PSI
Check	2½”-12”	Silent	Pump Discharge	DI (ASTM A-395 or 536) DI/EPDM	Grooved	300 PSI/230 PSI
Check	4”-12”	Silent	Pump Discharge	DI (ASTM A-395 or 536) DI/EPDM	Grooved	300 PSI/230 PSI
Check	2”-4”	Swing	Piping (Horizontal)	DI (ASTM A-536) SS/EPDM	Grooved	300 PSI/230 PSI
Strainer	2”-12”	Y-Type	ACV’s, P&F HXs	DI (ASTM A-395 or 536) /EPDM SS 1/16” or 1/8” screen	Grooved	300 PSI/230 PSI
Strainer	1½”-12”	T-Type	ACV’s, P&F HXs	DI (ASTM A-395 or 536) /EPDM SS 1/8” screen	Grooved	400 PSI/350 PSI

2.3 PIPING, EQUIPMENT, PANEL AND VALVE IDENTIFICATION

A. All piping, equipment, panels and valves furnished and/or installed under this Section of the Specifications including automatic temperature controls shall be identified with pipe markers, valve tags, and equipment name plates. Refer to Part 3 – IDENTIFICATION for materials and methods of installation.

2.4 MOTORS, DRIVES AND STARTERS

A. All equipment shall be provided complete with motors and drives, unless otherwise indicated.

B. Motors shall be Premium Efficiency (as available by size/speed/horsepower) and shall conform to NEMA Standards and shall be suitable for load, duty service and location. Motors shall have nameplates giving manufacturer's name, serial number, horsepower, efficiency, speed and current characteristics. Motors shall be Century “E+3”, General Electric “Energy Saver Premium”, Reliance “Premium Energy Efficient” Series, Baldor “Super Premium Efficiency”, or approved equal.

C. Motors shall be tested in accordance with the standards of ANSI C50 and conform therewith for insulation resistance and electric strength. Minimum efficiency levels shall be as listed in latest edition of ANSI/ASHRAE Standard 90.1 or the state’s energy code, whichever is higher. All motors shall be tested in accordance with IEEE Standard 112, Test Method B. Provide on nameplate the type of bearing grease to use.

D. Motors 1/2 HP and larger shall have ball or roller bearings with pressure grease lubrication, specifically wound for the scheduled voltages. All bearings shall be suitable for radial and thrust loading.

E. Single-Phase Motors

1. Motors 1/20 HP and Smaller: Shaded-pole type.
2. Motors over 1/20 HP and less than 1/12 HP shall be one of the following, to suit starting torque and requirements of specific motor application:
    a. Permanent-split capacitor.
    b. Split phase.
    c. Capacitor start, inductor run.
    d. Capacitor start, capacitor run.
3. Motors not less than 1/12 HP and less than 1 HP shall have a minimum efficiency of 70% (rated in accordance with DOE 10 CFR 431), a means to adjust motor speed for balancing or modulation or remote speed control (based on the application requirements), and be one of the following, to suit starting torque and requirements of specific motor application:
    a. Electronically commutated (ECM).
    b. Permanent-split capacitor.
    c. Capacitor start, inductor run.
    d. Capacitor start, capacitor run.

4. Bearings: Prelubricated, antifriction ball bearings for motors 1/12 HP and larger or, for motors under 1/12 HP, ball or sleeve bearings. All bearings shall be suitable for radial and thrust loading.

5. Fractional horsepower motors, integral to equipment intended for installation in finished public spaces, shall be provided with an overload device responsive to motor current. The device shall be integral to the motor and include a wired, concealed, NEMA rated disconnect switch.

F. Thermal Protection: Internal protection to automatically open power supply circuit to motor when winding temperature exceeds a safe value calibrated to temperature rating of motor insulation. Thermal-protection device shall automatically reset when motor temperature returns to normal range.

G. Motors shall be furnished complete with conduit terminal box of size adequate to accommodate conduits and wires as sized on the Electrical Drawings or specified under this Section.

H. Motor capacity shall be sufficient to operate associated driven devices under conditions of operation and load and with overload and at least the horsepower indicated or specified. All motors shall be of the premium efficiency, high power factor, low energy consuming type most suitable for the application and installed environment. Any motor replacement necessary for compliance to the application shall be at no additional cost to the Owner.

I. Motors shall be suitable for continuous duty at rated horsepower with temperature rise not to exceed 40°C for drip proof motors, 50°C for splash proof motors, 55°C for totally enclosed or explosion proof motors. All non-VFD motors shall be capable of 15% overload without overheating and suitable for operation for the ambient conditions of its specific location.

J. Direct connected motors shall be furnished with adjustable base. Motors connected to driven equipment by belt or shaft shall be furnished with adjustable sliding bases, except fractional HP motors, which shall have slotted mounting holes.

K. Drives for belted motors shall be as manufactured by Dodge Manufacturing Company, Browning Manufacturing Company, T.B. Woods Company or equal with adjustable motor sheaves and adjustable slide bases. The drive belts shall be as short as practicable. All fans and fan units shall be furnished with cogged-type triple V-belt drives, each sized for 150% of the design drive capacity. All multiple belt drives shall have matched sets of belts.

L. Where starters or variable speed drives are not integral with packaged equipment specified in this section, the Electrical Subcontractor shall furnish all starters and drives in accordance with Division 26 drawings and specifications.

M. For packaged equipment, motor controllers shall be equipped with all poles, auxiliary contacts and other devices necessary to permit the interlocking and control sequences required. Controller operating coils shall be generally designed for 120 volt operation, and 3 phase motors shall be provided with thermal overload protection in all phases.

N. All electrical apparatus furnished under this Section shall be approved by UL (or other agencies approved by the authority having jurisdiction) and shall be labeled or listed where such is applicable. Where custom-built equipment is specified and the UL label or listing

is not applicable to the completed product, all components used in the construction of such equipment shall be labeled or listed by UL where such is applicable to the component.

2.5 BOILERS (CAST IRON, GAS-FIRED)

A. Provide cast iron gas-fired hot water boilers and burners as scheduled with all required operating and safety controls (including those shown on the control drawing as by the manufacturer). Units shall be as manufactured by Weil-Mclain, Smith, Peerless, or approved equal.

B. Units shall meet requirements of:

1. American National Standard Institute - ANSI Z21.13-1989 Standard for Gas-Fired Low Pressure Steam and Hot Water Boilers; ANSI Z223.1 (NFPA 54-1988) for Gas-Fired Boilers; and National Electrical Code (NFPA 70).
2. American Society of Mechanical Engineers (ASME) Section IV of the Boiler and Pressure Vessel Code, Rules for the Construction of Heating Boilers.
3. American Society of Mechanical Engineers (ASME) Section VI of the Boiler and Pressure Vessel Code, Recommended Rules for the Care and Operation of Heating Boilers.
4. Hydronics Institute (HI) - Testing and rating Standard for Cast Iron and Steel Heating Boilers and the (Minimum Efficiency Standards of) National Appliance Energy Conservation Act of 1992, effective 1 January, 1994.
5. 522 CMR 16.00
6. UL 795-1989 Gas Burners, as applicable.

C. Boilers:

1. Each Boiler shall be furnished as a knocked down unit for field erection in strict accordance with the manufacturer’s instructions and recommendations. Multiple “U” steel channels shall be supplied to provide level support for the Boiler(s) when shimmed and grouted to the concrete pad. Steel “L” shaped angle irons shall not be acceptable for floor rails. Provide four hold down bolts of at least 5/8-inch diameter into the concrete and fastened through the steel base channels of the Boiler.
2. Boiler shall be equipped with a flange mounted flame retention type, forced draft Burner designed and tested for a minimum of 82% combustion efficiency based on I=B=R testing procedure to meet ASHRAE 90.1 and the National Energy Policy Act of 1992 requirements.
3. Furnished with insulated boiler mounting plate having necessary holes and tappings to mount burner. High temperature sealing rope is used to provide a permanent gas tight seal between front section and plate.Installing Contractor shall furnish and install pipe and pedestal for each Burner to provide additional floor support.
4. Boiler is to be furnished with two observation ports (one in front and one in back) to allow visual inspection of the flame. Port openings must be of captured seal design – a machined groove assures uniform compression of the sealing ring and protects the seal from contaminants. Elastomer sealing rings are to be used to provide permanent watertight seal between sections. Unlike cast iron or steel push

nipples, the elasticity of the seals fills any gaps caused by misalignment or expansion or contraction. Boiler is to be provided with sufficient tappings to install required controls.

5. Boiler is to be designed with a low silhouette to provide maximum headroom.

6. Boiler shall be constructed of cast iron sections utilizing wet base design and not require a refractory combustion chamber.

7. Boiler shall be constructed for a minimum 50 PSI water working pressure or more as scheduled in accordance with the ASME Section IV Rules for Construction of Heating Boilers. Individual sections shall have been subjected to a hydrostatic pressure test of 200 PSIG at the factory before shipment and they shall be marked, stamped or cast with the National Board Standard.

8. Provide with cast-in air elimination to separate air from circulating water.

9. Constructedto provide balanced water flow through entire section assembly using single supply and return connections for water. No external headers are necessary for water.

10. Boiler sections shall be assembled with short, individual draw rods. Boiler sections shall be cast with sealing grooves to assure permanent gas-tight seal. Boiler sections shall be sealed watertight by elastomer sealing rings, not cast iron nipples. Each port opening is machined to completely capture sealing ring between sections.

11. Boiler shall have individual cleanout openings between sections covered with insulated steel covers designed to ensure a gas tight seal.

12. Flue connector(s) shall be Back Horizontal outlet, provided with cast iron flue collar with a built-in adjustable damper capable of being locked into place after adjustment.

13. The Boiler shall be provided with insulated heavy gauge steel jackets with durable powdered paint enamel finish. Jacket shall have removable side panels on the left side so that the jacket can be removed for cleaning without removing screws or disturbing system piping.

14. Limited 10-year warranty against workmanship and defects to be in writing by manufacturer.

15. Boiler trim shall include:

    a. Combination Pressure-temperature gauge.

    b. A19ADP-1 high limit aquastat (set at 210˚F) equipped with manual reset and SPDT switch for alarm and alarm terminal.

    c. Automatic reset high limit aquastat set at 20˚F below the manual reset set point.

    d. Operating aquastat and Low Fire control.

    e. ASME approved water relief valve sized to exceed the Gross Output of the Boiler that shall be factory set to relieve pressure at 50 PSI water working pressure.

    f. One (1) M&M #PS-851-M-120 Low Water cutoff device with manual reset. Probe LWCO shall incorporate a Burner circuit test switch that, when depressed, will test out the burner control circuit by dropping out the

Burner if the circuit is properly wired. Boiler shall be fitted with either a float type or a probe type LWCO located above the lowest safe permissible water level established by the Boiler manufacturer. LWCO shall be UL listed and FM approved, suitable for commercial hydronic heating service at 50 PSI. If a float type LWCO is installed, it shall be vented at a high point and equipped with a pair of McDonnell & Miller Test-N-Check Model TC-4 valves. Simple time delay shall not be considered acceptable to this installation.

D. Boiler foundations

1. Installer to construct needed support and level concrete foundations where boiler room floor is uneven or will not support the weight of the boiler. Contractor to modify existing boiler housekeeping pads as required to proper installation per manufacturers installation instructions.

E. Electrical Coordination: Coordinate with electrical Contractor to provide the following:

1. All Boiler room wiring from the main disconnect switch panel to the Burner Control panels, Flame Safeguard Controls, Multiple Boiler Control System, Circulators, Limits, Operating controls, Gas Valves, switches and additional control devices shall be furnished and installed under this section of the work.

2. Motors shall meet the requirements of separate specification “Motors, Drives and Starters” paragraph, be a maximum of 1 HP. furnished for operation on voltages indicated on plans. Control circuit shall be taken from a two-wire branch circuit, one side grounded, not exceeding 150 Volts, line to line. All safety control switching shall be accomplished in the hot ungrounded conductor and through the 24V low voltage wiring provided by the Boiler manufacturer and in accordance with the manufacturer’s instructions and recommendations.

3. An electrical thermal switch fused to break the ungrounded conductor in the main circuit at 165^{o} F. shall be installed in the main power line within six feet over the top of the burner. If the ceiling above the Burner exceeds 12 feet in height, an additional thermal switch shall be installed on the ceiling and series connected with the lower switch. Fuse protection for the control circuit shall be provided. A manually operated remote heating plant shutdown switch shall be furnished and installed just outside the Boiler room door and shall be marked for easy identification. If there is more than one (1) Boiler room door, there shall be a switch located at each door. Shutdown switches must be wired to disconnect all power to the Boiler controls.

4. Furnish and install a flow switch, Honeywell or equivalent, installed in the common supply water piping up-stream of the Multiple boiler Water Temperature Sensor. Flow switch shall be wired so as to prevent Burner operation during no-flow conditions across the supply water temperature sensors.

5. All wiring for the Boiler and Burner shall be rated for the Maximum operating temperature to which it may be exposed. All wiring between components shall have copper conductors not less than 18 AWG and constructed in accordance with the NEC/NFPA 70. All field installed romex, conduit, junction boxes and the like shall be installed so as not to interfere with the Boiler manufacturers recommended cleaning and maintenance procedures.

F. Boiler shall be furnished with a Natural Gas burner system listed by the Boiler Manufacturer, tested to I=B=R standards and capacities and which shall be listed by the

Gas Regulatory Board. Burner shall incorporate all the necessary devices and controls to make a complete fuel burning system and shall bear Underwriters Laboratories seal of approval.

G. Burner Configuration:

1. Flame retention type, nozzlemix multi-port, forced draft burner.
2. Provide burners with operating mode as indicated on mechanical schedule on sheet M0.00 with Combustion air flow switch and Proven Low Fire Start Interlock.
3. Codes – CSD-1
4. Burner mounted control panel complete with the following controls and devices:
   a. RM7895A/UV Primary Control equipped with LED sequence status lights and S7800A keyboard display module. Provide Pre-Purge; 15 second Trial for Pilot; 15 second Trial for Main Flame with 4 second Flame Failure response time with non-recycling safety shutdown upon loss of Main Flame at point of supervision.
   b. Low Fire “Hold” switch and SPST Burner Service Switch. Provide the following factory installed isolating relays:
      1) Alarm Relay to initiate a remote "Boiler Off" alarm signal to DDC/ATC on Control Lockout. One (1) relay per Burner.
      2) 4” Inch Dia. alarm bell with silencing switch and relays, wired to alarm each of the three (3) specified conditions that will generate a Lockout condition.
   c. The burner shall be provided with fresh air contacts and alarm for control of combustion air damper.
   d. Pilot Lights to indicate:
      1) “Main Fuel Valve Open”
      2) “High Limit”
      3) “Control Lockout”
      4) “Low Gas Pressure”
      5) “High Gas Pressure”
5. Burner shall be furnished with a gas pilot of the pre-mix type with interrupted Pilot ignition and the Primary Control shall monitor the Main Flame so that the Main Fuel Valve cannot open until the Pilot Flame has been established and proven.
6. Gas valve train shall be furnished in accordance with UL-795 requirements for Automatic Gas Fired Boilers, and shall comply fully with the Massachusetts Fuel Gas Code for Gas Utilization Equipment in Large Boilers including not less than the following:
   a. Separate Pilot and separate Main Gas pressure regulators. Each regulator shall be designed for operation with up to a Maximum of 14” inches W.G. inlet gas pressure. Vent to outdoors.
   b. Pilot and Main manual shutoff gas cocks. Manual shutoff gas cock larger than 2” inches shall be of the lubricated plug or ball type with stops.

c. Dual Safety Shutoff Gas Valves piped in series. An approved motor driven Safety Shutoff Gas Valve complete with actuator shall be provided in the Main gas line to the Burner. An approved auxiliary solenoid Safety Shutoff Gas Valve shall be provided upstream from the main SSOV. Combination Gas Valve/Pressure Regulator similar to V4943B shall not be considered acceptable.

d. Leakage test cock and Pilot gas solenoid valve.

e. One quarter inch (1/4") plugged tappings shall be provided, one of which shall be located upstream of the Main gas pressure regulator and another to be located near the Burner head to permit gas pressure readings with a Manometer.

f. Gas pressure supervision shall be provided by listed pressure switches interlocked to accomplish a non-recycling safety shutdown in the event of High or Low gas pressure. Vent to outdoors.

7. Gas valve train components shall be furnished as specified above with the Pilot Gas train, and combustion air dampers and linkage installed and wired at the factory. All other components shall be furnished loose for field assembly. Gas valve train assembly shall be sized for minimum acceptable pressure drop firing Natural Gas with a minimum gas pressure of 4.00" inches W.G. at the inlet to the Main Gas pressure regulator.

8. All Main gas and Pilot gas pressure regulators and High and Low gas pressure switches are to be independently vented to a safe outdoor location. Vent lines shall be of steel or wrought iron pipe, 3/4" inch IPS minimum, which shall discharge to outside atmosphere. Pilot gas pressure regulators shall also be vented to outdoors unless constructed or equipped to limit the escape of gas from the vent opening in the event of diaphragm failure to not more than 2.5 cubic feet per hour. Vent lines from regulators shall not be connected into a common line with the bleed line from gas operated diaphragm valves or from pressure relief valves.

H. Provide the services of a Company Field Advisor of the Boiler manufacturer for the following:

1. To assist and review the installing Contractor with the assembly and erection of the Boiler. Upon completion of the Boiler assembly, the Boiler manufacturer's Company Field Advisor shall certify the proper assembly and connection of the Boiler prior to startup.

2. The Boiler manufacturers Company Field Advisor shall be Present at time of Start-up to supervise the initial firing of the Boiler.

3. The Boiler manufacturer's Company Field Advisor shall instruct Boiler Room Operating Personnel.

I. After final assembly and connection, each Boiler shall be thoroughly cleaned internally following the manner described within the Boiler manufacturers installation instructions, or by ASME Section VI, either method acceptable by the boiler manufacturer.

J. The process of cleaning the Boiler(s) shall include the use of a boil-out compound of Caustic Soda or Tri-Sodium Phosphate at the rate of one (1) pound of either chemical per 50 Gallons of total water in the system being cleaned. This cleaning shall include Boiler Cleanout, Surface Blowoff, Blowdown and a wash as directed and detailed in referenced instructions. The process of cleaning the Boiler(s) shall be repeated as often as necessary

and as directed by the boiler manufacturer to ensure that all mill scale, core sand, rust, dirt and debris, cutting oils and thread sealers or any other contaminants have sufficiently been eliminated from the Boiler and to produce a condition of the Boiler water that is clean and considered acceptable to the boiler manufacturer.

K. All field tests after the Boilers have been installed and connected to the system shall be limited to not more than 50 PSI. Installing Contractor shall furnish all equipment, piping, labor, staging, fittings, valves, hoses and other materials and shall pay all required permits for Inspection as may be required to perform such tests as may be directed by these Contract Documents and as required by the Consulting Engineer and the State Boiler Inspector.

1. An initial hydrostatic pressure test of 50 PSI shall be conducted on each Boiler for a period of not less than 5 hours. Tests shall be of such duration as necessary and as directed by the Consulting Engineer to ensure that each Boiler has been installed and piped correctly with no leaks or other improper operating conditions.

2. Installing Contractor shall contact and notify the State Boiler Inspector when the installation of the Boilers, Burners and controls is substantially complete. Installing Contractor shall request an inspection of the Boilers to be conducted by the State Boiler Inspector and to have a Certificate of Inspection issued upon satisfactory inspection.

3. After receipt of certificate of Inspection, Installing Contractor shall furnish a suitable glass front frame in which to place said certificate. Frame, with Inspection certificate inserted therein, shall then be placed on or posted in a suitable location within the Boiler room in which the new Boilers have been installed.

4. Installing Contractor shall maintain all apparatus in satisfactory operating condition. Perform periodic Burner tune-up and cleaning of the Boiler fireside surfaces when dirty, provide preventative maintenance, perform turndown tests, conduct tests for Flame Safeguard, Combustion Efficiency, Draft tests, Limit Control tests and Safety Valve tests, check the ignition system and adjust, repair or replace any as necessary while the heating system is under his Ownership and control a and until such time as the Owner accepts the equipment, issues the Final certificate of Payment and assumes the full obligation of Ownership.

5. Installing Contractor shall note that any follow-up Burner Service (Hereinafter specified) as may be absorbed by the authorized Service representative shall in no way absolve the Installing Contractor from any and all responsibility for the Care, Service and Preventative Maintenance for Materials furnished to this Contract, while the Heating System is under his Control, and until final acceptance by the Owner.

L. Acceptance Testing:

1. An authorized representative of the Boiler or Burner manufacturer shall perform the initial start-up, final adjusting and testing of the Burners and Controls in the presence of the Gas Inspector and the gas Company representative and the Owners Operating Personnel.

2. The process of Start-Up and Acceptance Testing shall include Purging of the Boilers; Burner Operation Tests, including CO sampling, Stack Temperature; CO_2 sampling; Tests for Venting; Ignition Tests; Pilot Turndown Tests; Manifold Pressure Tests, Instruction to the Owner and all other such procedures as may be directed by the Consulting Engineer.

3. The final results of a Combustion Efficiency Test with all pertinent Combustion Data shall be logged onto a check sheet which shall be submitted to the Consulting Engineer to prove compliance with this section of the Specifications and for Record purposes.

4. Combustion efficiency testing shall include no less than the following:

   a. Clock and adjust Burner input at the Meter to establish correct rate of fire and set each Burner to rated input at High Fire. Set Main Gas regulator and provide all adjustments to both Primary and Secondary Air as necessary to ensure proper flame shape at 100% input with no direct impingement upon heating surfaces and with good quality through the High to Low rates of input with not more than 0.04% CO in the flue gas analysis.

   b. CO_2 in the flue gas at Low and High rates of fire with recorded Gross and Net Stack Temperatures to establish stack loss value. Burner shall be set to operate at the overall best performance and combustion efficiency for which the equipment is designed and capable of.

   c. Adjustment and checkout of all aquastat controls, limits, switches, operating controls, low water cutoff devices, gas valves, pressure regulators, combustion controls, high and low gas pressure switches and all Lockout conditions.

   d. He shall supervise purging of the Boiler and shall conduct Pilot turndown tests. All required tests for proper venting which shall include setting and adjusting the Boiler outlet damper to the Boiler manufacturer's specifications.

   e. Provide instruction to the Owners Operating Personnel in the procedures to resolve a "Lockout" condition. Operating personnel shall also be instructed in the Operation and routine daily maintenance of the Burner and controls during the lightoff process. The Owner shall arrange to have the personnel who require training to be present at the Lightoff.

M. Factory Authorized Service representative shall provide the initial Burner lightoff and One (1) Year of Follow-Up Burner service. This requirement shall not be waived, nor shall the responsibility for the Service Contract be assumed by any other party unless previously approved by the Consulting Engineer in writing.

N. Authorized manufacturers service representative shall furnish One (1) Year of Follow-Up Burner Service on the Burner and Controls which shall commence from the Date of Original Lightoff and shall continue to provide Follow-Up Burner Service coverage up to and including the First Anniversary of Burner Lightoff.

O. Follow-Up Burner service shall include labor and materials to replace any parts or controls which might fail in service as the result of a defect in materials or manufacture. Normal wear and tear on parts as the result of daily operation will not be included as "no charge" items (nozzles, igniters, etc.) and other such devices, which may require replacement as the result of operation during the Service Contract shall not be included as "defective".

P. Preventative maintenance, in the form of yearly tune-up and bi-yearly cleanings and adjustments shall be the responsibility of the Installing Contractor throughout the duration of his Guarantee Contract while the equipment is under the Acceptance criteria of these

Contract Documents and by the Owners obligated Service Company after Final Acceptance.

2.6 INSULATION

A. Scope: Provide all labor, equipment, materials and accessories, and perform all operations required, for the correct installation of insulation on the following systems and all other necessary items connected into the systems subject to condensation, loss of heat, or personnel protection (above 120 degrees F):

1. Piping insulation (other than pre-insulated underground piping), jackets and accessories (including all valves and fittings with easily removable sections for maintenance of strainers, balance valves, and unions).
2. Equipment and flue gas breeching insulation, and covering (including easily removable sections for maintenance).
3. Ductwork insulation, jackets, and lining (including all fittings).

B. Environmental Requirements: Maintain ambient temperatures and conditions required by manufacturers of adhesives, mastics, and insulation cements.

C. Quality Assurance: Insulation materials must be asbestos free, UL listed, and manufactured at facilities certified and registered to conform to ISO 9000 Quality Standard. All insulating products and jackets shall carry a 25/50-flame spread/smoke developed rating as tested in accordance with ASTM E 84.

D. Workmanship: All insulation shall be installed by a licensed applicator and applied in accordance with the manufacturer's recommendations. All work shall comply with all applicable federal, state, and local codes including, but not limited to, OSHA. All work shall conform to industry and trade accepted standards for commercial and industrial insulations. Verify that piping, heat trace, and ductwork has been tested (including applicable pressure/leakage tests) before applying insulation materials. Surfaces to be insulated shall be cleaned free of dirt, scale, moisture, oil and grease. No vapor barrier leaks or insulation voids will be accepted. Continue insulation vapor barrier through penetrations except where prohibited by code. All fire rated walls and penetrations shall be sealed with fire stopping. Locate insulation and cover seams in least visible locations. Neatly finish insulation at supports, protrusions, and interruptions. For all systems requiring a vapor barrier seal all terminations including fittings, wall penetrations, and supports with vapor barrier mastic such as Foster 30-65, Childers CP-35 or approved equal. In addition, in brine or chilled water pipe systems vapor seal pipe terminations every four pipe sections, using Foster 30-65, Childers CP-35 or approved equal. Bevel and seal ends of insulation at equipment, flanges, and unions. Where insulation is used over stainless surfaces, the material shall be chlorine free.

E. Delivery and Storage of Materials

1. Deliver all materials to the job site and protect the insulation against dirt, water, chemical and mechanical damage before, during and after installation. Do not install damaged insulation and remove it from the job site.

2. Deliver insulation, coverings, cements, adhesives coatings etc. to the site in factory-fabricated containers with the manufacturer's stamp or label affixed showing fire hazard ratings of the products, name of manufacturer and brand.

3. Installed insulation that has not been weatherproofed shall be protected from inclement weather by an approved waterproof sheeting installed by the Contractor. Any water-damaged insulation shall be removed and replaced by the Contractor at no additional cost.

F. Manufacturers: Johns Manville (JM), CertainTeed, Owens-Corning, 3M, Armstrong, Knauf, Armacell, or approved equal. Note that the listed manufacturers may not be able to supply all the insulation products required for the project. Unless otherwise noted, JM insulation products are listed to provide the minimum standards required for each type of insulation.

G. Pipe Insulation: Provide the following products depending on temperature of each system. Insulation shall be marked to show the locations of all unions, break flanges, strainers, check and balancing valves.

1. For piping with a service temperature between 40°F and 600°F such as chilled water, hot water, dual temperature water, make-up and feed water, blow-down, all outdoor condenser water piping, all indoor condenser water supply piping from the towers to the free cooling heat exchanger, condensate drain, glycol heat recovery (with down to 0°F minimum winter temperature), boiler feed water, heated oil, water defrost piping in refrigerated rooms, steam, and steam condensate, provide glass fiber insulation equal to JM Micro-Lok. Insulation shall be rigid molded and noncombustible, meeting ASTM C 547, Type I. K-factor shall be 0.23 at 75°F mean temperature. All-purpose vapor retardant jacket shall be JM AP-T PLUS. Jacket shall be white kraft paper reinforced with glass fiber yarn and bonded to aluminum foil, secure with self-sealing longitudinal laps and butt strips or AP Jacket with outward clinch expanding staples (coated with vapor barrier mastic for all chilled water, dual temperature water and glycol heat recovery systems). A breather mastic for applications above ambient pipe service temperatures (fittings, tees, valves, etc.) shall be water based Foster 46-50 or Childers CP-10 / CP-11. A rigid, non-compressible insulation, equal to Pittsburg-Corning FoamGlas or KingspanTarec Kooltherm shall be used at all pipe hangers and supports for all steel chilled water piping where the pipe is supported by hangers, anchors, and guide with a minimum length of 18 inches.

H. Minimum pipe insulation thicknesses shall be as shown on the drawings.

I. Field Applied Piping and Fitting Jackets

1. Provide covers for insulation of all pipe fittings (i.e. elbows, tees, end caps, reducers, unions, flanges, mechanical joints), strainers and valves with surface temperatures between –20°F and 150°F (all water, low pressure steam and condensate systems with glass fiber insulation and over 1" foam insulation on refrigerant piping). Provide easily removable sections for cleaning and maintenance of unions, balancing valves, and strainers. Fitting covers shall be 30-mil thick white PVC equal to JM Zeston 2000 molded high impact, UV resistant covers. Attach with water-resistant pressure sensitive color matching vinyl tape to maintain vapor barrier. Insulate all fittings per manufacturer's recommendations to prevent surface temperature from exceeding the 150°F limit.

2. Other than where foam type insulation is used on up to 1" outdoor pipe, with 2 coats of UV protection, protect all piping insulation that passes through walls and

floors, all outdoor pipe insulation, mechanical room pipe insulation (all within 7 feet of floor) and elsewhere where called for on drawings with 0.016 inch thick smooth or embossed aluminum sheet jacket or 0.01 inch thick smooth or corrugated type 304 stainless steel or 30 mil thick Zeston 2000 perma-weld high impact UV resistant PVC jacket with perma-weld fitting covers. Seams shall be on the bottom half of the pipe arranged to shed water. Provide minimum 2-inch overlap for all longitudinal and transverse joints. All seams of outdoor jacket shall be filled with waterproof adhesive. Provide 1" wide draw bands (same material as jacket) on 12" centers.

J. Equipment and Flue Gas Breeching Insulation - General:

1. Apply insulation as close as possible to equipment by grooving, scoring, and beveling insulation, if necessary. As required, secure insulation to equipment with studs, pins, clips, adhesive, wires, or bands.

2. Fill joints, cracks, seams, and depressions with bedding compound to form smooth surface. On cold equipment, use vapor retardant cement.

3. Provide insulated dual temperature equipment or cold equipment containing fluids below ambient temperature with vapor retardant jackets.

4. Cover fiber glass and calcium silicate insulation on warm or room temperature equipment with 0.016 inch thick (smooth or embossed) aluminum jacket, or with metal mesh and finish with heavy coat of insulating cement or mastic (such as Foster 35-00/46-50 or Childers CP-10/11).

5. For equipment located outdoors, in mechanical equipment rooms (all within 7 feet of floor), or in finished spaces insulated with fiber glass, finish with perma-weld Zeston 2000 jacketing (up to a surface temperature of 150°F) and fitting covers or 0.016 inch thick (smooth or embossed) aluminum jacketing. Outdoor aluminum jacketing seams shall be on the bottom half of the pipe arranged to shed water. Provide minimum 2-inch overlap for all longitudinal and transverse joints. All seams of outdoor jacket shall be filled with waterproof sealant equal to Foster Elastolar 95-44.

6. Do not insulate over nameplate or ASME stamps. Bevel and seal insulation around such.

7. Provide easily removable/replaceable sections (without damage) of insulation for areas that will require maintenance, repair, or cleaning, such as pumps (bearings, seals, and impellers), heat exchangers (tube pull), strainers (basket pull), expansion tanks (bladder access), etc.

K. Equipment and Flue Gas Breeching Insulation: Provide the following insulation types for the listed equipment.

1. Insulate higher temperature equipment and flue gas breeching between 600°F and up to 1200°F with 5" thick rigid molded hydrous calcium silicate block insulation. Insulation shall be equal to JM Thermo-12/Gold meeting ASTM C 533, non-combustible, asbestos free (color coded throughout material thickness) with K-factor of 0.41 at 300°F mean temperature when tested in accordance with ASTM C 177 and C 518. Insulation shall be securely banded in place, tightly butted, joints staggered and secured with 16 gauge galvanized or stainless steel wire or 1/2" x .015" galvanized steel bands on 12" maximum centers for large areas.