

PROJECT MANUAL

BOILER REPLACEMENT

EASTERN MIDDLE SCHOOL

51 HENDRIE AVENUE

RIVERSIDE, CT

BID #2502-25

FEBURARY 4TH, 2025

ISSUED FOR BID

MEP ENGINEER:

LANDMARK FACILITIES GROUP, INC.

252 EAST AVENUE

NORWALK, CT 06855



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GREENWICH PUBLIC SCHOOLS
Purchasing Department
290 Greenwich Avenue
Greenwich, Connecticut 06830
(203) 625-7411
eugene_watts@greenwich.k12.ct.us

EUGENE H. WATTS
Manager of School Procurement

February 4, 2025

Dear Sir/Madam:

You are invited to submit a bid for Boiler Replacement at Eastern Middle School for the Greenwich Public School District. The attached bid specifications detail the requirements we are looking for.

Bidders are urged to read all documents carefully and fill out all information requested. Bids which are incomplete, obscure, or conditional, and which contain irregularities of any kind, will be subject to rejection for failure to comply strictly with these conditions.

Bids must be submitted on the schedule forms attached. All unit prices must be filled in and the cost sheet must be the first page of the submitted bid. Each bid must be submitted and clearly marked with (1) original and six (6) copies of your bid. Faxed emailed or late bids will not be accepted. The original bid and copies must be in a sealed envelope plainly marked with the Vendors name and address and the following information:

Boiler Replacement at Eastern Middle School

Bid Number: 2502-25
Opening Date: 2/25/25
Opening Time: 2:00 p.m.

Mandatory Walk-through

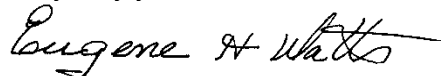
Eastern Middle School, 51 Hendrie Avenue, Riverside, CT 06878
February 10, 2025 @ 10:00 a.m.

The meeting for the bid opening will be held remotely by telephone. The details to join the meeting remotely are as follows:

Dial-In by phone: 1 262 833-7654 Pin: 889 411 281#

All bidders and other interested people are invited to call in to hear Bid #2502-25 being read at 2:00 p.m.

Very truly yours,



Eugene H. Watts

INSTRUCTIONS TO BIDDERS

1.1 The Greenwich Public Schools, Greenwich, CT, invites bid proposals for the following:

A. **BOILER REPLACEMENT at EASTERN MIDDEL SCHOOL** for the Greenwich Public Schools.

1.2 BACKGROUND:

A. TOWN / DISTRICT: The Town of Greenwich is approximately 30 miles northeast of New York City and has a population of about 60,000 residents. The Greenwich Public Schools enjoy a national reputation for excellence and have strong support from the community. The fifteen public schools have an enrollment of 9,000 students and consists of eleven elementary schools (K-5), three middle schools (6-8), and one comprehensive high school (9-12).

B. MEP ENGINEER: Landmark Facilities Group, Inc. 252 East Avenue, Norwalk CT 06855

1.3 SCHEDULE:

A. Mandatory Pre-Bid Walk Through:

1. Monday, **February 10th**, 2025 at 10:00 a.m., Eastern Middle School (Main Entrance).

B. Bid Due Date:

1. Sealed proposals will be received as indicated below, and at that time and place will be publicly opened and read aloud.

2. Date: **February 25th, 2025**

3. Time: **2:00 p.m. local time**

4. Location: **Phone Dial In**

5. All bidders and other interested persons are invited to be present at this bid opening(s).

C. QUESTIONS:

1. Questions concerning this bid will be received by email only and directed to:

a. **bid_department@greenwich.k12.ct.us**.

b. In the subject line you must put BID #2502-25, Boiler Replacement at Eastern Middle School.

c. All questions must be submitted no later than 12:00pm, **February 14th**, 2025.

2. All answers will be provided by written BID ADDENDUM at **www.greenwichschools.org**

at noon on **February 18th**, 2025. It is the responsibility of all bidders to verify that they are current with all posted information.

3. Failure to comply with these conditions will result in the bidder waiving his right to dispute the bid specifications and conditions.

1.4 BID SUBMISSION / REQUIREMENTS:

A. Bidders are required to order their bid such that the bid form appears on page 1 of the bid package.

B. Each bid shall be signed and accompanied by a bid security payable to the Town of

Greenwich in the amount of ten (10%) of the bid and shall be in the form of a Bid Bond only as issued in the bid documents. Bid Bonds must use the Greenwich Public Schools Bid Bond Form (included within the bid documents), issued by a surety company listed on the current

U.S. Dept of Treasury's Federal Register and be licensed to underwrite bonds in the State of Connecticut.

C. Each bid shall be accompanied by a completed copy of the CONTRACTOR'S

QUALIFICATION STATEMENT included in the bid documents. The Greenwich Public

Schools reserves the right to request further information and/or supplemental information with

respect to the QUALIFICATION STATEMENT of its sole discretion.

- D. Each bidder shall utilize the specified manufacturers. Should the contractor desire to substitute other articles, materials, apparatus, products, or processes, other than those specified or approved as equal, the contractor shall apply to the engineer, in writing, for approval of such substitution. It should be noted that the bid shall not be based on a substituted article, material, apparatus, product, or process. No substitution review shall take place prior to bid.
- E. Each form of the bid contains a section for alternates and for unit prices. All alternate prices must be completed with a dollar value. Blanks, "Not Applicable" (N/A), "No Effect", etc in these portions of the BID FORM shall be construed to indicate that the particular alternate shall be performed without increase to the contract price as they relate to the scope of the trade package.
- F. Unit prices which do not affect the work of the bidder's trade may be filled in "Not Applicable" or "(N/A)". "Not Applicable" or Blanks in these Bid Forms and shall be construed to indicate that the unit price is not applicable as it relates to the scope of the trade package.
- G. TAX: No amount shall be added for the Connecticut sales tax or Federal tax. The Greenwich Public School system is exempt from the payment of taxes imposed by the Federal government and/or State of Connecticut. Taxes must not be included in the bid price.
- H. PERMIT FEES: Greenwich Public Schools will secure the building permit(s) and upon award of the Contract they will be transferred to the awarded contractor / vendor. No cost should be included in the base bid for the building permit.
- I. WAGES: All work shall be done in accordance with applicable State statutes; conditions of Prevailing Wages shall apply. Prevailing Wage Schedule provided herein is for demonstrable purposes only. It is the responsibility of the bidder / vendor to verify actual rates.
- J. COLLUSION AMONG BIDDERS:
 - 1. More than one offer from an individual, firm, partnership, corporation, or association under the same or different name will be rejected. Reasonable grounds for believing that a bidder is interested in more than one bid for the work contemplated will cause rejection of all bids in which the bidder is interested. Any or all bidders will be rejected if there is any reason for believing that collusion exists among the bidders.
 - 2. Participants in such collusion may not be considered in future offers for the same work. Each bidder, by submitting a bid, certifies that it is not party to any collusive action.
 - 3. Each bid shall be accompanied by a completely filled in and properly executed **Non-Collusive Affidavit**, provided on [page 18].
- K. EMPLOYMENT DISCRIMINATION BY CONTRACTOR PROHIBITED:
 - 1. The successful bidder will not discriminate against any employee or applicant for employment because of race, religion, color, sex, or national origin, except where religion, sex, or national origin is a bona-fide occupational qualification reasonably necessary to the normal operation of the contractor.
 - 2. The successful bidder agrees to post in a conspicuous place, available to employees and applicants for employment, notices setting forth the provision of this nondiscrimination clause.
 - 3. The successful bidder in all solicitations or advertisements for employment, placed by or on

behalf of the contractor, will state that such successful bidder is an EQUAL OPPORTUNITY EMPLOYER.

- L. QUALIFICATIONS: No qualifications to the bid are allowed. If bids are qualified, they may be deemed non-responsive and subsequently rejected.
- M. No Bidder may withdraw their Bid within 90 days after the actual date of Bid Opening
- N. COPIES: Failure to submit a bid with four copies does not constitute a material defect.
- O. BID EVALUATION: A committee composed of various administrators will evaluate bids. The following criteria guidelines will be used in analyzing and evaluating this bid:
 - 1. Conformance to the requirements of this bid, i.e. conformance to Terms, Conditions, and Scope of Work.
 - 2. Proven skills and technical competence.
 - 3. Background of the firm.
 - 4. For Vendor firm, identification of all personnel who will have a principal responsibility.
 - 5. The Board of Education may consider proximity of the vendor's service as a factor in determining lowest responsible bid. Companies must be located within 100 miles of the School District in order to submit a bid.
 - 6. The Board of Education shall have the right to take such steps as it deems necessary to determine the ability of the bidder to perform the work and the bidder shall furnish the Board of Education with information and data for this purpose as the Board of Education may request. The right is reserved to reject any bid where, on investigation, the evidence or information submitted by such bidders does not satisfy the Board of Education that the bidder is qualified to carry out properly the terms of the Contract.
 - 7. Apparent low bidder agrees to submit the following Supplements to Greenwich Public Schools within 48 hours after submission of the Bid for consideration in award of the Contract:
 - a. Subcontractors; Include the names of all Subcontractors and the portions of the Work they will perform.
 - b. Cost Breakdown identifying the Bid Price/Sum segmented into portions as requested, broken down per school building. (Schedule of Values)
- P. AWARD: The Contract shall be awarded to the lowest responsible and qualified bidder, meaning the bidder whose bid is the lowest of those bidders possessing the skill, ability, and integrity necessary to faithfully perform the work based on objective criteria considering past performance and financial responsibility. In considering past performance, the Greenwich Public Schools shall evaluate the skill, ability, and integrity of bidders in terms of the bidders' fulfillment of contract obligations and all the bidders' experience or lack of experience with projects of similar size and scope. The Greenwich Public Schools reserves the right to consider as unqualified to do the work required by the bid documents any bidder that does not habitually perform with its own forces the major portion of the work involved in the bid documents. No contract will be awarded to any bidder who is at time of award not qualified under applicable regulations issued by the Secretary of Labor, United States of Department of Labor, or any applicable State and local laws and regulations.
- Q. REJECTION: after review of all sectors, terms, and conditions, including price, Greenwich Public Schools reserves the right to reject any and all bids, or any part thereof, or waive defects in same.

- R. Any bid may be withdrawn prior to the opening time and date. Any bids received after the specified time and date will not be considered.

1.5 BIDDER QUALIFICATIONS:

- A. The Department of Administrative Services (DAS) Construction Contractor Prequalification Program ([C.G.S. 4a-100](#)) requires all contractors to prequalify before they can bid on a contract or perform work pursuant to a contract for the construction, reconstruction, alteration, remodeling, repair or demolition of any public building or any other public work by the state or a municipality, estimated to cost more than \$500,000 and which is funded in whole or in part with state funds, except a public highway or bridge project or any other construction project administered by the Department of Transportation.
- B. Companies must be located within 100 miles of the School District in order to submit a bid.
- C. Companies submitting a bid must be in business under the same corporate name for a minimum of five (5) years.
- D. Non-Connecticut Contractors: Pursuant to Connecticut General Statutes §12-430(7), as amended by Public Act No. 11-61, Section 66, a non-resident contractor shall comply with the State of Connecticut's bonding requirements.

1.6 CONTRACT:

- A. SINGLE PRIME CONTRACT will be let for:
 - 1. General Construction
 - 2. Bid awards must be approved by the Greenwich Public Schools. All contractors shall be required to execute the Greenwich Public Schools standard form of Contract and accompanying Payment & Performance Bonds without exception.
- B. LENGTH: This bid is for awarding the contract to cover the period beginning March 24, 2025. Once this Bid is awarded, successful bidder must make arrangements to meet with Greenwich Public Schools as required.
- C. SUBSTANTIAL COMPLETION: Contractor shall complete all work within the building and on the project site such that the property and building are occupiable by the owner for all purposes, contractor shall complete all system testing and testing record documentation, and all systems shall be inspected and approved by the authority having jurisdiction on or before **August 22nd**, 2025.
- D. FINAL COMPLETION: Contractor shall complete all work associated with the project including but not limited to incomplete items identified on the punch list, closeout documentation, project record documents, operation and maintenance manuals on or before **December 31st**, 2025.
- E. OPTION TO EXTEND: All work associated with the project shall be completed on or before December 31st, 2025. The Board of Education may, at their option and with the approval of the vendor, extend the period of the Contract to June 30th, 2026. If the Board of Education intends to extend the contract period, the vendor shall be notified in writing by the purchasing department at least fourteen (14) calendar days prior to the expiration of the original contract.
- F. AWARD OF CONTRACT: The contract will be awarded by the Board of Education to a qualified firm or person at compensation determined to be fair and reasonable considering budgetary limitations, scope, complexity, and the nature of goods and/or services.
 - 1. If there is a conflict between the Contract Agreement and the General Conditions, the

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Contract Agreement shall prevail.

2. The successful bidder will produce for the Greenwich Public Schools review a current financial statement, which will remain strictly confidential.
- G. The contractor shall simultaneously with the signing of the Contract, furnish the Town the executed Performance, Maintenance, and Payment Bond of a surety company authorized to do business in the State of Connecticut, and acceptable to the Town, in the sum of all the full amount of the Contract Obligation in the form provided by the town. The Performance Bond will not be required where the total estimated cost of labor and materials under the contract with respect to which such general bid is submitted is less than one hundred thousand dollars (\$100,000). Once a contract exceeds \$100,000 the bidder will be responsible for obtaining and paying for all bonds required by Greenwich Public Schools.
- H. FEE PAYMENTS: The Greenwich Public Schools reserves the right to provide payment in accordance with completion of services based on the Project Schedule.
- I. BACKGROUND CHECK: The bidder is required to do Employee Background Checks as imposed by Conn. Gen. Stat. 10-221d and 10-222c.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION

3.1 PROVISIONS:

- A. Consumption or use of alcohol and / or drugs is prohibited on school property. Any individual with alcohol or drugs will be removed from said property and will not be allowed to work on the project. Smoking is prohibited in all school buildings and on school grounds.
- B. Greenwich Public Schools reserves the right to reject any proposed subcontractor for reasonable cause.

BID FORM

The undersigned hereby proposes to furnish all labor, materials, devices, appliances, supplies, equipment, services, and other facilities necessary to complete all of the work of the above referenced Contract, as required by, and in accordance with, the provisions of the Instructions to Bidders, the Conditions of the Contract, the Drawings and Specifications, all as prepared by Landmark Facilities Group, Inc. dated February 4th, 2025; and that, if this Proposal is accepted, the Undersigned agrees to enter into an Agreement with the Owner to perform this work for the sum(s) as follows:

SUBMITTED BY: _____

Bidder's Full Name (please print) _____

Bidder's Primary Email Address _____

Address _____

City,

State,

Zip

1.1 BASE BID VALUE:

- A. **BASE BID:** The Base Bid Proposal for all work required by the Contract Document for the Boiler Replacement Project at **Eastern Middle School** and Related Work is as follows:

_____ (\$ _____) DOLLARS

1.2 ALTERNATE VALUES:

- A. The values of Alternates to the Base Bid amount are identified below.

1. [Alternate #1 _____.
2. Alternate #2 _____.
3. Alternate #3 _____.
4. Alternate #4 _____.
5. Alternate #5 _____.
6. Alternate #6 _____.]

1.3 ACCEPTANCE:

- A. If this bid is accepted by Greenwich Public Schools within the time period stated above, we will:
1. Execute the Agreement within seven days of receipt of Notice of Award.
 2. Furnish the required bonds within seven days of receipt of Notice of Award.
- B. If this bid is accepted within the time stated, and we fail to commence the Work or we fail to provide the required Bond(s), the security deposit shall be forfeited as damages to Greenwich Public Schools by reason of our failure, limited in amount to the lesser of the face value of the security deposit or the difference between this bid and the bid upon which a Contract is signed.

1.4 CONTRACT TIME:

- A. The Undersigned agrees in the Base Bid to complete the work as per the Milestone Schedule provided in the Specifications.

1.5 ADDENDA:

- A. The following Addenda have been received. The modifications to the Bid Document noted below have been considered and all cost are included in the Bid Sum.

1. Addendum#_____ Date_____.
2. Addendum#_____ Date_____.
3. Addendum#_____ Date_____.
4. Addendum#_____ Date_____.
5. Addendum#_____ Date_____.

1.6 BIDDER'S FURTHER AFFIRMATION AND DECLARATION

- A. The above name bidder and should this bid be a joint bid each party thereto, further affirm and declares;
1. That said bidder is of lawful age and the only one interested in this bid; and that no other person, firm, or corporation, except those hereinabove names has any interest in this bid or in the contract proposed to be entered into.
 2. That said bidder is not in arrears to the Greenwich Public School upon debt or contract, and is not a defaulter, as surety or otherwise upon any obligation to the Greenwich Public Schools.
 3. That no member of the Greenwich Public Schools or any officer or employee of the Greenwich Public Schools or person whose salary is payable in whole or in part from the School District treasury, or the spouse of any foregoing is or shall be or become interested, directly or indirectly, as a contracting party, partner, stockholder, surety, or otherwise, in this bid, or in the performance of the Contract, or in the supplies, materials, or equipment and work or labor to which it relates, or in any portion of the profits thereof.
 4. That he/she has carefully examined the site of the work and that, from his/her own investigations, he/she has satisfied him/herself as to the nature and location of the work, and character, quality and quantity of material, and all difficulties likely to be encountered, the kind and extent of equipment and other facilities needed for the performance of the work, the general and local conditions, and all other items which may, in any way, affect the work or its performance
 5. That if a corporation, this bid or proposal containing the Non-Collusive Binding Certification and the foregoing Affirmation and Declaration has been authorized by the Board of Directors of such Corporation, which authorization includes the signing and submission of this bid or proposal and the inclusion therein of the said Certificate of Non-Collusion and Affirmation and Declaration as the Act and Deed of the Corporation.

BID FORM SIGNATURE(S)

Signature

Corporate Seal

Company Name: _____

was hereunto affixed in the presence of:

Subscribed and sworn before me this day of _____ 2025

Notary Public: _____

My Commission Expires: _____

CONTRACTOR'S QUALIFICATION STATEMENT

With the submittal of the Bid Proposal Form (Section 00 0400), the bidder shall attach this Contractor's Qualification Statement and shall answer the Questions herein. Failure to answer these questions in full may be cause for rejection of the bidder's proposal. **If more space is needed, please attach other sheets with reference to subject paragraph.**

The Board of Education reserves the right to consider, but not limited to, the financial responsibility, experience and reputation in the construction industry, as well as the specific qualifications listed below and elsewhere in this document in considering bids and awarding the contract. The Board of Education reserves the right to waive any informalities if, at its discretion the interest of the Greenwich Public Schools will be better served.

The Undersigned certifies under oath that the information provided herein is true and sufficiently complete so as not to be misleading.

SUBMITTED TO: Greenwich Public Schools

ADDRESS: 290 Greenwich Avenue, Greenwich, CT 06830

SUBMITTED BY:

NAME:

ADDRESS:

PRINCIPAL OFFICE:

NAME OF PROJECT: Boiler Replacement at Eastern Middle School

TYPE OF WORK (file separate for each Classification of Work)

- ☐ General Construction
- ☐ HVAC
- ☐ Plumbing
- ☐ Electrical
- ☐ Fire Alarm
- ☐ Other _____

1.1 ORGANIZATION

- A. How many years has your organization been in business as a Contractor?
- B. How many years has your organization been in business under its present business name?
 - 1. Under what other or former names has your organization operated?
- C. What is the firm's bonding range?
 - 1. Single
 - 2. Aggregate
- D. If your organization is a corporation, answer the following:
 - 1. Date of Incorporation:
 - 2. State of Incorporation:
 - 3. President's name:
 - 4. Vice-president's name(s):
 - 5. Secretary's name:
 - 6. Treasurer's name:

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- E. If your organization is a partnership, answer the following:
1. Date of organization:
 2. Type of partnership (if applicable):
 3. Name(s) of general partner(s):
- F. If your organization is individually owned, answer the following:
1. Date of organization:
 2. Name of owner:
- G. If the form of your organization is other than those listed above, describe it and name the principals.

1.2 OWNERSHIP, MANAGEMENT, AFFILIATION

- A. Identify each person who is or has been within the past five years, an owner of 5.0% or more of the firm's shares, one of the five largest shareholders, a director, an officer, a partner or the proprietor, or a managerial employee.

First Name	MI	Last Name	DOB	% Owned	Director Y or N	Officer Y or N	Title	Partner Y or N

- B. Joint Ventures: Provide information for all firms involved. Fill in name, % owned, office held; indicate by Y or N whether director, officer, partner and title.

First Name	MI	Last Name	DOB	% Owned	Director Y or N	Officer Y or N	Title	Partner Y or N

- C. Identify any other firms in which now or in the past five years, the firm or any of the individuals listed in questions 1.2.A and 1.2.B above, either owned or owns 5.0% or more of the shares of or was or is one of the five largest shareholders, a director, an officer, a partner or a proprietor of said other firm. ☐ Yes, list below ☐ No
- D. Has the firm or any firm listed in response to questions above defaulted or been terminated and its surety called upon to complete, any contract awarded within the past five years ☐ Yes ☐ No. If yes, give date(s), agency(ies)/owner(s), project(s), contract numbers, and describe including the result:
- E. List below any projects performed by the bidder in the past five (5) years on which any of the following events occurred:
1. Were any extension of time requested by the contractor, and were such requests granted?
 2. Was litigation and/or arbitration commenced by either the Owner or the bidder as a result of the work of the project performed by the bidder?
 3. Were any liens filed on the project by subcontractors or material suppliers of the bidder?
 4. Did the bidder make any claims for extra work on the project, and did said claim result in a change order?

Project	Type of Event	Name/Address of Owner	Name & Phone # of Contact Person at Owner

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- F. For all contracts within the past five years: (a) List all liens or claims over \$25,000 filed against the firm and remaining undischarged or unsatisfied for more than 90 days; and (b) list and describe all liquidated damages assessed.

Federal ID No.	% Owned	Firm/Company Name: Position	Company Address

1.3 FINANCIAL INFORMATION

- A. Greenwich Public Schools reserves the right to obtain the firm's most recent annual financial statement upon request.

1.4 OTHER INFORMATION

- A. Within the past five years has the firm, any affiliate, any predecessor company or entity or any person identified in questions number 1.1 through 1.2 above been the subject of any of the following: (Respond to each question and describe in detail the circumstances of each affirmative answer: (Attach additional pages if necessary).

1. A judgment of conviction for any business-related conduct constituting a crime under state or federal law. No ☐ Yes ☐
2. A criminal investigation or indictment for any business-related conduct constituting a crime under state or federal law? No ☐ Yes ☐
3. An order of protection filed against an officer or employee prohibiting access to jobsite(s) or prohibiting contact with any staff of any owner? No ☐ Yes ☐
4. A grant of immunity for any business-related conduct constituting a crime under state and federal law? No ☐ Yes ☐
5. A federal or state suspension or debarment? No ☐ Yes ☐
6. A rejection of any bid for lack of qualifications, responsibility or because of the submission of an informal, non-responsive or incomplete bid? No ☐ Yes ☐
7. A rejection of any proposed subcontract for lack of qualifications, responsibility or because of the submission of an informal, non-responsive or incomplete bid? No ☐ Yes ☐
8. A denial or revocation of prequalification? No ☐ Yes ☐
9. A voluntary exclusion from bidding/contracting agreement? No ☐ Yes ☐
10. Any administrative proceeding or civil action seeking specific performance or restitution in connection with any public works contract except any disputed work proceeding? No ☐ Yes ☐
11. An OSHA Citation and Notification of Penalty containing a violation classified as serious? No ☐ Yes ☐
12. An OSHA Citation or Notification of Penalty containing a violation classified as willful? No ☐ Yes ☐
13. A prevailing wage or supplement payment violation? No ☐ Yes ☐
14. A State Labor Law violation deemed willful? No ☐ Yes ☐
15. Any other federal or state Citations, Notices, violation orders, pending administrative hearings or proceedings or determinations of a violation of any labor law or regulation? No ☐ Yes ☐
16. Any criminal investigation, felony indictment or conviction concerning formation of or any business association with, an allegedly false or fraudulent women's, minority or disadvantaged business enterprise? No ☐ Yes ☐
17. Any denial, decertification, revocation or forfeiture of Women's Business Enterprise, Minority Business Enterprise or Disadvantaged Business Enterprise status? No ☐ Yes ☐
18. Rejection of a low bid on a State contract for failure to meet statutory affirmative action M/WBE requirements? No ☐ Yes ☐
19. A consent order with the NYS Department of Environmental Conservation or a federal, state or local government enforcement determination involving a violation of federal or ☐ ☐

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- | | | | | |
|--|----|--------------------------|-----|--------------------------|
| state environmental laws? | No | | Yes | |
| 20. Any bankruptcy proceeding? | No | ☐ | Yes | ☐ |
| 21. Any suspension or revocation of any business or professional license? | No | ☐ | Yes | ☐ |
| 22. Any citations, notices, violation orders, pending administrative hearings or proceedings or determinations for violation of: | | | | |
| Federal, state or local health laws, rules or regulations? | No | ☐ | Yes | ☐ |
| Federal, state or local environmental laws, rules and regulations? | No | ☐ | Yes | ☐ |
| Unemployment insurance or workers compensation coverage or claim requirements? | No | ☐ | Yes | ☐ |
| ERISA (Employee Retirement Income Security Act)? | No | ☐ | Yes | ☐ |
| Federal, state or local human rights laws? | No | ☐ | Yes | ☐ |
| Federal or state security laws? | No | ☐ | Yes | ☐ |
| 23. Withdrawal or an agreement to withdraw a bid submitted to a public owner or a request by a public owner to withdraw a bid? | No | ☐ | Yes | ☐ |
| 24. During the five year period preceding the submission of this bid, has the bidder been named as a part in any lawsuit in an action involving a claim for personal injury or wrongful death arising from the performance of work related to any project in which it has been engaged? If the answer to the question is yes, list all such lawsuits, the index number associated with said lawsuit and the status of the lawsuit at the time of the submission of this bid. | No | ☐ | Yes | ☐ |
| 25. During the five year period preceding the submission of this bid, has the bidder been the subject of proceedings before the Department of Labor for alleged violations of the Labor Law as it related to the payment of prevailing wages and/or supplemental payment requirements? If the answer to the question is yes, list each such instance of the commencement of a Department of Labor proceeding, for which project such proceeding was commenced, and the status of the proceeding at the time of the submission of this bid. | No | ☐ | Yes | ☐ |
| 26. During the five year period preceding the submission of this bid, has the bidder been the subject of proceedings involving allegations that it violated the Worker's Compensation Law including but not limited to the failure to provide proof of worker's compensation or disability coverage and/or any lapses thereof? If the answer to the question is yes, list such instance of violation and the status of the claimed violation at the time of disposition of this bid. | No | ☐ | Yes | ☐ |
| 27. Has the bidder, its officers, directors, owner and/or managerial employees been convicted of a crime or been the subject of a criminal indictment during the five years preceding the submission of this bid? If the answer to the question is yes, list the name of the individual convicted or indicted, the charge against the individual and the date of disposition of the charge. | No | ☐ | Yes | ☐ |
| 28. During the five year period preceding the submission of this bid, has the bidder been charged with and/or found guilty of any violations of federal, state or municipal environmental and/or health laws, codes, rules and/or regulations? If the answer to the question is yes, list the nature of the charge against the bidder, the date of the charge, and the status of the charge at the time of the submission of this bid. | No | ☐ | Yes | ☐ |
| 29. Has the bidder ever defaulted or had its surety called upon to complete any contract awarded within the past five years? If the answer to the question is yes, list the projects, the dates and the nature of the termination (convenience, suspension, for cause). | No | ☐ | Yes | ☐ |
| 30. Has any officer or partner of the bidder's organization ever defaulted or had its surety called upon to complete any contract awarded within the past five years or been an officer or partner of some other organization that has been terminated from a project by an owner? If yes, state: | No | ☐ | Yes | ☐ |

Boiler Replacement at Eastern Middle School

Name of Individual	Name of Organization	Reason(s)

B. LICENSING

1. List jurisdictions and trade categories in which your organization is legally qualified to do business, and indicate registration of license numbers, if applicable.
2. List jurisdictions in which your organization's partnership or trade name is filed:
3. Has any director, officer, owner or managerial employee had any professional license suspended or revoked? If the answer is yes, list the name of the individual, the professional license he/she formally had, whether the license was revoked or suspended and the date of the revocation or suspension; No ☐ Yes ☐

1.5 EXPERIENCE

- A. List the categories of work that your organization will perform with its own forces:
- B. Claims and Suits. (If the answer of any of the questions below is yes, please attach details.)
 - a. Have you or has any director, officer, owner or managerial employee ever failed to complete any work awarded to them?
If yes, list the project(s) the date(s) and the reason(s) for the failure to complete. No ☐ Yes ☐
 - b. Are there any judgments, claims, arbitration proceedings or suits pending or outstanding against your organization or its officers? No ☐ Yes ☐
 - c. Has your organization filed any law suits or requested arbitration with regard to construction contracts within the last five years? No ☐ Yes ☐
 - d. Within the past five years, has any officer or principal of your organization ever been an officer or a principal of another organization when it failed to complete a construction contract? If the answer is yes, please attach details. No ☐ Yes ☐
- C. On a separate sheet, list **all** similar construction projects your organization has in progress or completed, giving the name of project, owner, engineer, contract amount, percent complete and scheduled completion date.
 1. State total worth of work in progress and under contract:
- D. On a separate sheet, list **all** projects, not listed above, that your organization has completed or in progress in the past five years, giving the name of the project, owner, engineer, contract amount, date of completion and percentage of the cost of the work performed with your own forces.
 1. State average annual amount of construction work performed during the past five years:
- E. On a separate sheet, list the construction experience and present commitment of the key individuals of your organization.

1.6 REFERENCES

- A. Trade reference:
- B. Bank references:
- C. Surety:
 1. Name of present bonding company:
 2. Name and address of agent:
 3. Name or previous bonding company:

Boiler Replacement at Eastern Middle School

1.7 CERTIFICATION

- A. The undersigned recognizes that this questionnaire is submitted for the purpose of the Greenwich Public Schools (Owner) to award a contract or approve a subcontract; acknowledges that the Owner may in its discretion, by means which it may choose, determine the truth and accuracy of all statements made herein; acknowledge that intentional submission of false or misleading information may constitute a felony, or a misdemeanor, and may also be punishable by a fine or imprisonment; and states that the information submitted
- B. in this questionnaire and any attached pages is true, accurate and complete.
Dated at this day of _____

Name of Organization:

By:

Title:

SWORN AND SUBSCRIBED TO BEFORE ME, A NOTARY PUBLIC, IN AND FOR

THE COUNTY OF _____ AND THE STATE OF _____

THIS _____ DAY OF _____, 2025

NOTARY PUBLIC

MY COMMISSION EXPIRES _____

GREENWICH PUBLIC SCHOOLS

BID #2502-25 DEADLINE: February 25th, 2025 AT 2:00 p.m.

Boiler Replacement at Eastern Middel School

REPLY SHEET (Page 1 of 3)

STATEMENT OF NON-COLLUSION

In submitting this bid/proposal, the undersigned declares that this is made without any connection with any persons making another bid/proposal on the same contract; that the bid/proposal is in all respects fair and without collusion, fraud, or mental reservation; and that no elected or appointed official of the Town, or any person or entity in the employ of the Town, is directly or indirectly interested in said bid/proposal or in the supplies or work to which it relates, or in any portion of the profits thereof, except as permitted under the Town of Greenwich Code of Ethics.

CODE OF ETHICS

In submitting this bid, the undersigned further declares and certifies that a) it has not, and will not induce or attempt to induce any Town of Greenwich employee or officer to violate the Town of Greenwich Code of Ethics in connection with its offer to provide goods or services under, or otherwise in the performance of, such contract, and b) if an elected or appointed official or any person in the employ of the Town has a direct or indirect interest in Vendor or any supplier or Subcontractor expected to be involved with the contract, such person or entity is in compliance with the safe harbor procedures established by the Town of Greenwich Board of Ethics or has received an advisory from the Town's Board of Ethics with respect to such involvement.

The undersigned further understands that the above declarations are material representations to the Town of Greenwich made as a condition to the acceptance of the bid/proposal. If found to be false, the Town of Greenwich retains the right to reject said bid/proposal and rescind any resulting contract and/or purchase order and notify the undersigned accordingly, thereby declaring as void said bid/proposal and contract or purchase order.

The Town of Greenwich Code of Ethics can be found at www.greenwichct.gov. Relevant provisions of the Town's Code of Ethics state:

Section 2. DEFINITIONS. (1) Indirect interest, without limiting its generality, shall mean and include the interest of any subcontractor in any prime contract with the Town and the interest of any person or his immediate family in any corporation, firm, or partnership which has a direct or indirect interest in any transaction with the Town. (2) Substantial financial interest shall mean any financial interest, direct or indirect, which is more than nominal, and which is not common to the interest of other citizens of the Town. (3) Town officer shall mean and include any official, employee, agent, consultant, or member, elected or appointed, of any board, department, commission, committee, legislative body, or other agency of the Town. (4) Transaction shall mean and include the offer, sale, or furnishing of any real or personal property, material, supplies, or services by any person, directly or indirectly, as Vendor, prime contractor, subcontractor, or otherwise, for the use and benefit of the Town for a valuable consideration, excepting the services of any person as a Town officer.

Section 3. GIFTS AND FAVORS. No Town officer or his immediate family shall accept any valuable gift, thing, favor, loan, or promise that might influence the performance or nonperformance of his official duties.

Section 4. IMPROPER INFLUENCE. No Town officer having a substantial financial interest in any transaction with the Town or in any action to be taken by the Town shall use his office to exert his influence or to vote on such transaction or action.

Boiler Replacement at Eastern Middle School

GREENWICH PUBLIC SCHOOLS

BID #2502-25 DEADLINE: February 25th, 2025 AT 2:00 p.m.

Boiler Replacement at Eastern Middle School

REPLY SHEET (Page 2 of 3)

By signing below, the undersigned acknowledges reviewing and understanding the Non-Collusion and Code of Ethics statements contained herein and confirms compliance with the contents:

AUTHORIZED SIGNATURE: _____

PRINT NAME: _____

BIDDER'S COMPANY NAME: _____

GREENWICH PUBLIC SCHOOLS

BID #2502-25 DEADLINE: February 25th, 2025 AT 2:00 p.m.

Boiler Replacement at Eastern Middle School

REPLY SHEET (Page 3 of 3)

BIDDER INFORMATION:

BIDDER'S COMPANY NAME _____

ADDRESS _____

TELEPHONE # _____ **FAX #** _____

E-MAIL ADDRESS _____

WEB SITE _____

AUTHORIZED SIGNATURE _____

PRINT NAME _____

TITLE _____

STATE OF CT TAXPAYER ID # _____

FEDERAL TAXPAYER ID # _____

INCORPORATED IN THE STATE OF _____ **Corporate Seal** ☐ **Yes** ☐ **No**

AWARD/CONTRACT SIGNATURE

The Bidder shall indicate below, the full name, title, and the complete mailing address of the authorized person (i.e., **officer of the company**) who will sign the contract (if applicable) for this procurement:



Prevailing Wage Rates System

Annual Adjusted July 1st Rates

Building Rates

County	Town	Classification	Hourly Rate	Hourly Benefit
Fairfield	Greenwich	1b) Asbestos/Toxic Waste Removal Laborers: Asbestos removal and encapsulation (except its removal from mechanical systems which are not to be scrapped), toxic waste removers, blasters.**See Laborers Group 7**		
Fairfield	Greenwich	1c) Asbestos Worker/Heat and Frost Insulator	\$47.06	33.30
Fairfield	Greenwich	2) Boilermaker	\$46.21	29.35
Fairfield	Greenwich	3a) Bricklayer, Cement Mason, Concrete Finisher (including caulking), Stone Masons	\$41.11	35.68 + a
Fairfield	Greenwich	3b) Tile Setter	\$38.81	32.20
Fairfield	Greenwich	3c) Tile and Stone Finishers	\$32.00	26.69
Fairfield	Greenwich	3d) Marble & Terrazzo Finishers	\$33.00	25.69
Fairfield	Greenwich	3e) Plasterer	\$44.52	29.63
Fairfield	Greenwich	-----LABORERS-----		
Fairfield	Greenwich	4) Group 1: General laborers, carpenter tenders, concrete specialists, wrecking laborers and fire watchers.	\$34.50	27.26
Fairfield	Greenwich	4) Group 1a: Acetylene Burners (Hours worked with a torch)	\$35.50	27.26
Fairfield	Greenwich	4a) Group 2: Mortar mixers, plaster tender, power buggy operators, powdermen, fireproofers/mixer/nozzleman (Person running mixer and spraying fireproof only).	\$34.75	27.26
Fairfield	Greenwich	4b) Group 3: Jackhammer operators/pavement breaker, mason tender (brick), mason tender (cement/concrete), forklift operators and forklift operators (masonry).	\$35.00	27.26

Fairfield	Greenwich	4c) **Group 4: Pipelayers (Installation of water, storm drainage or sewage lines outside of the building line with P6, P7 license) (the pipelayer rate shall apply only to one or two employees of the total crew who primary task is to actually perform the mating of pipe sections) P6 and P7 rate is \$26.80.	\$35.50	27.26
Fairfield	Greenwich	4d) Group 5: Air track operator, sand blaster and hydraulic drills.	\$35.25	27.26
Fairfield	Greenwich	4e) Group 6: Blasters, nuclear and toxic waste removal.	\$37.50	27.26
Fairfield	Greenwich	4f) Group 7: Asbestos/lead removal and encapsulation (except it's removal from mechanical systems which are not to be scrapped).	\$37.50	27.26
Fairfield	Greenwich	4g) Group 8: Bottom men on open air caisson, cylindrical work and boring crew.	\$35.00	27.26
Fairfield	Greenwich	4h) Group 9: Top men on open air caisson, cylindrical work and boring crew.	\$34.50	27.26
Fairfield	Greenwich	4i) Group 10: Traffic Control Signalman	\$20.70	27.26
Fairfield	Greenwich	4j) Group 11: Toxic Waste Removers A or B With PPE	\$37.50	27.26
Fairfield	Greenwich	5) Carpenter, Acoustical Ceiling Installation, Soft Floor/Carpet Laying, Metal Stud Installation, Form Work and Scaffold Building, Drywall Hanging, Modular-Furniture Systems Installers, Lathers, Piledrivers, Resilient Floor Layers.	\$39.54	28.68
Fairfield	Greenwich	5a) Millwrights	\$40.56	28.87
Fairfield	Greenwich	6) Electrical Worker (including low voltage wiring) (Trade License required: E1,2 L-5,6 C-5,6 T-1,2 L-1,2 V-1,2,7,8,9)	\$44.00	42.745
Fairfield	Greenwich	7a) Elevator Mechanic (Trade License required: R-1,2,5,6)	\$64.01	39.19+a+b
Fairfield	Greenwich	-----LINE CONSTRUCTION-----		
Fairfield	Greenwich	Groundman	\$26.50	6.5% + 9.00
Fairfield	Greenwich	Linemen/Cable Splicer	\$48.19	6.5% + 22.00
Fairfield	Greenwich	8) Glazier (Trade License required: FG-1,2)	\$41.63	25.80+ a
Fairfield	Greenwich	9) Ironworker, Ornamental, Reinforcing, Structural, and Precast Concrete Erection	\$45.25	41.27 + a
Fairfield	Greenwich	-----OPERATORS-----		
Fairfield	Greenwich	Group 1: Crane Handling or Erecting Structural Steel or Stone; Hoisting Engineer (2 drums or over). (Trade License Required)	\$55.42	28.80 + a
Fairfield	Greenwich	Group 1a: Front End Loader (7 cubic yards or over); Work Boat 26 ft. and Over	\$50.79	28.80 + a
Fairfield	Greenwich	Group 2: Cranes (100 ton rate capacity and over); Bauer Drill/Caisson. (Trade License Required)	\$55.03	28.80 + a

Fairfield	Greenwich	Group 2a: Cranes (under 100 ton rated capacity).	\$54.09	28.80 + a
Fairfield	Greenwich	Group 2b: Excavator over 2 cubic yards; Pile Driver (\$3.00 premium when operator controls hammer)	\$50.40	28.80 + a
Fairfield	Greenwich	Group 3: Excavator; Gradall; Master Mechanic; Hoisting Engineer (all types of equipment where a drum and cable are used to hoist or drag material regardless of motive power of operation), Rubber Tire Excavator (Drott-1085 or similar); Grader Operator; Bulldozer Finegrade. (slopes, shaping, laser or GPS, etc.). (Trade License Required)	\$49.45	28.80 + a
Fairfield	Greenwich	Group 4: Trenching Machines; Lighter Derrick; CMI Machine or Similar; Koehring Loader (Skooper); Goldhofer.	\$48.97	28.80 + a
Fairfield	Greenwich	Group 5: Specialty Railroad Equipment; Asphalt Spreader, Asphalt Reclaiming Machine; Line Grinder; Concrete Pumps; Drills with Self Contained Power Units; Boring Machine; Post Hole Digger; Auger; Pounder; Well Digger; Milling Machine (over 24 mandrel).	\$48.22	28.80 + a
Fairfield	Greenwich	Group 5 continued: Side Boom; Combination Hoe and Loader; Directional Driller.	\$48.22	28.80 + a
Fairfield	Greenwich	Group 6: Front End Loader (3 up to 7 cubic yards); Bulldozer (rough grade dozer).	\$47.83	28.80 + a
Fairfield	Greenwich	Group 7: Asphalt Roller; Concrete Saws and Cutters (ride on types); Vermeer Concrete Cutter; Stump Grinder; Scraper; Snooper; Skidder; Milling Machine (24" and under mandrel).	\$47.40	28.80 + a
Fairfield	Greenwich	Group 8: Mechanic; Grease Truck Operator; Hydroblaster; Barrier Mover; Power Stone Spreader; Welding; Work Boat Under 26 ft.; Transfer Machine; Rigger Foreman.	\$46.90	28.80 + a
Fairfield	Greenwich	Group 9: Front End Loader (under 3 cubic yards); Skid Steer Loader regardless of attachments; (Bobcat or Similar); Forklift, Power Chipper; Landscape Equipment (including Hydroseeder); Vacuum Excavation Truck and Hydrovac Excavation Truck (27 HG pressure or greater).	\$46.35	28.80 + a
Fairfield	Greenwich	Group 10: Vibratory hammer; ice machine; diesel and air, hammer, etc.	\$43.77	28.80 + a
Fairfield	Greenwich	Group 11: Conveyor, earth roller, power pavement breaker (whiphammer), robot demolition equipment.	\$43.77	28.80 + a
Fairfield	Greenwich	Group 12: Wellpoint Operator.	\$43.69	28.80 + a
Fairfield	Greenwich	Group 13: Compressor Battery Operator.	\$42.97	28.80 + a
Fairfield	Greenwich	Group 14: Elevator Operator; Tow Motor Operator (solid tire no rough terrain).	\$41.52	28.80 + a
Fairfield	Greenwich	Group 15: Generator Operator; Compressor Operator; Pump Operator; Welding Machine Operator; Heater Operator.	\$41.01	28.80 + a
Fairfield	Greenwich	Group 16: Maintenance Engineer.	\$40.19	28.80 + a
Fairfield	Greenwich	Group 17: Portable Asphalt Plant Operator; Portable Crusher Plant Operator; Portable Concrete Plant Operator; Portable Grout Plant Operator; Portable Water Filtration Plant Operator.	\$45.63	28.80 + a

Fairfield	Greenwich	Group 18: Power Safety Boat; Vacuum Truck; Zim Mixer; Sweeper; (Minimum for any job requiring a CDL license); Rigger; Signalman.	\$42.57	28.80 + a
Fairfield	Greenwich	Surveyor: Chief of Party	\$45.87	28.80 + a
Fairfield	Greenwich	Surveyor: Assistant Chief of Party	\$42.30	28.80 + a
Fairfield	Greenwich	Surveyor: Instrument Man	\$40.70	28.80 + a
Fairfield	Greenwich	Surveyor: Rodman or Chainman	\$35.03	28.80 + a
Fairfield	Greenwich	-----PAINTERS (Including Drywall Finishing)-----		
Fairfield	Greenwich	10a) Brush and Roller	\$38.07	25.80
Fairfield	Greenwich	10b) Taping Only/Drywall Finishing	\$38.82	25.80
Fairfield	Greenwich	10c) Paperhanger and Red Label	\$38.57	25.80
Fairfield	Greenwich	10e) Blast and Spray	\$41.07	25.80
Fairfield	Greenwich	11) Plumber (excluding HVAC pipe installation) (Trade License required: P-1,2,6,7,8,9 J-1,2,3,4 SP-1,2)	\$49.58	36.15
Fairfield	Greenwich	12) Well Digger, Pile Testing Machine	\$37.26	24.05 + a
Fairfield	Greenwich	Roofer: Cole Tar Pitch	\$45.00	23.85 + a
Fairfield	Greenwich	Roofer: Slate, Tile, Composition, Shingles, Singly Ply and Damp/Waterproofing	\$43.50	23.85 + a
Fairfield	Greenwich	15) Sheetmetal Worker (Trade License required for HVAC and Ductwork: SM-1,SM-2,SM-3,SM-4,SM-5,SM-6)	\$53.22	46.19
Fairfield	Greenwich	16) Pipefitter (Including HVAC work) (Trade License required: S-1,2,3,4,5,6,7,8 B-1,2,3,4 D-1,2,3,4, G-1, G-2, G-8 & G-9)	\$49.58	36.15
Fairfield	Greenwich	-----TRUCK DRIVERS-----		
Fairfield	Greenwich	17a) 2 Axle, Helpers	\$33.16	32.36 + a
Fairfield	Greenwich	17b) 3 Axle, 2 Axle Ready Mix	\$33.27	32.36 + a
Fairfield	Greenwich	17c) 3 Axle Ready Mix	\$33.33	32.36 + a
Fairfield	Greenwich	17d) 4 Axle	\$33.39	32.36 + a
Fairfield	Greenwich	17e) 4 Axle Ready Mix	\$33.44	32.36 + a
Fairfield	Greenwich	17f) Heavy Duty Trailer (40 Tons and Over)	\$35.66	32.36 + a

Fairfield	Greenwich	17g) Specialized Earth Moving Equipment (Other Than Conventional Type on-the-Road Trucks and Semi-Trailers, Including Euclids)	\$33.44	32.36 + a
Fairfield	Greenwich	17h) Heavy Duty Trailer up to 40 tons	\$34.39	32.36 + a
Fairfield	Greenwich	17i) Snorkle Truck	\$33.54	32.36 + a
Fairfield	Greenwich	18) Sprinkler Fitter (Trade License required: F-1,2,3,4)	\$49.98	32.85 + a
Fairfield	Greenwich	19) Theatrical Stage Journeyman	\$25.76	7.34

As of: July 1, 2024

REFERENCES

List at least five (5) references for similar projects in size, scope, and complexity, within Connecticut and/or New York.

THIS PAGE MUST BE COMPLETED AND SUBMITTED WITH YOUR BID.

1) Client _____

Project Address _____

Approximate \$ Value _____ Date: Started _____ Completed _____

Contact: Name _____ Telephone # _____

2) Client _____

Project Address _____

Approximate \$ Value _____ Date: Started _____ Completed _____

Contact: Name _____ Telephone # _____

3) Client _____

Project Address _____

Approximate \$ Value _____ Date: Started _____ Completed _____

Contact: Name _____ Telephone # _____

4) Client _____

Project Address _____

Approximate \$ Value _____ Date: Started _____ Completed _____

Contact: Name _____ Telephone # _____

5) Client _____

Project Address _____

Approximate \$ Value _____ Date: Started _____ Completed _____

Contact: Name _____ Telephone # _____

FORM OF BID BOND

TOWN OF GREENWICH, CONNECTICUT
BID BOND

Date Bond Executed

Principal

Surety

Penal Sum of Bond (express in words and figures)

Date of Bid

KNOW ALL MEN BY THESE PRESENTS, that we, the principal and surety above named, are held and firmly bound unto the Town of Greenwich, Connecticut, in the penal sum of the amount stated above, for the payment of which sum well and truly to be made, we bind ourselves, our heirs, executors, administrators, and successors, jointly and severally, firmly by these presents, THE CONDITION OF THIS OBLIGATION IS SUCH, that whereas the principal has submitted the accompanying bid, dated as shown above for _____.
(name of bid)

NOW THEREFORE, if the principal shall not withdraw said bid within the period specified therein after the opening of the same, or if no period be specified, within sixty (60) days after said opening, and shall within the period specified therefor, or if no period specified, within ten (10) days after the prescribed forms are presented to him for signature, execute such further contractual documents, if any, as may be required by the term of the Bid as accepted, and give bonds with good and sufficient surety or sureties as may be required, for the faithful performance and proper fulfillment of the resulting contract, and for the protection of all person supplying labor and material in the prosecution of the work provided for in such contract or in the event of the withdrawal of said bid within the period specified, or the failure to enter into such contract and give such bonds within the time specified, if the principal shall pay the Town of Greenwich, Connecticut, the difference between the amount specified in said bid and the amount for which said Town may procure the required work, supplies, and services, if the latter amount be in excess of the former, then the above obligation shall be void and of no effect, otherwise to remain in full force and virtue.

IN WITNESS WHEREOF the above bounden parties have executed this instrument under their several seals on the date indicated above. The name and corporate seal (if applicable) of each corporate party being hereto affixed:

CERTIFICATE AS TO CORPORATE PRINCIPAL

I, _____, certify that I am the
_____ of the corporation named as principal in the within bond;
that _____, who signed said bond on behalf of the principal, was
then _____ of the corporation; that I know his signature, and his signature
thereto is genuine; and that said bond was duly signed, sealed and attested for and in behalf of
said corporation by authority of its governing body.

(Corporate Seal)

PERFORMANCE, MAINTENANCE AND PAYMENT BOND

BOND NO. _____ **CONTRACT NO.** _____

KNOW ALL MEN BY THESE PRESENTS. That we _____

_____, as Principal, and _____

a corporation organized under the laws of the State of _____ and authorized to do business in the State of Connecticut as Surety, for holden and firmly bound jointly and severally unto the Town of Greenwich, Connecticut, herein referred to as the Town, the territorial corporation located in the County of Fairfield, in the penal sum of

_____ Dollars (\$ _____),

to be paid to it or its certain attorney, successors or assigns, to which payment well and truly to be made, we the said Obligors do bind ourselves, and each of us, our heirs, executors, administrators, and successors firmly by these presents.

IN WITNESS WHEREOF we have hereunto set for cause to be set our respective hands, names and seals this

_____ day of _____, 20__

The condition of this obligation is such, that whereas the above named Principal has entered into a certain written contract with the Town of Greenwich, Connecticut, dated the

_____ day of _____, 20__

NOW, THEREFORE, if the said Principal shall well and faithfully perform said contract according to its provisions, and fully indemnify and save harmless the Town from all costs and damages which the Town may suffer by reason of failure so to do, and shall pay for all equipment, appurtenances, materials and labor furnished, used or employed in the execution of said contract, and shall indemnify and save harmless the Town from all suits or claims of any nature or description against the Town by reason of any injuries or damages sustained by any person or persons on account of any act or omission of said Principal, his servants or agents, or his subcontractors in the construction of the work or in guarding the work, or on account of the use of faulty or improper materials, or by reason of claims under the Workmen's Compensation Laws or other laws by any employee of the Principal or his subcontractors, or by reason of the use of patented material, machinery, device, equipment, process, method of construction or design in any way involved in the work, and shall indemnify the Town against such defective workmanship, material and equipment as may be discovered within one (1) year after completion and final acceptance of the work, and shall make good in such defective workmanship and material as may be discovered within said period of one (1) year, then the obligation shall be void, otherwise to remain in full force and effect.

The Surety hereby stipulates and agrees that any modifications, omissions or additions in or to the terms of the aforesaid contract, or in or to the plans or specifications therefor, or any extension of time, shall in no wise affect the obligation of the Surety under this bond, the surety hereby waiving any and all right to any notice of any such modifications, omissions, changes, additions or extensions.

Contractor Name: _____ By: _____

Surety Name: _____ By: _____

INSURANCE PROCEDURE

PLEASE NOTE:

THIS PAGE MUST BE RETURNED WITH YOUR BID/RFP. FAILURE TO DO SO MAY RESULT IN YOUR BID/RFP BEING REJECTED.

Please take the insurance requirements of the Contract to your agent/broker immediately upon receipt of the bid documents to determine your existing coverage and any costs for new or additional coverage required for the work noted in this Request for BID/RFP. Any BID/RFP with deficient insurance requirements will be rejected.

STATEMENT OF VENDOR:

I have read the insurance requirements for this work and have taken the documentation to my insurance agent/broker. The BID/RFP cost reflects any additional costs relating to insurance requirements for this work.

Signature

Date

Insurance Requirement Sheet

Insurance Requirements: Before starting and until final completion and acceptance of the work called for in the Contract and expiration of the guarantee period provided for in the Contract, the Contractor and its subcontractors, if any, shall procure and maintain insurance of the types and amounts checked in paragraphs A through F below for all Contract operations.

- ☒ A. General Liability, with minimum coverages for combined bodily injury and property damage liability of \$2,000,000 general aggregate, \$1,000,000 per occurrence including:
- ☒ 1. Commercial General Liability.
 - ☒ 2. Town as additional insured.
 - ☐ 3. Owners and Contractors Protective Liability (separate policy in the name of the Town).
- ☒ B. Comprehensive Automobile Liability, with minimum coverages of \$1,000,000 combined single limit for bodily injury and property damage, including, where applicable, coverage for any vehicle, all owned vehicles, scheduled vehicles, hired vehicles, non-owned vehicles and garage liability.
- ☒ C. Excess Liability, with minimum coverage of \$5,000,000 in umbrella form, or such other form as approved by Town Department Head and Risk Management Director.
- ☒ D. Workers' Compensation and Employer's Liability, with minimum coverages as provided by Connecticut State Statutes.
- ☐ E. Professional Liability (for design and other professionals for Errors and Omissions), with minimum coverage of \$1,000,000. If the policy is on a claims-made basis, coverage shall be continually renewed or extended for three (3) years after work is completed under the Contract.
- ☐ F. Other (Builder's Risk, etc.):_____.
- ☒ G. **CERTIFICATE HOLDER: TOWN OF GREENWICH
And GREENWICH BOARD OF EDUCATION. (Also fill in on ACORD Certificate of Insurance)
290 Greenwich Avenue, Greenwich, CT 06830.**

The **Acord certificate of insurance form** must be executed by your insurance agent/broker and returned to this office. Company name and address must conform on all documents including insurance documentation. It is required that the agent/broker note the individual insurance companies providing coverage, rather than the insurance group, on the Acord form. The Contract number (provided to the awarded Contractor), project name and a brief description must be inserted in the "Description of Operations" field. It must be confirmed on the Acord Form that the Town of Greenwich and The Greenwich Board of Education are endorsed as additional insured by having the appropriate box checked off and stating such in the "Description of Operations" field. **A letter from the awarded vendor's agent/broker certifying that the Town of Greenwich and The Greenwich Board of Education has been endorsed onto the general liability policy as an additional insured is also mandatory.** This letter must follow exactly the format provided by the Purchasing Department. If the insurance coverage required is provided on more than one Acord certificate of insurance, then additional endorsement letters are also required. Contract development will begin upon receipt of complete, correct insurance documentation. The Contractor shall be responsible for maintaining the above insurance coverages in force to secure all of the Contractor's obligations under the Contract with an insurance company or companies with an AM Best Rating of A or better, licensed to write such insurance in Connecticut and acceptable to the Risk Manager, Town of Greenwich. For excess liability only, non-admitted insurers are acceptable, provided they are permitted to do business through Connecticut excess line brokers per listing on the current list of Licensed Insurance Companies, Approved Reinsurers, Surplus Lines Insurers and Risk Retention Groups issued by the State of Connecticut Insurance Department.

(SAMPLE ENDORSEMENT LETTER)

**AGENT/BROKER
(LETTERHEAD)**

(Date)

Eugene H. Watts, Senior Buyer
Purchasing Department
Town of Greenwich/Board of Education
290 Greenwich Avenue – Havemeyer Building
Greenwich, CT 06830

Re: Town of Greenwich/Greenwich Board of Education / **Contract #**
Project Name:

Dear Mr. Watts:

The undersigned hereby certifies as follows:

- (1) I am a duly licensed insurance agent under the laws of the State of **[insert State]** and an authorized representative of all companies affording coverage under the Acord form submitted herewith;
- (2) The Town of Greenwich, Greenwich Board of Education, and Landmark Facilities Group, Inc have been endorsed as an additional insured under the general liability policy no. [insert policy number], issued by **[insert company affording coverage] to [name of insured];**
- (3) The general liability policy referenced in paragraph (2) above meets or exceeds the coverage in Commercial General Liability ISO form CG 00 01 10 01, including contractual liability;
- (4) The policies listed in the Acord form submitted to the Town of Greenwich in connection with the above-referenced contract have been issued to the insured in the amounts stated and for the periods indicated in the Acord form; and
- (5) The Town of Greenwich shall be given thirty (30) days prior written notice of cancellation, lapse or restrictive amendment (except ten days' notice of nonpayment) of the policies listed in the Acord form.

Sincerely,

Authorized Representative for all companies listed in the Acord form

ACORD**CERTIFICATE OF LIABILITY INSURANCE**

PRODUCER	THIS CERTIFICATE IS ISSUED AS A MATTER OF INFORMATION ONLY AND CONFERS NO RIGHTS UPON THE CERTIFICATE HOLDER, THIS CERTIFICATE DOES NOT AMEND, EXTEND OR ALTER THE COVERAGE AFFORDED BY THE POLICIES BELOW.
	INSUREERS AFFORDING COVERAGE
Vendor Name & Address Contract # _____	INSURER A:
	INSURER B:
	INSURER C:
	INSURER D:
	INSURER E:

COVERAGES

THE POLICIES OF INSURANCE LISTED BELOW HAVE BEEN ISSUED TO THE INSURED NAMED ABOVE FOR THE POLICY PERIOD INDICATED, NOTWITHSTANDING ANY REQUIREMENT, TERM OF CONDITION OF ANY CONTRACT OR OTHER DOCUMENT WITH RESPECT TO WHICH THIS CERTIFICATE MAY BE ISSUED OR MAY PERTAIN, THE INSURANCE AFFORDED BY THE POLICIES DESCRIBED HEREIN IS SUBJECT TO ALL THE TERMS, EXCLUSIONS AND CONDITIONS OF SUCH POLICIES. LIMITS SHOWN MAY HAVE BEEN REDUCED BY PAID CLAIMS.

INSR	TYPE OF INSURANCE	POLICY NUMBER	POLICY EFFECTIVE DATE(MM/DD/YY)	POLICY EXPIRATION DATE(MM/DD/YY)	LIMITS	
	GENERAL LIABILITY COMMERCIAL GENERAL LIABILITY ☐ CLAIMS MADE ☒ OCCUR ☐ _____ ☐ _____ GENERAL AGGREGATE LIMIT APPLIES PER: ☐ POLICY ☐ PROJECT ☐ LOC				EACH OCCURENCE	\$1,000,000
	FIRE DAMAGE (Any one fire)					
	MED EXP (Any one person)					
	PERSONAL & ADV INJURY					
	GENERAL AGGRREGATE				\$2,000,000	
	PRODUCTS-COMP/OP AGG					
	AUTOMOBILE LIABILITY ☐ ANY AUTO ALL OWNED AUTOS ANY PROPRIETOR/PARTNER/ EXECUTIVE SCHEDULED AUTOS HIRED AUTOS NON-OWNED AUTOS ☐ _____ ☐ _____				COMBINED SINGLE LIMIT (Ea accident)	\$1,000,000
	BODILY INJURY (Per person)					
	BODILY INJURY (Per accident)					
	PROPERTY DAMAGE (Per accident)					
	GARAGE LIABILITY ☐ ANY AUTO ☐ _____				AUTO ONLY-EA ACCIDENT	
	OTHER THAN AUTO ONLY:				EAACC AGG	
	EXCESS LIABILITY ☐ OCCUR ☐ CLAIMS MADE ☐ DEDUCTIBLE ☐ RETENTION \$				EACH OCCURENCE	\$5,000,000
	AGGREGATE				\$5,000,000	
	WORKERS COMPENSATION AND EMPLOYERS' LIABILITY ANY PROPRIETOR/PARTNER/ EXECUTIVE/OFFICER/ MEMBER EXCLUDED? (Mandatory in NH) If yes, describe under DESCRIPTION OF OPERATION below.	Y/N ☐			☒ PER STATUTE	OTHER
	E.L. EACH ACCIDENT					
	E.L. DISEASE-EA EMPLOYEE					
	E.L. DISEASE - POLICY LIMIT					
	Professional Liability					

DESCRIPTION OF OPERATIONS/LOCATIONS/VEHICLES/EXCLUSIONS ADDED BY ENDORSEMENT/SPECIAL PROVISIONS

The Town of Greenwich, The Greenwich Board of Education, and Landmark Facilities Group, Inc. are named as additional insured for Contract #. It is agreed by all parties to Contract # that the Contractors insurance will be primary and non-contributory.

CERTIFICATE HOLDER	X	ADDITIONAL INSURED; INSURER LETTER: __	CANCELLATION
Certificate Holder: Town of Greenwich and Greenwich Board of Education 101 Field Point Road Greenwich, CT 06830			SHOULD ANY OF THE ABOVE-DESCRIBED POLICIES BE CANCELLED BEFORE THE EXPIRATION DATE THEREOF, THE ISSUING COMPANY WILL ENDEAVOR TO MAIL 30 DAYS WRITTEN NOTICE TO THE CERTIFICATE HOLDER NAMED TO THE LEFT, BUT FAILURE TO DO SO SHALL IMPOSE NO OBLIGATION OR LIABILITY OF ANY KIND UPON THE INSURER, ITS AGENTS OF REPRESENTATIONS AUTHORIZED REPRESENTATIVE

A.M. BEST KEY RATING GUIDE FORM

The following insurance companies are licensed in the State of Connecticut per the 2021 edition of the **A.M. Best Key Rating Guide For Property and Casualty**,

1. Company Name: _____

a. Page Number: _____

b. Rating is: _____

2. Company Name: _____

a. Page Number: _____

b. Rating is: _____

3. Company Name: _____

a. Page Number: _____

b. Rating is: _____

4. Company Name: _____

a. Page Number: _____

b. Rating is: _____

5. Company Name: _____

a. Page Number: _____

b. Rating is: _____

AFFIRMATIVE ACTION COMPLIANCE AFFIDAVIT

**COMMISSION ON HUMAN RIGHTS AND OPPORTUNITIES
CONTRACT COMPLIANCE REGULATIONS
NOTIFICATION TO BIDDERS**

AFFIRMATIVE ACTION COMPLIANCE AFFIDAVIT

The contract to be awarded is subject to contract compliance requirements mandated by Sections 4a-60 and 4a-60a of the Connecticut General Statutes; and, when the awarding agency is the State, Sections 46a-71(d) and 46a-81i(d) of the Connecticut General Statutes. There are Contract Compliance Regulations codified at Section 46a-68j-21 through 43 of the Regulations of Connecticut State Agencies, which establish a procedure for awarding all contracts covered by Sections 4a-60 and 46a-71(d) of the Connecticut General Statutes. According to Section 46a-68j-30(9) of the Contract Compliance Regulations, every agency awarding a contract subject to the contract compliance requirements has an obligation to “aggressively solicit the participation of legitimate minority business enterprises as bidders, contractors, subcontractors and suppliers of materials.” “Minority business enterprise” is defined in Section 4a-60 of the Connecticut General Statutes as a business wherein fifty-one percent or more of the capital stock, or assets belong to a person or persons: “(1) Who are active in daily affairs of the enterprise; (2) who have the power to direct the management and policies of the enterprise; and (3) who are members of a minority, as such term is defined in subsection (a) of Section 32-9n.” “Minority” groups are defined in Section 32-9n of the Connecticut General Statutes as “(1) Black Americans . . . (2) Hispanic Americans . . . (3) persons who have origins in the Iberian Peninsula . . . (4) Women . . . (5) Asian Pacific Americans and Pacific Islanders; (6) American Indians . . .” An individual with a disability is also a minority business enterprise as provided by Section 4a-60g of the Connecticut General Statutes. The above definitions apply to the contract compliance requirements by virtue of Section 46a-68j-21(11) of the Contract Compliance Regulations.

The awarding agency will consider the following factors when reviewing the bidder’s qualifications under the contract compliance requirements:

- (a) the bidder’s success in implementing an affirmative action plan;
- (b) the bidder’s success in developing an apprenticeship program complying with Sections 46a-68-1 to 46a-68-17 of the Administrative Regulations of Connecticut State Agencies, inclusive;
- (c) the bidder’s promise to develop and implement a successful affirmative action plan;
- (d) the bidder’s submission of employment statistics contained in the “Employment Information Form”, indicating that the composition of its workforce is at or near parity when compared to the racial and sexual composition of the workforce in the relevant labor market area; and
- (e) the bidder’s promise to set aside a portion of the contract for legitimate minority business enterprises. See Section 46a-68j-30(10)(E) of the Contract Compliance Regulations.

Boiler Replacement at Eastern Middle School

***INSTRUCTIONS:** Bidders must sign acknowledgement below and return acknowledgement to Awarding Agency along with bid proposal.

The undersigned acknowledges receiving and reading a copy of the “Notification to Bidders” form.

Signature

Date

On behalf of:

CONSENT OF SURETY

The Undersigned surety, being the surety which issued bonds No. _____ for the Town of Greenwich Contract No. _____ hereby consents to release of final payment and all retainages to the contractor-principal.

(Name of Surety)

By _____
Its

ACKNOWLEDGMENT

STATE OF

ss:

COUNTY OF

This is to certify the above signatory who executed this instrument was either known to me or satisfactorily proven to me to be the person whom he purports to be.

Notary Public

AFFIDAVIT FOR FINAL PAYMENT

The undersigned, being duly sworn, deposes and says:

1. That he is the _____ of the contractor in
(Title)
the project hereinafter referred to and is authorized to execute this affidavit on behalf of the contractor;

2. In connection with Contract # _____ for _____
(Project Title)

it is represented that all payrolls, bills for services, materials, supplies, equipment, and other indebtedness have been paid or otherwise satisfied and that there are no outstanding claims against the undersigned by any sub-contractor or material supplier, or no outstanding claims or intent to file a claim against the Town of Greenwich.

This Affidavit is made at the request of the Town of Greenwich for the purpose of inducing final payment and knowing that it will rely upon the truth of the representation herein made.

(Authorized signature)

(Type or print name of authorized person)

Subscribed and sworn to before me, a Notary

Public, in and for the County of _____

and State of _____, this _____ day

of _____, 2025

Notary Public

<u>LIST OF DRAWINGS</u>	
SECTION / DRAWING NO.	DESCRIPTION
T-001	PROJECT COVER SHEET
M-001	MECHANICAL DESCRIPTION, SYMBOLS, LEGEND AND NOTES
MD-100	MECHANICAL DEMO PLAN
M-100	MECHANICAL PLANS
M-200	MECHANICAL PIPING & CONTROLS DIAGRAM
M-300	MECHANICAL SCHEDULES
M-400	MECHANICAL DETAILS
P-001	PLUMBING DESCRIPTION, SYMBOLS, LEGEND AND NOTES
PD-100	PLUMBING DEMO PLAN
P-100	PLUMBING PLANS
E-001	ELECTRICAL LEGEND, NOTES, & ABBREVIATIONS
ER-100	ELECTRICAL BOILER ROOM REMOVALS PLAN
E-100	ELECTRICAL BOILER ROOM POWER PLAN
E-110	ELECTRICAL BOILER ROOM LIGHTING PLAN (ALT #E1)
E-200	ELECTRICAL PANEL SCHEDULES
E-201	ELECTRICAL DIAGRAMS, SCHEDULES, & MATRIX OF OPERATIONS

Form AU-764
Deposit by a Person Doing Business
With a Nonresident Contractor



Purpose: A person doing business with a nonresident contractor uses **Form AU-764** to deposit 5% of the total contract price with the Department of Revenue Services (DRS) for a specific project in the state. The deposit ensures all taxes due to the State of Connecticut from the contractor are paid to DRS. Read the instructions on the reverse side before you complete this form. If you need help, call **860-541-3280**, Monday through Friday, 8:00 a.m. to 5:00 p.m., and choose Option 7.

Part I: Nonresident Contractor Information			
Name		Connecticut Tax Registration No.	
Address (Street or PO Box, City, State, and ZIP Code)			
Part II: Person Doing Business With a Nonresident Contractor Information			
Name		Connecticut Tax Registration No., Federal ID No., or SSN	
Address (Street or PO Box, City, State, and ZIP Code)			
Part III: Project Information			
Physical Location of Project (Street, City or Town)		Name of Project	
Commencement Date	Completion Date for Nonresident Contractor	Total Contract Price or Amount of Change Order ☐ Check the box if this deposit is for a change order	Amount of Deposit
Conditions of the deposit for the project detailed above: • The nonresident contractor has entered into a contract related to real property at a Connecticut location. • The person doing business with the nonresident contractor is depositing 5% of the total contract price with DRS to ensure all taxes that become due and owing during the period of the contract will be paid. • The deposit is made within 30 days of the completion of the project. • The deposit will be returned to the nonresident contractor upon written request by the contractor after DRS has examined its records and determined all taxes, interest, and penalties due during the term of the contract have been paid. • The person doing business with the nonresident contractor must attach a copy of the final periodic billing to Form AU-764.			
Declaration: I, an authorized agent of the person doing business with a nonresident contractor named above, declare under the penalty of law that I have examined Form AU-764 and, to the best of my knowledge and belief it is true, complete, and correct. I understand the penalty for willfully delivering a false document or return to DRS is a fine of not more than \$5,000, or imprisonment for not more than five years, or both.			
Print Name		Title	
Authorized Signature		Date	
Receipt of Deposit: DRS acknowledges receipt of \$ _____ from the person named above as doing business with a nonresident contractor related to real property at the Connecticut location noted above.			
Signature of Authorized DRS Representative		Telephone	Date

General Instructions

A person doing business with a nonresident contractor working in Connecticut must submit **Form AU-764, *Deposit by a Person Doing Business With a Nonresident Contractor***, with a deposit of 5% of the total contract price, including change orders and add-ons, not later than 30 days after the completion of the contract. This applies to all contracts with nonresident contractors, regardless of the nature of the real property affected or the tax-exempt status of the property owner. For more information, see **Special Notice 2003(20), *Legislation Affecting Contracts With Nonresident Contractors***.

A *nonresident contractor* is a contractor who does not maintain a regular place of business in this state. A *regular place of business* means any bona fide office, factory, warehouse, or other space in Connecticut at which a contractor is doing business in its own name in a regular and systematic manner, and which place is continuously maintained, occupied, and used by the contractor in carrying on its business through its employees regularly in attendance to carry on the contractor's business in the contractor's own name. A regular place of business does not include a place of business for a statutory agent for service of process or a temporary office whether or not it is located at the site of construction. A regular place of business also does not include locations used by the contractor only for the duration of the contract, such as short-term leased offices, warehouses, storage facilities, or facilities that do not have full time staff with regular business hours. An office maintained, occupied and used by a person affiliated with a contractor is not a regular place of business of the contractor.

Specific Instructions

Part I: Enter the name and complete address of the nonresident contractor on whose behalf the deposit is being made. Include the nonresident contractor's Connecticut tax registration number.

Part II: Enter the name and complete address of the person doing business with the nonresident contractor. If the nonresident contractor is the general contractor, enter the name and address of the owner of the property. If the nonresident contractor is a subcontractor, enter the name and address of the general contractor.

Enter the Connecticut tax registration number of the person doing business with the nonresident contractor. If the person doing business with the nonresident contractor does not have a Connecticut tax registration number, enter that person's Federal Employer Identification Number or Social Security Number.

Part III: Enter the name of the project and the complete address, including the street address and the city or town where the project is physically located.

Enter the commencement date of this project. The commencement date is the date the contract is signed or the date the nonresident contractor begins work on the project, but it is never later than the date the nonresident contractor begins work.

Enter the date on which work on this project was completed, which is the date the final periodic billing for the contract was made by the nonresident contractor. Note the final periodic billing may be due before payment of any retainage becomes due. The person making the deposit must attach a copy of the final periodic billing to **Form AU-764**.

If this is a deposit for a change order occurring after the deposit for the initial contract has been remitted to DRS, enter the additional amount being deposited for the change order and check the box. For a change order made after the final periodic billing for the original contract, the change order is deemed complete when it is billed by the nonresident contractor. Attach a copy of the final billing for the change order.

Enter, in words and figures, the total amount paid to the nonresident contractor under the contract or for the change order. Check the box if the deposit is for a change order.

Multiply the total contract price or the amount of the change order by 5% (.05) and enter the result on this line.

Declaration: An authorized representative of the person doing business with a nonresident contractor must sign and date the declaration. Return **Form AU-764**, with the copy of the final periodic billing, to:

Department of Revenue Services
State of Connecticut
Discovery Unit
25 Sigourney Street
Hartford CT 06106

Receipt: DRS will acknowledge receipt of the deposit by completing the bottom of Form AU-764 and returning a copy of it to the person making the deposit. Unless indicated otherwise, the person doing business with the nonresident contractor will not be liable for any claim of the nonresident contractor for the amount or for any claim of DRS for any taxes arising from the activities of the nonresident contractor on the project for which the bond deposit was made, once DRS has verified that total deposits represent 5% of the total contract price paid to the nonresident contractor for this project, including any change orders, and that the deposit is made within 30 days of completion of the project.

Form REG-1

Business Taxes Registration Application

1. Reason for Filing Form REG-1 Check the applicable box:

DRS use only Connecticut Tax Registration Number

- ☐ Opening a new business including but not limited to:
- a. An existing out-of-state business opening a location in Connecticut;
 - b. Selling at a craft show, flea market, fair, or other venue in Connecticut or selling over the Internet; or
 - c. An existing out-of-state business having employees in Connecticut (including nonresident contractors and loan-out companies).
- ☐ Opening a new location. Enter your Connecticut Tax Registration No: _____
- ☐ Registering for additional taxes. Enter your Connecticut Tax Registration No: _____
- ☐ Reopening a closed business.
Enter Connecticut Tax Registration No. of the closed business: _____
- ☐ Purchasing an ongoing business. The buyer of an existing business may be responsible for tax liabilities of the previous owner. See the Informational Publication on Successor Liability for Sales and Use Taxes, Admissions and Dues Tax, and Connecticut Income Tax Withholding, on the DRS website.
Enter Connecticut Tax Registration No. of the previous owner: _____
- ☐ Forming a business entity under Connecticut law or a non-Connecticut entity required to register with or to obtain a certificate of authority from the Connecticut Secretary of the State before transacting business in Connecticut.
- ☐ Establishing a passive investment company (PIC).
- ☐ Changing organization type. Enter your current Connecticut Tax Registration No: _____
- ☐ Hiring household employees and intend to withhold Connecticut income tax.
- ☐ Other (explain); see *Who Needs to Complete REG-1*. _____

2. Business Information: Type of organization

- ☐ Sole proprietorship ☐ Single member LLC (SMLLC) ☐ Corporation
- ☐ General partnership ☐ Single member LLC taxed as a corporation ☐ S Corporation
- ☐ Limited liability partnership (LLP) ☐ Single member LLC taxed as an S corporation ☐ Qualified subchapter S subsidiary (QSSS)
- ☐ Limited liability company (LLC) taxed as a partnership
- ☐ Limited liability company (LLC) taxed as a corporation
- ☐ Limited partnership (LP) ☐ Limited liability company (LLC) taxed as an S corporation
- ☐ Limited partnership taxed as a corporation ☐ Other (explain): _____

3. Nature of Business Activity

Check the box(es) that best describe your business:

- ☐ Retailer ☐ Wholesaler ☐ Manufacturer ☐ Service provider ☐ Other (explain): _____

4. Major Business Activity

Describe your major business activities: _____

5. Business Name and Address

Organization name: Enter the name of the sole proprietor, partnership, corporation, or LLC.		Federal Employer Identification Number, if applicable
Business trade name		CT Secretary of the State Business ID No., if applicable
Business Location: Enter the physical address of the business. A post office box or rural route number is not acceptable. Home-based businesses and flea market or craft show vendors must enter a home address.		
Address line 1		Address line 2
City	State	ZIP code
Mailing address line 1 (Street or PO Box)		Address line 2
City	State	ZIP code
Business telephone number	Email address	Bank name

6. List All Owners, Partners, Corporate Officers, or LLC Members Attach a separate sheet if needed.

Name (last, first, middle initial)			Title
Home address line 1 (street)		Home address line 2	
City	State	ZIP code	Home telephone number
SSN	Date of birth	Bank name	

Name (last, first, middle initial)			Title
Home address line 1 (street)		Home address line 2	
City	State	ZIP code	Home telephone number
SSN	Date of birth	Bank name	

Name (last, first, middle initial)			Title
Home address line 1 (street)		Home address line 2	
City	State	ZIP code	Home telephone number
SSN	Date of birth	Bank name	

Name (last, first, middle initial)			Title
Home address line 1 (street)		Home address line 2	
City	State	ZIP code	Home telephone number
SSN	Date of birth	Bank name	

7. Income Tax Withholding

Are you an employer that transacts business or maintains an office in Connecticut and intends to pay wages to resident employees or nonresident employees who work in Connecticut?..... ☐ Yes ☐ No

If you have a Connecticut tax registration number for withholding for another location and intend to file withholding for this new location under that number, enter that number here: _____ and skip to Section 8; otherwise continue.

Are you an out-of-state company voluntarily registering to withhold Connecticut income tax for your Connecticut resident employees who work outside of Connecticut?..... ☐ Yes ☐ No

Do you intend to withhold Connecticut income tax from pension plans, annuity plans, retirement distributions, or gambling distributions? ☐ Yes ☐ No

Do you pay nonresident athletes or entertainers for services they render in Connecticut? ☐ Yes ☐ No

Do you only have household employees and wish to withhold Connecticut income tax?..... ☐ Yes ☐ No

Do you only have agricultural employees and wish to withhold Connecticut income tax?..... ☐ Yes ☐ No

If **Yes**, do you file federal Form 943, Employer's Annual Tax Return for Agricultural Employees, and wish to file **Form CT-941, Connecticut Quarterly Reconciliation of Withholding**, annually? ☐ Yes ☐ No

If you answered **Yes** to any of the income tax withholding questions, enter the date you will start withholding Connecticut income tax. m m d d y y

If you use a payroll service, enter the name of the payroll company: _____

8. Sales and Use TaxesDo you sell, or will you be selling, goods in Connecticut (either wholesale or retail)? ☐ Yes ☐ NoDo you rent equipment or other tangible personal property to individuals or businesses in Connecticut? ☐ Yes ☐ NoDo you serve meals or beverages in Connecticut? ☐ Yes ☐ NoDo you provide a taxable service in Connecticut? See the Informational Publication, *Getting Started in Business*, and the *Special Notice on Legislative Changes Affecting the Sales and Use Taxes*, on the DRS website, for a list of taxable services..... ☐ Yes ☐ NoIf you answered **Yes** to any of the sales and use taxes questions, enter the date you will start selling or leasing goods or taxable services. m m d d y y**8a Prepaid Wireless Service E 9-1-1**Do you sell prepaid wireless service in Connecticut?..... ☐ Yes ☐ NoIf you answered **Yes**, enter the date you will start to sell these in Connecticut. m m d d y y**9. Room Occupancy Tax**Do you provide lodging rooms for rent in a hotel, motel, or rooming house in Connecticut for 30 consecutive days or less? ☐ Yes ☐ NoIf you answered **Yes**, enter the date you will start to provide rooms for rent for lodging purposes in Connecticut. m m d d y y**10. Business Entity Tax** Do not complete this section if the entity is liable for the corporation business tax.The **business entity tax** applies to all of the following business types formed under Connecticut law and to those non-Connecticut entities required to register with or obtain a certificate of authority from the Connecticut Secretary of the State before transacting business in the state, whether or not the business has registered or filed a certificate of authority, as the case may be, with the Connecticut Secretary of the State.

- S corporations (Qualified subchapter S subsidiaries (QSSS) are not liable for the business entity tax.);
- Limited liability companies (LLCs or SMLLCs) — any limited liability company that is, for federal income tax purposes, either:
- Treated as a partnership if it has two or more members; or
- Disregarded as an entity separate from its owner if it has a single member;
- Limited liability partnerships (LLPs); and
- Limited partnership (LPs).

Are you a business entity as described above? ☐ Yes ☐ No

Enter state you are organized under: Enter date of organization. m m d d y y

If not organized in Connecticut, enter the earlier of the date you started business in Connecticut or the date you registered with the Connecticut Secretary of the State. m m d d y y

Enter the month your tax year closes:

11. Corporation and Unrelated Business Income Taxes**Corporation Business Tax** Do not complete this section if the entity is liable for the business entity tax.Are you a corporation? ☐ Yes ☐ NoAre you an LLC, SMLLC, or other association taxed as a corporation?..... ☐ Yes ☐ NoIs this corporation exempt from federal income tax? ☐ Yes ☐ NoHave you received a determination from the Internal Revenue Services (IRS) that this corporation is exempt from federal income tax? ☐ Yes ☐ NoIf **Yes**, enclose a copy of your IRS letter of determination.

Enter state you are organized under: Enter date of organization. m m d d y y

If not a Connecticut corporation, enter the earlier of the date you started business in Connecticut or the date you registered with the Connecticut Secretary of the State. m m d d y y

Enter the month the corporate year closes:

Unrelated Business Income TaxAre you a federally exempt organization that has unrelated business income attributable to a trade or business in Connecticut?..... ☐ Yes ☐ NoIf you answered **Yes**, enter the date the unrelated business income tax liability started. m m d d y y**Passive Investment Company (PIC)**Is this corporation a passive investment company as defined in Conn. Gen. Stat. §12-213(a)(27)? ☐ Yes ☐ No

Enter the date the PIC was organized. m m d d y y

Enter Connecticut tax registration number of the PIC's related financial service or insurance company:

12. Business Use Tax

If you are registered for or are registering for sales and use taxes, you do not need to complete this section.

Business use tax is due when a business purchases taxable goods or services including the purchase or lease of assets, consumable goods, and promotional items, for use in Connecticut without paying Connecticut sales tax.

Will you be purchasing taxable goods or services for use in Connecticut without paying Connecticut sales tax? ☐ Yes ☐ No

If you answered **Yes** to the business use tax question, **enter the tax liability start date.** m m d d y y

If you answered **No**, you must complete the *Business Use Tax Declaration* section below.

Business Use Tax Declaration: By registering for any of the taxes listed in this application, you have indicated to the Department of Revenue Services (DRS) that you may have a business use tax liability. Therefore, based on your application, you will be automatically registered for the business use tax unless you complete the following declaration.

I, _____ (name of taxpayer or authorized representative of taxpayer), acknowledge I have read and understand the information concerning the business use tax and declare I will not be liable for business use tax. Please initial here. _____

13. Registration Fee Schedule

Enter the registration fee amount indicated. If you are liable for either sales and use taxes or room occupancy tax, or both, as indicated in Sections 8 or 9, you must pay a \$100 registration fee. Enter the appropriate registration fee(s) from Addendum A if you are registering for the cigarette tax. You must include the total registration fee due with Form REG-1 or your registration application **will not be processed** and will be returned.

Make your check payable to: **Commissioner of Revenue Services**. If you register by mail, send Form REG-1 with your payment to: Department of Revenue Services, PO Box 2937, Hartford CT 06104-2937

Registration Fee

a.	If registering for sales and use taxes or room occupancy tax , enter \$100.*	a.	
b.	If registering for cigarette tax , see Addendum A.	b.	
c.	Total registration fee due: Add Line a and Line b.	c.	

* No fee is required for room occupancy tax if you are registered or are registering for sales and use taxes.

14. All Applicants Must Sign the Following Declaration

I declare under penalty of law that I have examined this application and, to the best of my knowledge and belief, it is true, complete, and correct. I understand the penalty for willfully delivering a false application to DRS is a fine of not more than \$5,000, or imprisonment for not more than five years, or both.

Sign here and keep a copy for your records.	Signature of owner, partner, LLC member, or corporate officer	Date	Telephone number
	Print name of owner, partner, LLC member, or corporate officer	Title	

Instructions for Form REG-1 Business Taxes Registration Application

How to Register

On-line Registration

Save time and register for a Connecticut tax registration number at your convenience when you file **Form REG-1, Business Taxes Registration Application**, on-line at the Department of Revenue Services (DRS) Web site at www.ct.gov/DRS. You will receive your tax registration number in the mail in about six days. If you owe a registration fee, you must pay the fee electronically by entering the account number and routing number for your checking or savings account.

If you are registering for a tax type that requires you attach Addendum B to the REG-1 or if you are registering as a cigarette retailer (included on Addendum A), you may register on-line. If you are registering for another tax type that requires you attach Addendum A, C, D, or E to the REG-1, you must register by mail or in person at any DRS office.

Mail in Registration

Complete Form REG-1 and mail it to DRS at:

Department of Revenue Services
PO Box 2937
Hartford CT 06104-2937

If you owe a registration fee, you must include payment by check or money order with the application. You will receive your Connecticut tax registration number in the mail in 5 to 6 weeks.

Walk-in Registration

You may file Form REG-1 in person at any DRS office. You will be issued a Connecticut tax registration number immediately. Bring a photo identification, such as a driver's license, and a check or money order if you owe a registration fee. (Cash is accepted at the Hartford location only.)

DRS offices are located in:

Bridgeport 10 Middle St. 203-336-7890	Hamden 3074 Whitney Ave. 203-287-8243	Hartford 25 Sigourney St. 860-297-5962
Norwich 2 Cliff St. 860-889-2669	Waterbury 55 West Main St., Suite 100 203-805-6789	

The application must be signed by the individual owner, partner, officer of the corporation, member of the limited liability company, or another who has written authorization to sign in the form of a Power of Attorney. If anyone other than the owner brings the signed application to the office and wants to obtain the registration as owner, he or she must have written authorization from the owner to obtain the registration on his or her behalf.

Purpose of Form REG-1

Use Form REG-1 to obtain a Connecticut tax registration number or to register for additional tax types under your current Connecticut tax registration number.

Use Form REG-1 to register for any of these taxes:

- Business entity tax
- Business use tax
- Corporation business tax (including PIC)
- Income tax withholding
- Room occupancy tax
- Sales and use taxes
- Unrelated business income tax

In addition to Form REG-1, you must complete and attach the appropriate addendum as noted to Form REG-1 to register for any of these taxes. The forms are available on the DRS Web site at www.ct.gov/DRS.

REG-1 Addendum A:

- Cigarette taxes
- Tobacco products tax

REG-1 Addendum B:

- Admissions and dues taxes
- Dry cleaning surcharge
- Motor vehicle rental surcharge
- Tourism surcharge

REG-1 Addendum C:

- Motor fuels tax
- Petroleum products gross earnings tax

REG-1 Addendum D:

- Alcoholic beverages tax

REG-1 Addendum E:

- Community antenna television system companies tax
- Railroad companies tax
- Satellite companies tax
- Solid waste assessment
- Suppliers of natural gas
- Utility companies tax

Registering for Other Tax Types

To register for these taxes, use the form listed:

- Authority to Collect Use Tax REG-7
- International Fuel Tax Agreement (IFTA) CT-IFTA-2
- Motor Carrier Road Tax REG-3MC

For more information on registering with the Department of Revenue Services (DRS), visit DRS Web site at www.ct.gov/DRS or call 1-800-382-6453 (in-state) or 860-297-5962 (toll-free).

Who Needs to Register with the DRS?

Businesses must register with the Connecticut DRS if they:

- Have people working in Connecticut
- Withhold Connecticut income tax
- Operate a business in Connecticut
- Are required to file an annual report with the Connecticut Secretary of the State and are subject to the business entity tax
- Provide taxable services in Connecticut
- Sell, rent, or lease goods in Connecticut (wholesale or retail)
- Furnish space for storage of tangible personal property
- Have a manufacturing facility in Connecticut
- Serve meals or beverages in Connecticut
- Purchase taxable goods or services for use in Connecticut
- Provide lodgings in Connecticut subject to the room occupancy tax
- Carry on a business as a corporation in Connecticut
- Distribute alcoholic beverages in Connecticut
- Distribute motor fuel used to propel motor vehicles on public highways or roads in Connecticut
- Sell petroleum products in Connecticut
- Operate a place of amusement, entertainment, or recreation in Connecticut
- Operate a social, health, athletic, or sporting club in Connecticut
- Sell or distribute cigarettes or tobacco products in Connecticut
- Own, lease, maintain, operate, manage, or control a community antenna television system in Connecticut
- Provide satellite television services to Connecticut
- Operate a railroad in Connecticut on a for-profit basis
- Are a resources recovery facility in Connecticut
- Market natural gas to an end user in Connecticut
- Provide distribution or transmission services for electricity in Connecticut
- Sell electricity as a municipality to customers in Connecticut
- Manufacture, sell, or distribute gas to be used for light, heat, or power in Connecticut
- Operate a dry cleaning establishment in Connecticut

Registration Fees

Sales and use taxes	\$ 50
Room occupancy tax*	\$ 50
Cigarette dealer's license	\$ 25
Cigarette distributor's license	\$ 1,000
Cigarette distributor chain operator	
5 to 14 retail locations	\$ 250
15 to 24 retail locations	\$ 500
25 or more retail locations	\$1,000
Cigarette manufacturer/importer	\$5,000
Distributor of tobacco products	\$100

* No fee is required for room occupancy tax if you are registered or are registering for sales and use taxes.

Electronic Filing Methods

Once you are registered with DRS, you may file certain tax forms by Internet or telephone using the DRS *Fast-File* program. Look for this logo.



Informational Publications

See Informational Publication 2003(28), *Getting Started in Business*, available on the DRS Web site at www.ct.gov/DRS

Connecticut Licensing Requirements

For information on other Connecticut licensing requirements, visit www.ct-cllc.com.

DRS Web Site

Visit the DRS Web site at www.ct.gov/DRS and click on *Businesses*.

Personal assistance is available by telephone or at any DRS office locations, Monday through Friday, during business hours.

CONN-TAX, the DRS telephone information line, is available anytime.

- 1-800-382-9463 (in-state) or
- 860-297-5962 (from anywhere).

TTY, TDD, and Text Telephone users only may transmit inquiry anytime by calling 860-297-4911.

Additional forms and publications are available anytime:

- **Internet:** Visit the DRS Web site at www.ct.gov/DRS
- **DRS TAX-FAX:** Call 860-297-5698 from the handset attached to your fax machine and select from the menu. Only forms (not publications) are available through TAX-FAX; or
- **Telephone:** Call 1-800-382-9463 (in-state) and select Option 2 from a touch-tone telephone, or 860-297-4753 (from anywhere).

Application Instructions

Complete the entire application unless the section instructions indicate otherwise. Answering Yes to any question in Sections 7 through 12 means you may have a Connecticut tax liability for that tax. In each section where you answer Yes to any question, you must indicate the date you first incurred a tax liability in Connecticut for that tax type.

Exceptions:

- Taxpayers with a valid Connecticut tax registration number who wish to register for another tax must complete Sections 1 through 6, Section 14, and the section for the specific tax type(s) for which you wish to register. See the section *Part of Form REG-1* on Page 1 of these instructions to determine if you have to complete an addendum to Form REG-1.
- Household employers who pay wages to and intend to withhold Connecticut income tax for housekeepers, nannies, health aides, caretakers, etc. – complete Sections 1 through 7 and 14 only.

THE FOLLOWING PAGES ARE A SAMPLE COPY OF THE TOWN
OF GREENWICH CONTRACT FOR YOUR REVIEW. YOU MUST
BE ABLE TO SIGN THIS CONTRACT AND MEET THE NECESSARY
INSURANCE AS REQUIRED BY THE TOWN OF GREENWICH IN
ORDER FOR YOUR PROPOSAL TO BE CONSIDERED.

**State of Connecticut
Town of Greenwich
Contract**

Town Department: Greenwich Public Schools
Division:

Contract No. _____

Name and
Address
Of
Contractor

Account Name:

Account Code:
Total Amount
of Contract:

This Agreement made this _____ day of _____, 2025 between Town of Greenwich hereafter called the Town and _____ hereafter called the Contractor.

Witnessed as follows:

1. The contractor agrees to furnish materials and perform services as shown in specifications and contract documents hereto attached and made a part hereof, and consisting of numbered pages from 1 to _____.
2. The Town agrees to pay the price designated for such materials and services upon certification by the proper agent of the Town.
3. This contract shall not be valid until approved by the Town Counsel and countersigned by the Town Comptroller.

TOWN OF GREENWICH

By _____
Its Chief Financial & Administrative Officer

CONTRACTOR

By _____
Its

Approved as to legal sufficiency

Date _____

Assistant Town Counsel

I hereby certify that the estimated amount of this contract does not exceed the unencumbered balances of amounts duly appropriated and against which this contract is chargeable as indicated hereon.

Date _____

Comptroller

AGREEMENT

CONTRACT NO. 7534

THIS AGREEMENT, executed this _____ day of _____ in the year Two Thousand Twenty Five (herein referred to as the "AGREEMENT"), by and between the Town of Greenwich, Connecticut, acting through Greenwich Public Schools hereunto duly authorized, "OWNER" and _____, whose principal office is located at _____, _____ acting herein by its, _____, duly authorized, "CONTRACTOR".

WITNESSETH, that the parties to these presents, each in consideration of the undertaking, promises and agreements on the part of the other herein contained, have undertaken, promised and agreed to do hereby undertake, promise and agree, the Owner for itself, its successors and assigns, and the Contractor for himself and his heirs, executors, administrators, successors and assigns, as follows:

1. **DEFINITIONS:**

Wherever the words hereinafter defined or pronouns used in their stead occur in the Contract Documents, they shall have the following meaning:

The word "Owner" shall mean the Town of Greenwich and shall include its authorized representative.

The word "Contractor" shall mean the person or organization identified as such in this Agreement and shall include his authorized representative.

The words "Contracting Officer or Agency" shall mean that official of the Town which awards the contract, executes the Agreement and is the Owner's authorized representative.

The Information for Bidders, the Contractor's Bid as accepted by the Owner, the Contract Conditions and Specifications and the General, Technical and Materials Specifications, the Drawings, and all addenda and amendments to any of the foregoing, collectively constitute the Contract Documents, and are sometimes herein referred to as the "Contract".

2. **DESCRIPTION OF WORK:**

This project consists of _____ per Bid No. _____ bid and exhibits B and C. All work must be completed by _____. This date may be extended by contract supplement form if a potential change order is required due to unforeseen circumstances, related errors and omissions in bid specifications. Such extensions are limited to a total of one year.

3. PAYMENT:

The Contractor shall be paid on a monthly basis after presentation of vouchers, and subject to acceptance and approval by the Town of Greenwich and by Dan Watson, Director of Facilities.

Such payments will be made by the Town of Greenwich monthly for all services actually rendered, and the acceptance by the Contractor of any such monthly payment shall be a release to the Town of all claims and all liability to the Contractor in connection with the contract, arising during the period for which payment is made. No payment, however, shall operate to release the Contractor or its sureties or insurers from any obligation under the Contract to be entered into or the Performance Bond or any insurance policies issued in connection with said contract.

4. PERFORMANCE MAINTENANCE AND PAYMENT BOND:

The Contractor shall, simultaneously with the signing of the Contract, furnish the Town the executed Performance, Maintenance and Payment Bond of a surety company authorized to do business in the State of Connecticut, and acceptable to the Town, in the sum of the full amount of the Contract obligation in the form provided by the Town. See Exhibit B.

THE ABOVE IS ONLY REQUIRED FOR CONTRACTS EXCEEDING \$100,000.00.

5. GUARANTEE:

The Contractor guarantees that the Work and services to be performed, furnished, used or installed in the construction of the same, shall be free from defects and flaws, and shall be performed and furnished in strict accordance with the Drawings, if any, Specifications, and other Contract Documents, that the strength of all parts of all manufactured equipment shall be adequate and as specified and that the performance test requirements of the Contract shall be fulfilled. This guarantee shall be for a period of one year from and after the date of completion and acceptance of the Work as stated in the final estimate. The Contractor shall repair, correct or replace as required, promptly and without charge, all work, equipment and material, or parts thereof, which fail to meet the above guarantee or which in any way fail to comply with or fail to be in strict accordance with the terms and provisions and requirements of the Contract during such one-year period, and also shall repair, correct, or replace all damage to the Work resulting from such failure.

6. DEFECTIVE WORK:

The inspection of the Work shall not relieve the Contractor of any of his obligations to perform and complete the Work as required by the Contract. Defective work shall be corrected and unsuitable materials, equipment apparatus and other items shall be replaced by the Contractor, notwithstanding that such work, materials, equipment, apparatus and other items may have been previously overlooked or accepted or estimated for payment. If the work or any part thereof shall be found defective at any time before the final acceptance of the work, the Contractor shall forthwith make good such defect in a manner satisfactory to the Town; if any material, equipment, apparatus or other items brought upon

the site for use or incorporation in the work, or selected for the same, is condemned by the Town as unsuitable or not in conformity with the Specifications or any of the other Contract Documents, the Contractor shall forthwith remove such materials, equipment, apparatus and other items from the site of the Work and shall at his own cost and expense make good and replace the same and any material furnished by the Town which shall be damaged or rendered defective by the handling or improper installation by the Contractor, his agents, servants, employees or subcontractors.

7. COMPLIANCE WITH LAWS:

The Contractor shall keep himself fully informed of all existing and future federal, state and local laws, ordinances, rules and regulations affecting those engaged or employed on the work, the materials and equipment used in the work or the conduct of the work, and of all orders, decrees and other requirements of bodies or tribunals having any jurisdiction or authority over the same. If any discrepancy or inconsistency is discovered in the Drawings, if any, Specifications or other Contract Documents in relation to any such law, ordinance, rule, regulation, order, decree or other requirement, the Contractor shall forthwith report the same to the Town in writing. The Contractor shall at all times observe and comply with, and cause all his agents, servants, employees and subcontractors to observe and comply with all such existing and future laws, ordinances, rules, regulations, orders, decrees and other requirements, and he shall protect, indemnify and save harmless the Town, its officers, agents, servants and employees from and against any and all claims, demands, suits proceedings, liabilities, judgments, penalties, losses, damages costs and expenses, including attorneys' fees, arising from or based upon any violation or claimed violation of any such law, ordinance, rule, regulation, order, decree or other requirement, whether committed by the Contractor or any of his agents, servants, employees or subcontractors.

8. INDEMNITY:

The Contractor shall indemnify and save harmless the Town and its officers, agents, servants and employees, from and against any and all claims, demands, suits, proceedings, liabilities, judgments, awards, losses, damages, costs and expenses, including attorneys' fees, on account of bodily injury, sickness, disease or death sustained by any person or persons or injury or damage to or destruction of any property, directly or indirectly arising out of, relating to or in connection with the Work, whether or not due or claimed to be due in whole or in part to the active, passive or concurrent negligence or fault of the Contractor, his officers, agents, servants or employees, any of his subcontractors, the Town any of his respective officers, agents, servants or employees and/or any other person or persons, and whether or not such claims, demands, suits or proceedings are just, unjust, groundless, false or fraudulent; and the Contractor shall and does hereby assume and agrees to pay for the defense of all such claims, demands, suits and proceedings; and provided that the Contractor shall not be required to indemnify the Town, its officers, agents, servants or employees against any such damages occasioned solely by acts or omissions of the Town other than supervisory acts or omissions of the Town in connection with the Work.

INDEMNITY AGAINST SUBCONTRACTORS' CLAIMS:

If any other contractor or any subcontractor of any such other contractor shall suffer or claim to have suffered loss, damage or delay by reason of the acts or omissions of the Contractor or of any of his subcontractors, the Contractor agrees to assume the defense against any such claim and to reimburse such other contractor or subcontractor for such loss or damage. The Contractor agrees to and does hereby indemnify and save harmless the Town from and against any and all claims by such other contractors or subcontractors, alleging such loss, damage or delay and from and against any and all claims, demands, suits, proceedings, liabilities, judgments, awards, losses, damages, costs and expenses including attorneys' fees, arising out of, relating to or resulting from such claims.

9. PATENTS:

The Contractor shall indemnify and save harmless the Town and all persons acting for or on behalf of the Town from all claims and liability of any nature or kind, and all damages, costs and expenses, including attorneys' fees, arising from or occasioned by an infringement or alleged infringement of any patents or patent rights on any invention, process, materials, equipment, article, or apparatus, or any part hereof, furnished and installed by the Contractor, or arising from or occasioned by the use or manufacture thereof, including their use by the Town.

10. CHANGES:

The Town, through its designated Agent, may make changes in the Work and in the Drawings, if any, and Specifications therefore by making alterations therein, additions, thereto or omissions there from. All work resulting from such changes shall be performed and furnished under and pursuant to the terms and conditions of the Contract. If such changes result in an increase or decrease in the Work to be done hereunder, or increase or decrease the quantities thereof, adjustment in compensation shall be made therefore. For eliminated or decreased work the Contractor shall allow the Town a reasonable credit as determined by the Parties. Except in an emergency endangering life or property, no change shall be made unless in pursuance of a written order from the Town authorizing the change, and no claim for additional compensation shall be valid unless the change is so ordered.

The Contractor agrees that he shall neither have nor assert any claim for or be entitled to any additional compensation for damages or for loss of anticipated profits on work that is eliminated.

11. CLAIMS FOR DAMAGES:

If the Contractor makes claim for any damages alleged to have been sustained by breach of contract or otherwise, he shall, within ten (10) days after occurrence of the alleged breach or within ten (10) days after such damages are alleged to have been sustained whichever date is the earlier, file with the Contracting Officer a written, itemized statement of the details of the alleged breach and the details and amount of the alleged damages.

The Contractor agrees that unless such statement is made and filed as so required, his claim for damages shall be deemed waived, invalid and unenforceable, and that he shall not be entitled to any compensation for any such alleged damages. Within ten (10) days after the timely filing of such statement, the Contracting Officer shall file with the appropriate department of the Town, one copy of the statement, and shall file with the Town and the Contractor his determination thereon. The Contractor shall not be entitled to claim any additional compensation for damages by reason of any direction, instruction, determination or decision of the Town or its agents, nor shall any such claims be considered, unless the Contractor shall have complied in all respects with the provisions of this paragraph.

12. ABANDONMENT OF THE WORK OR OTHER DEFAULT:

If the Work shall be abandoned, or any part thereof shall be sublet without previous written consent of the Town, or the Contract or any moneys payable hereunder shall be assigned otherwise than as herein specified, or if at any time the Contracting Officer shall be of the opinion, and shall so certify in writing, that the conditions herein specified as to rate of progress are not being complied with, or that the Work or any part thereof is being unnecessarily or unreasonably delayed, or that the Contractor has violated or is in default under any of the provisions of the Contract, or if the Contractor becomes bankrupt or insolvent or goes or is put into liquidation or dissolution, either voluntarily or involuntarily, or petitions for an arrangement or reorganization under the Bankruptcy Act, or makes a general assignment for the benefit of creditors or otherwise acknowledges insolvency, the happening of any of which shall be and constitute a default under the Contract, the Town may notify the Contractor in writing, with a copy of such notice mailed to the surety, to discontinue all Work or any part thereof; thereupon the Contractor shall discontinue such Work or such part thereof as the Town may designate; and the Town may, upon giving such notice, by Contract or otherwise as it may determine, complete the Work or such part thereof and charge the entire cost and expense of so completing the work. The Town shall be entitled to reimbursement from the Contractor and the Contractor agrees to pay to the Town any losses, damages, costs and expenses, including attorneys' fees, sustained or incurred by the Town by reason of any of the foregoing causes. For the purpose of such completion the Town may for itself or for any Contractors employed by the Town take possession of and use or cause to be used any and all materials, equipment, plant, machinery, appliances, tools, supplies and such other items of every description that may be found or located at the site of the Work.

All costs, expenses, losses, damages, attorneys' fees, and any and all other charges incurred by the Town under this subsection shall be charged against the Contractor and deducted and/or paid by the Town out of any moneys due and payable or to become due or payable under the Contract to the Contractor; in computing the amounts chargeable to the Contractor, the Town shall not be held to a basis of the lowest prices for which the completion of the Work or any part thereof might have been accomplished, but all sums actually paid or obligated therefore to effect its prompt completion shall be charged to and against the account of the Contractor. In case the costs, expenses, losses, damages, attorneys' fees and other charges together with all payments theretofore made to or for the account of the Contractor are less than the sum which would have been payable under the Contract if the Work had been properly performed and completed by the Contractor, the Contractor shall be entitled to receive the difference, and, and in case such costs,

expenses, losses, damages, attorneys' fees and other charges, together with all payments theretofore made to or for the account of the Contractor, shall exceed the said sum, the Contractor shall pay the amount of the excess to the Town.

13. LIENS:

If at any time any notices of lien or other legal process are filed for labor performed or materials or equipment manufactured, furnished, or delivered to or for the Work, the Contractor shall, at its own cost and expense, promptly discharge, remove or otherwise dispose of the same, and until such discharge, removal or disposition, the Town shall have the right to retain from any moneys payable hereunder an amount which, in its sole judgment, it deems necessary to satisfy such liens and pay the costs and expenses, including attorneys' fees, of defending any actions brought to enforce the same, or incurred in connection therewith or by reason thereof.

14. CLAIMS:

If at any time there be any evidence of any claims for which the Contractor is or may be liable or responsible hereunder, the Contractor shall promptly settle or otherwise dispose of the same, and until such claims are settled or disposed of, the Town may retain from any moneys which would otherwise be payable hereunder so much thereof as, in its sole judgment, it may deem necessary to settle or otherwise dispose of such claims and to pay the costs and expenses, including attorneys' fees, of defending any actions brought to enforce such claims or incurred in connection therewith or by reason thereof.

15. LIABILITY OF TOWN:

No person, firm or corporation, other than the Contractor, who signed this Contract as such, shall have any interest herein or rights hereunder. No claim shall be made or be valid either against the Town or any agent of the Town and neither the Town nor any agent of the Town shall be liable for or be held to pay any money, except as herein provided. The acceptance by the Contractor of the payment as fixed in the final estimate shall operate as and shall be a full and complete release of the Town and of every agent of the Town of and from any and all claims, demands, damages and liabilities of, by or to the Contractor for anything done or furnished for or arising out of or relating to or by reason of the Work or for or on account of any act or neglect of the Town or of any agent of the Town or of any other person, arising out of, relating to or by reason of the Work, except the claim against the Town for the unpaid balance, if any there be, of the amounts retained as herein provided.

16. PROVISIONS REQUIRED BY LAW DEEMED INSERTED:

Each and every provision of law and clause required by law to be inserted in the Contract shall be deemed to be inserted herein, and the Contract shall be read and enforced as though they were included herein. If through mistake or otherwise any such provision is not inserted, or is not correctly inserted, then upon the application of either party, the Contract shall forthwith be physically amended to make such insertion.

17. PERMITS:

The Contractor shall, at his own expense, take out and maintain all necessary permits from the State, Town, or other public authorities; shall give all notices required by law; and shall post all bonds and pay all fees and charges incident to the due and lawful prosecution of the Work.

18. NOT TO SUBLET OR ASSIGN:

The Contractor shall constantly give his personal attention to the faithful prosecution of the Work, shall keep the same under his personal control, shall not assign the Contract or sublet the Work or any part thereof without the previous written consent of the Town, and shall not assign any of the moneys payable under the Contract, or his claim thereto, unless by and with the like written consent of the Town and the surety on the Contract Bonds. Any assignment or subletting in violation hereof shall be void and unenforceable.

19. EMPLOY COMPETENT PEOPLE:

The Contractor shall employ only competent people on the Work and shall not employ people or means which may cause strikes, work stoppages and/or disturbances by workmen employed by the Contractor, any subcontractor, the Town, the Contracting Officer or any other contractor. Whenever the Contracting Officer notifies the Contractor in writing that in his opinion any person on the Work is incompetent, unfaithful, disorderly, or otherwise unsatisfactory or not employed in accordance with the provisions of the Contract, such person shall be discharged from the Work and shall not again be employed on it, except with the written consent of the Contracting Officer.

20. EMPLOY SUFFICIENT LABOR AND EQUIPMENT:

If in the sole judgment of the Contracting Officer the Contractor is not employing sufficient labor, plant, equipment or other means to complete the Work within the time specified, the Contracting Officer may, after giving written notice, require the Contractor to employ such additional labor, plant, equipment and other means as the Contracting Officer deems necessary to enable the Work to progress properly.

21. INTOXICATING LIQUORS:

The Contractor shall not sell and shall neither permit nor suffer the introduction or use of intoxicating liquors upon or about the Work.

22. ACCESS TO WORK:

The Town, the Contracting Officer, and their officers, agents, servants and employees may at any and all times and for any and all purposes, enter upon the Work and the site thereof and the premises used by the Contractor, and the Contractor shall at all times provide safe and proper facilities therefore.

23. EXAMINATION OF WORK:

The Contracting Officer shall be furnished by the Contractor with every reason able facility for examining and inspecting the Work and for ascertaining that the Work is being performed in accordance with the requirements and intent of the Contract, even to the extent of requiring the uncovering or taking down portions of finished work by the Contractor.

24. EXTRA WORK:

The Contractor shall perform any extra work (work in connection with the Contract but not provided for herein) when and as ordered in writing by the Contracting Officer, at the unit prices stipulated in the Contract for such work or, if none are so stipulated, either (a) at the price agreed upon before such work is commenced and named in the written order for such work, or (b) if the Contracting Officer so elects, for the reasonable cost of such work, as determined by the Contractor and approved by the Contracting Officer, plus a percentage of such cost, as may be agreed upon by Contract and Contracting Officer.

25. CHANGES NOT TO AFFECT BONDS:

It is distinctly agreed and understood that any changes made in the work or the Drawings or Specifications therefore (whether such changes increase or decrease the amount thereof or the time required for its performance) or any changes in the manner or time of payments made by the Town to the Contractor, or any other modifications of the Contract, shall in no way annul, release, diminish or affect the liability of the surety on the Contract Bonds given by the Contractor, it being the intent hereof that notwithstanding such changes the liability of the surety on said bonds continue and remain in full force and effect.

26. PRICES FOR WORK:

The Town shall pay and the Contractor shall receive the prices stipulated in the Bid made a part hereof as full compensation for everything performed and furnished and for all risks and obligations undertaken by the Contractor under and as required by the Contract.

27. MONEYS MAY BE RETAINED:

The Town may at any time retain from any moneys which would otherwise be payable hereunder so much thereof as the Town may deem necessary to complete the Work hereunder and to reimburse it for all costs, expenses, losses, damage and damages chargeable to the Contractor hereunder.

28. USE OR PARTIAL PAYMENT NOT ACCEPTANCE:

It is agreed that this is an entire contract for one whole and complete Work or result and that neither the Town's entrance upon or use of the Work or any part thereof nor any partial payments by the Town shall constitute an acceptance of the Work or any part thereof before its entire completion and final acceptance.

29. NON-CONNECTICUT CONTRACTORS:

Pursuant to Connecticut General Statutes §12-430(7), as amended by Connecticut Public Act #11-61, Section 66, a nonresident contractor shall comply with the State of Connecticut's bonding requirements.

30. PAYMENT TO SUBCONTRACTORS:

As required by Section 49-41a of the Connecticut General Statutes, within thirty days after payment to the Contractor by the Town for work under this Contract, he shall pay any amounts due any subcontractor, whether for labor performed or materials furnished when such labor or materials has been included in a requisition submitted by such Contractor and paid by the Town.

31. INSURANCE:

Insurance coverage required as noted in "Exhibit A" attached.

32. PREVAILING WAGE RATES; CONSTRUCTION SAFETY AND HEALTH COURSE:

Except as noted below, the Contractor shall comply with the current provisions of Section 31-53 of the General Statutes of the State of Connecticut, a part of which is quoted as follows:

"The wages paid on an hourly basis to any person performing the work of any mechanic, laborer or worker on the work herein contracted to be done and the amount of payment or contribution paid or payable on behalf of each such person to any employee or welfare fund, as defined in subsection (h) of section 31-53 of the General Statutes, shall be at a rate equal to the rate customary or prevailing for the same work in the same trade or occupation in the town in which such public works project is being constructed. Any contractor who is not obligated by agreement to make payment or contribution on behalf of such persons to any such employee welfare fund shall pay to each mechanic, laborer or worker as part of such person's wages the amount of payment or contribution for such person's classification on each pay day."

All Contractors and subcontractors shall submit certified weekly payrolls, on forms furnished by the Town, for all contracts meeting the aforementioned monetary limits. The certified payrolls shall be submitted with the Contractor's monthly certificate for payment.

Section 31-55a of the General Statutes of the State of Connecticut provides that the prevailing wage rates applicable to any awarded contract or subcontract are subject to annual adjustments each July 1st for the duration of the project.

Each Contractor that is awarded a contract shall pay the annual adjusted prevailing wage rate that is in effect each July 1st, as posted by the Department of Labor. It is the Contractor's responsibility to obtain the annual adjusted prevailing wage rate increases directly from the Department of Labor's web site. The annual adjustments will be posted on the Departments of Labor web page: www.ctdol.state.ct.us. For those without Internet access, contact the division listed below.

The Contractor shall also furnish proof with the weekly certified payroll for the first week each employee begins work that any person performing the work of a mechanic, laborer or worker has completed a course of at least ten (10) hours in duration in construction safety and health approved by the federal Occupational Safety and Health Administration in accordance with Connecticut General Statutes Section 31-53b and regulations adopted by the State of Connecticut Labor Commissioner.

The provisions of this section (32) shall not apply where the total cost of all work to be performed by all Contractors and subcontractors in connection with new construction of any public works project is less than four hundred thousand dollars (\$400,000) or where the total cost of all work to be performed by all contractors and subcontractors in connection with any remodeling, refinishing, refurbishing, rehabilitation, alteration or repair of any public works project is less than one hundred thousand dollars (\$100,000).

Questions can be directed to the Contract Compliance Unit, Wage and Workplace Standards Division, Connecticut Department of Labor, 200 Folly Brook Blvd., Wethersfield, CT 06109 at 860-263-6790.

33. GOVERNING LAW:

The laws of the State of Connecticut shall govern this Contract and any and all litigation related to this Contract. In the event of litigation related to this Contract, the exclusive forum shall be the State of Connecticut and the exclusive venue for such litigation shall be the Judicial District for Stamford/Norwalk at Stamford.

34. The Contractor is required to perform and submit to Greenwich Public Schools, Employee Background Checks as imposed by Section 2 of Public Act 16-67, which amended Conn. Gen. Stat. 10-222c.

IN WITNESS, WHEREOF, the parties of the AGREEMENT have hereunto set their hand and seals the day first above written.

TOWN OF GREENWICH, CONNECTICUT

BY _____
Benjamin Branyan

Chief Financial & Administrative Officer

Date: _____

THE CONTRACTOR

BY _____

Date: _____

Insurance Requirement Sheet

Insurance Requirements: Before starting and until final completion and acceptance of the work called for in the Contract and expiration of the guarantee period provided for in the Contract, the Contractor and its subcontractors, if any, shall procure and maintain insurance of the types and amounts checked in paragraphs A through F below for all Contract operations.

- ☒ A. General Liability, with minimum coverages for combined bodily injury and property damage liability of \$2,000,000 general aggregate, \$1,000,000 per occurrence including:
- ☒ 1. Commercial General Liability.
 - ☒ 2. Town as additional insured.
 - ☐ 3. Owners and Contractors Protective Liability (separate policy in the name of the Town).
- ☒ B. Comprehensive Automobile Liability, with minimum coverages of \$1,000,000 combined single limit for bodily injury and property damage, including, where applicable, coverage for any vehicle, all owned vehicles, scheduled vehicles, hired vehicles, non-owned vehicles and garage liability.
- ☒ C. Excess Liability, with minimum coverage of \$5,000,000 in umbrella form, or such other form as approved by Town Department Head and Risk Management Director.
- ☒ D. Workers' Compensation and Employer's Liability, with minimum coverages as provided by Connecticut State Statutes.
- ☐ E. Professional Liability (for design and other professionals for Errors and Omissions), with minimum coverage of \$1,000,000. If the policy is on a claims-made basis, coverage shall be continually renewed or extended for three (3) years after work is completed under the Contract.
- ☐ F. Other (Builder's Risk, etc.):_____.
- ☒ G. **CERTIFICATE HOLDER: TOWN OF GREENWICH
And GREENWICH BOARD OF EDUCATION. (Also fill in on ACORD Certificate of Insurance)
290 Greenwich Avenue, Greenwich, CT 06830.**

The **Acord certificate of insurance form** must be executed by your insurance agent/broker and returned to this office. Company name and address must conform on all documents including insurance documentation. It is required that the agent/broker note the individual insurance companies providing coverage, rather than the insurance group, on the Acord form. The Contract number (provided to the awarded Contractor), project name and a brief description must be inserted in the "Description of Operations" field. It must be confirmed on the Acord Form that the Town of Greenwich and The Greenwich Board of Education are endorsed as additional insured by having the appropriate box checked off and stating such in the "Description of Operations" field. **A letter from the awarded vendor's agent/broker certifying that the Town of Greenwich and The Greenwich Board of Education has been endorsed onto the general liability policy as an additional insured is also mandatory.** This letter must follow exactly the format provided by the Purchasing Department. If the insurance coverage required is provided on more than one Acord certificate of insurance, then additional endorsement letters are also required. Contract development will begin upon receipt of complete, correct insurance documentation. The Contractor shall be responsible for maintaining the above insurance coverages in force to secure all of the Contractor's obligations under the Contract with an insurance company or companies with an AM Best Rating of A or better, licensed to write such insurance in Connecticut and acceptable to the Risk Manager, Town of Greenwich. For excess liability only, non-admitted insurers are acceptable, provided they are permitted to do business through Connecticut excess line brokers per listing on the current list of Licensed Insurance Companies, Approved Reinsurers, Surplus Lines Insurers and Risk Retention Groups issued by the State of Connecticut Insurance Department.

(SAMPLE ENDORSEMENT LETTER)

**AGENT/BROKER
(LETTERHEAD)**

(Date)

Eugene H. Watts, Senior Buyer
Purchasing Department
Town of Greenwich/Board of Education
290 Greenwich Avenue – Havemeyer Building
Greenwich, CT 06830

Re: Town of Greenwich/Greenwich Board of Education / **Contract #**
Project Name:

Dear Mr. Watts:

The undersigned hereby certifies as follows:

- (1) I am a duly licensed insurance agent under the laws of the State of **[insert State]** and an authorized representative of all companies affording coverage under the Acord form submitted herewith;
- (2) The Town of Greenwich, Greenwich Board of Education, and Landmark Facilities Group, Inc have been endorsed as an additional insured under the general liability policy no. [insert policy number], issued by **[insert company affording coverage] to [name of insured];**
- (3) The general liability policy referenced in paragraph (2) above meets or exceeds the coverage in Commercial General Liability ISO form CG 00 01 10 01, including contractual liability;
- (4) The policies listed in the Acord form submitted to the Town of Greenwich in connection with the above-referenced contract have been issued to the insured in the amounts stated and for the periods indicated in the Acord form; and
- (5) The Town of Greenwich shall be given thirty (30) days prior written notice of cancellation, lapse or restrictive amendment (except ten days' notice of nonpayment) of the policies listed in the Acord form.

Sincerely,

Authorized Representative for all companies listed in the Acord form

<u>ACORD</u>		CERTIFICATE OF LIABILITY INSURANCE			
PRODUCER		THIS CERTIFICATE IS ISSUED AS A MATTER OF INFORMATION ONLY AND CONFERS NO RIGHTS UPON THE CERTIFICATE HOLDER, THIS CERTIFICATE DOES NOT AMEND, EXTEND OR ALTER THE COVERAGE AFFORDED BY THE POLICIES BELOW.			
		INSUREERS AFFORDING COVERAGE			
INSURED		INSURER A:			
		INSURER B:			
		INSURER C:			
		INSURER D:			
		INSURER E:			
COVERAGES					
THE POLICIES OF INSURANCE LISTED BELOW HAVE BEEN ISSUED TO THE INSURED NAMED ABOVE FOR THE POLICY PERIOD INDICATED, NOTWITHSTANDING ANY REQUIREMENT, TERM OF CONDITION OF ANY CONTRACT OR OTHER DOCUMENT WITH RESPECT TO WHICH THIS CERTIFICATE MAY BE ISSUED OR MAY PERTAIN, THE INSURANCE AFFORDED BY THE POLICIES DESCRIBED HEREIN IS SUBJECT TO ALL THE TERMS, EXCLUSIONS AND CONDITIONS OF SUCH POLICIES. LIMITS SHOWN MAY HAVE BEEN REDUCED BY PAID CLAIMS.					
INS	TYPE OF INSURANCE	POLICY NUMBER	POLICY EFFECTIVE	POLICY EXPIRATION	LIMITS
	GENERAL LIABILITY COMMERCIAL GENERAL LIABILITY ☐ CLAIMS MADE ☒ OCCUR ☐ ☐ GENERAL AGGREGATE LIMIT APPLIES ☐ POLICY ☐ PROJECT ☐ LOC				EACH OCCURENCE FIRE DAMAGE (Any one fire) MED EXP (Any one person) PERSONAL & ADV INJURY GENERAL AGGRREGATE PRODUCTS-COMP/OP AGG
	AUTOMOBILE LIABILITY ☐ ANY AUTO ALL OWNED AUTOS ☐ SCHEDULED AUTOS HIRED AUTOS NON-OWNED AUTOS ☐ ☐				COMBINED SINGLE LIMIT (Ea accident) BODILY INJURY (Per person) BODILY INJURY (Per accident) PROPERTY DAMAGE (Per accident)
	GARAGE LIABILITY ☐ ANY AUTO ☐				AUTO ONLY-FA ACCIDENT OTHER THAN EA ACC AUTO ONLY- AGG
	EXCESS LIABILITY ☐ OCCUR ☐ CLAIMS MADE ☐ DEDUCTIBLE ☐ RETENTION \$				EACH OCCURENCE AGGREGATE
	WORKERS COMPENSATION AND				WC OTH- E1 EACH ACCIDENT E1 DISEASE-FA EMPLOYEE E1 DISEASE - POLICY LIMIT
	Professional Liability				
DESCRIPTION OF OPERATIONS/LOCATIONS/VEHICLES/EXCLUSIONS ADDED BY ENDORSEMENT/SPECIAL PROVISIONS Additional Insured: The Town of Greenwich, Greenwich Board of Education and Landmark Facilities Group, Inc. are named as additional insured for Contract # ____ It is agreed by both parties to Contract No ____ that the Contractors insurance will be primary and non-contributory					
CERTIFICATE HOLDER	☒	ADDITIONAL INSURED; INSURER LETTER: ____		CANCELLATION	
Certificate Holder: Town of Greenwich and Greenwich Board of Education 101 Field Point Road Greenwich, CT 06830				SHOULD ANY OF THE ABOVE DESCRIBED POLICIES BE CANCELLED BEFORE THE EXPIRATION DATE THEREOF, THE ISSUING COMPANY WILL ENDEAVOR TO MAIL 30 DAYS WRITTEN NOTICE TO THE CERTIFICATE HOLDER NAMED TO THE LEFT, BUT FAILURE TO DO SO SHALL IMPOSE NO OBLIGATION OR LIABILITY OF ANY KIND UPON THE INSURER, ITS AGENTS OF REPRESENTATIONS	
				AUTHORIZED REPRESENTATIVE	

SECTION 221116
DOMESTIC WATER PIPING

PART 1 - GENERAL

1.1 SUMMARY

- A. Work Included: Provide Domestic water piping in accordance with the Contract Documents.” The “General Conditions Governing All Contracts” shall apply to all work under the contract. The work of this section shall include, but not be limited to, the following:
- B. Section Includes:
 - 1. Aboveground & below grade domestic water pipes, tubes, fittings, and specialties inside the building.

1.2 PERFORMANCE REQUIREMENTS

- A. Seismic Performance: Domestic water piping and support and installation shall withstand effects of earthquake motions determined according to ASCE/SEI 7.

1.3 SUBMITTALS

- A. Product Data: For the following products:
 - 1. Specialty valves.
 - 2. Transition fittings.
 - 3. Dielectric fittings.
 - 4. Flexible connectors.
 - 5. Escutcheons.
 - 6. Sleeves and sleeve seals.
 - 7. Water penetration systems.
- B. Coordination Drawings: For piping in equipment rooms and other congested areas, drawn to scale, on which the following items are shown and coordinated with each other, using input from Installers of the items involved:
 - 1. Domestic water piping.
- C. Field quality-control reports.

1.4 QUALITY ASSURANCE

- A. Piping materials shall bear label, stamp, or other markings of specified testing agency.

1.5 COORDINATION

- A. Coordinate sizes and locations of concrete bases with actual equipment provided.

PART 2 - PRODUCTS

2.1 PIPING MATERIALS

- A. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, fitting materials, and joining methods for specific services, service locations, and pipe sizes.

2.2 COPPER TUBE AND FITTINGS

A. Hard Copper Tube: ASTM B 88, Type L water tube, drawn temper.

1. Cast-Copper Solder-Joint Fittings: ASME B16.18, pressure fittings.
2. Wrought-Copper Solder-Joint Fittings: ASME B16.22, wrought-copper pressure fittings.
3. Bronze Flanges: ASME B16.24, Class 150, with solder-joint ends.
4. Copper Unions: MSS SP-123, cast-copper-alloy, hexagonal-stock body, with ball-and-socket, metal-to-metal seating surfaces, and solder-joint or threaded ends.
5. Copper Pressure-Seal-Joint Fittings:
 - a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1) Elkhart Products Corporation; Industrial Division.
 - 2) NIBCO INC.
 - 3) Viega; Plumbing and Heating Systems.
 - b. NPS 2 and Smaller: Wrought-copper fitting with EPDM-rubber O-ring seal in each end.
 - c. NPS 2-1/2 to NPS 4: Cast-bronze or wrought-copper fitting with EPDM-rubber O-ring seal in each end.
6. Copper-Tube Extruded-Tee Connections:
 - a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1) T-DRILL Industries Inc.
 - b. Description: Tee formed in copper tube according to ASTM F 2104.

2.3 PIPING JOINING MATERIALS

- A. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.
- B. Brazing Filler Metals: AWS A5.8/A5.8M, BCuP Series, copper-phosphorus alloys for general-duty brazing unless otherwise indicated.

2.4 DIELECTRIC FITTINGS

- A. General Requirements: Assembly of copper alloy and ferrous materials or ferrous material body with separating nonconductive insulating material suitable for system fluid, pressure, and temperature.
- B. Dielectric Unions:
 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following or approved equal:
 - a. Capitol Manufacturing Company.
 - b. Central Plastics Company.
 - c. EPCO Sales, Inc.
 - d. Hart Industries International, Inc.

- e. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
- f. Zurn Plumbing Products Group; Wilkins Water Control Products.

2. Description:

- a. Pressure Rating: 150 psig at 180 deg F.
- b. End Connections: Solder-joint copper alloy and threaded ferrous.

C. Dielectric Flanges:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following or approved equal:

- a. Capitol Manufacturing Company.
- b. Central Plastics Company.
- c. EPCO Sales, Inc.
- d. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Description:

- a. Factory-fabricated, bolted, companion-flange assembly.
- b. Pressure Rating: 175 psig minimum.
- c. End Connections: Solder-joint copper alloy and threaded ferrous; threaded solder-joint copper alloy and threaded ferrous.

D. Dielectric Couplings:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following or approved equal:

- a. Calpico, Inc.
- b. Lochinvar Corporation.

2. Description:

- a. Galvanized-steel coupling.
- b. Pressure Rating: 300 psig at 225 deg F.
- c. End Connections: Female threaded.
- d. Lining: Inert and noncorrosive, thermoplastic.

E. Dielectric Nipples:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following or approved equal:

- a. Perfection Corporation; a subsidiary of American Meter Company.
- b. Precision Plumbing Products, Inc.
- c. Victaulic Company.

2. Description:

- a. Electroplated steel nipple complying with ASTM F 1545.
- b. Pressure Rating: 300 psig at 225 deg F.

- c. End Connections: Male threaded or grooved.
- d. Lining: Inert and noncorrosive, propylene.

2.5 ESCUTCHEONS

- A. General: Manufactured ceiling, floor, and wall escutcheons and floor plates.
- B. One Piece, Cast Brass: Polished, chrome-plated or rough-brass finish with setscrews.
- C. One Piece, Deep Pattern: Deep-drawn, box-shaped brass with chrome-plated finish.
- D. One Piece, Stamped Steel: Chrome-plated finish with setscrew or spring clips.
- E. Split Casting, Cast Brass: Polished, chrome-plated or rough-brass finish with concealed hinge and setscrew.
- F. Split Plate, Stamped Steel: Chrome-plated finish with concealed hinge, setscrew or spring clips.
- G. One-Piece Floor Plates: Cast-iron flange with holes for fasteners.
- H. Split-Casting Floor Plates: Cast brass with concealed hinge.

2.6 SLEEVES

- A. Cast-Iron Wall Pipes: Fabricated of cast iron, and equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop unless otherwise indicated.
- B. Galvanized-Steel-Sheet Sleeves: 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint.
- C. Molded-PE Sleeves: Reusable, PE, tapered-cup shaped, and smooth outer surface with nailing flange for attaching to wooden forms.
- D. Molded-PVC Sleeves: Permanent, with nailing flange for attaching to wooden forms.
- E. PVC-Pipe Sleeves: ASTM D 1785, Schedule 40.
- F. Galvanized-Steel-Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, zinc-coated, with plain ends.
- G. Stack Sleeve Fittings: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring and bolts and nuts for membrane flashing.
 - 1. Underdeck Clamp: Clamping ring with setscrews.

2.7 SLEEVE SEALS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following or approved equal:
 - 1. Advance Products & Systems, Inc.
 - 2. Calpico, Inc.
 - 3. Metraflex, Inc.
 - 4. Pipeline Seal and Insulator, Inc.

- B. Description: Modular sealing element unit, designed for field assembly, used to fill annular space between pipe and sleeve.
 - 1. Sealing Elements: EPDM-rubber interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
 - 2. Pressure Plates: Stainless steel.
 - 3. Connecting Bolts and Nuts: Stainless steel of length required to secure pressure plates to sealing elements.

PART 3 - EXECUTION

3.1 PIPING INSTALLATION

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of domestic water piping. Indicated locations and arrangements are used to size pipe and calculate friction loss, expansion, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.
- B. Install shutoff valve immediately upstream of each dielectric fitting.
- C. Install domestic water piping level and plumb.
- D. Install seismic restraints on piping.
- E. Install piping concealed from view and protected from physical contact by building occupants unless otherwise indicated and except in equipment rooms and service areas.
- F. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- G. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal, and coordinate with other services occupying that space.
- H. Install piping adjacent to equipment and specialties to allow service and maintenance.
- I. Install piping to permit valve servicing.
- J. Install nipples, unions, special fittings, and valves with pressure ratings the same as or higher than system pressure rating used in applications below unless otherwise indicated.
- K. Install piping free of sags and bends.
- L. Install fittings for changes in direction and branch connections.
- M. Install unions in copper tubing at final connection to each piece of equipment, machine, and specialty.

3.2 JOINT CONSTRUCTION

- A. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- B. Remove scale, slag, dirt, and debris from inside and outside of pipes, tubes, and fittings before assembly.
- C. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:

1. Apply appropriate tape or thread compound to external pipe threads.
 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged.
- D. Brazed Joints: Join copper tube and fittings according to CDA's "Copper Tube Handbook," "Braze Joints" Chapter.
- E. Soldered Joints: Apply ASTM B 813, water-flushable flux to end of tube. Join copper tube and fittings according to ASTM B 828 or CDA's "Copper Tube Handbook."
- F. Extruded-Tee Connections: Form tee in copper tube according to ASTM F 2144. Use tool designed for copper tube; drill pilot hole, form collar for outlet, dimple tube to form seating stop, and braze branch tube into collar.
- G. Ductile-Iron-Piping Grooved Joints: Cut groove end of pipe. Assemble coupling with housing, gasket, lubricant, and bolts. Join ductile-iron pipe and grooved-end fittings according to AWWA C606 for ductile-iron-pipe, cut-grooved joints.
- H. Flanged Joints: Select appropriate asbestos-free, nonmetallic gasket material in size, type, and thickness suitable for domestic water service. Join flanges with gasket and bolts according to ASME B31.9.
- I. Dissimilar-Material Piping Joints: Make joints using adapters compatible with materials of both piping systems.

3.3 VALVE INSTALLATION

- A. Install shutoff valve close to water main on each branch and riser serving plumbing fixtures or equipment, on each water supply to equipment, and on each water supply to plumbing fixtures that do not have supply stops. Use ball or gate valves for piping NPS 2 and smaller. Use butterfly or gate valves for piping NPS 2-1/2 and larger.

3.4 TRANSITION FITTING INSTALLATION

- A. Install transition couplings at joints of dissimilar piping.
- B. Transition Fittings in Aboveground Domestic Water Piping NPS 2 and Smaller: Plastic-to-metal transition fittings or unions.

3.5 DIELECTRIC FITTING INSTALLATION

- A. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.
- B. Dielectric Fittings for NPS 2 and Smaller: Use dielectric unions.
- C. Dielectric Fittings for NPS 2-1/2 to NPS 4: Use dielectric flanges.

3.6 HANGER AND SUPPORT INSTALLATION

- A. Hangers and Supports for Plumbing Piping and Equipment.
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.
 - B. Support vertical piping and tubing at base and at each floor.
 - C. Rod diameter may be reduced one size for double-rod hangers, to a minimum of 3/8 inch.
 - D. Install hangers for copper tubing with the following maximum horizontal spacing and minimum rod diameters:
 1. NPS 3/4 and Smaller: 60 inches with 3/8-inch rod.
 2. NPS 1 and NPS 1-1/4: 72 inches with 3/8-inch rod.
 3. NPS 1-1/2 and NPS 2: 96 inches with 3/8-inch rod.
 - E. Install supports for vertical copper tubing every 10 feet.
 - F. Install hangers for steel piping with the following maximum horizontal spacing and minimum rod diameters:
 1. NPS 1-1/4 and Smaller: 84 inches with 3/8-inch rod.
 2. NPS 1-1/2: 108 inches with 3/8-inch rod.
 3. NPS 2: 10 feet with 3/8-inch rod.
 - G. Install supports for vertical steel piping every 15 feet.
 - H. Support piping and tubing not listed in this article according to MSS SP-69 and manufacturer's written instructions.
- 3.7 CONNECTIONS
- A. Drawings indicate general arrangement of piping, fittings, and specialties.
 - B. Install piping adjacent to equipment and machines to allow service and maintenance.
 - C. Connect domestic water piping to water-service piping with shutoff valve; extend and connect to the following:
 1. Equipment: Cold- and hot-water supply piping as indicated, but not smaller than equipment connections. Provide shutoff valve and union for each connection. Use flanges instead of unions for NPS 2-1/2 and larger.
- 3.8 ESCUTCHEON INSTALLATION
- A. Install escutcheons for penetrations of walls, ceilings, and floors.
 - B. Escutcheons for New Piping:
 1. Piping with Fitting or Sleeve Protruding from Wall: One piece, deep pattern.
 2. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One piece, cast brass with polished chrome-plated finish.
 3. Bare Piping at Ceiling Penetrations in Finished Spaces: One piece, cast brass with polished chrome-plated finish.
 4. Bare Piping in Unfinished Service Spaces: One piece, cast brass with rough-brass finish.
 5. Bare Piping in Equipment Rooms: One piece, cast brass.

6. Bare Piping at Floor Penetrations in Equipment Rooms: One-piece floor plate.

3.9 SLEEVE INSTALLATION

- A. General Requirements: Install sleeves for pipes and tubes passing through penetrations in floors, partitions, roofs, and walls.
- B. Sleeves are not required for core-drilled holes.
- C. Permanent sleeves are not required for holes formed by removable PE sleeves.
- D. Cut sleeves to length for mounting flush with both surfaces unless otherwise indicated.
- E. Install sleeves in new partitions, slabs, and walls as they are built.
- F. For interior wall penetrations, seal annular space between sleeve and pipe or pipe insulation using joint sealants appropriate for size, depth, and location of joint. Comply with requirements in Division 7 Section "Joint Sealants" for joint sealants.
- G. Seal space outside of sleeves in concrete slabs and walls with grout.
- H. Install sleeves that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation unless otherwise indicated.
- I. Install sleeve materials according to the following applications:
 - 1. Sleeves for Piping Passing through Concrete Floor Slabs: Steel pipe.
 - 2. Sleeves for Piping Passing through Concrete Floor Slabs of Mechanical Equipment Areas or Other Wet Areas: Steel pipe.
 - a. Extend sleeves 2 inches above finished floor level.
 - b. For pipes penetrating floors with membrane waterproofing, extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified. Secure flashing between clamping flanges. Install section of cast-iron soil pipe to extend sleeve to 2 inches above finished floor level.
 - 3. Sleeves for Piping Passing through Gypsum-Board Partitions:
 - a. PVC pipe sleeves for pipes smaller than NPS 6.
 - b. Galvanized-steel sheet sleeves for pipes NPS 6 and larger.
 - c. Exception: Sleeves are not required for water supply tubes and waste pipes for individual plumbing fixtures if escutcheons will cover openings.
 - 4. Sleeves for Piping Passing through Interior Concrete Walls:
 - a. Steel pipe sleeves for pipes smaller than NPS 6.
- J. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Comply with requirements in Division 7 Section "Penetration Firestopping" for firestop materials and installations.

3.10 SLEEVE SEAL INSTALLATION

- A. Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble sleeve seal components and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

3.11 IDENTIFICATION

- A. Identify system components. Comply with requirements in Division 15 Section "Identification for Plumbing Piping and Equipment" for identification materials and installation.
- B. Label pressure piping with system operating pressure.

3.12 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Piping Inspections:
 - 1. Do not enclose, cover, or put piping into operation until it has been inspected and approved by the City of New York.
 - 2. During installation, notify the City of New York at least one day before inspection must be made. Perform tests specified below in presence of the City of New York:
 - a. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in and before setting fixtures.
 - b. Final Inspection: Arrange final inspection for the City of New York to observe tests specified below and to ensure compliance with requirements.
 - 3. Reinspection: If the City of New York find that piping will not pass tests or inspections, make required corrections and arrange for reinspection.
 - 4. Reports: Prepare inspection reports and have them signed by the City of New York.
- C. Piping Tests:
 - 1. Fill domestic water piping. Check components to determine that they are not air bound and that piping is full of water.
 - 2. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit a separate report for each test, complete with diagram of portion of piping tested.
 - 3. Leave new, altered, extended, or replaced domestic water piping uncovered and unconcealed until it has been tested and approved. Expose work that was covered or concealed before it was tested.
 - 4. Cap and subject piping to static water pressure of 50 psig above operating pressure, without exceeding pressure rating of piping system materials. Isolate test source and allow to stand for four hours. Leaks and loss in test pressure constitute defects that must be repaired.
 - 5. Repair leaks and defects with new materials and retest piping or portion thereof until satisfactory results are obtained.
 - 6. Prepare reports for tests and for corrective action required.
- D. Domestic water piping will be considered defective if it does not pass tests and inspections.
- E. Prepare test and inspection reports.

3.13 ADJUSTING

- A. Perform the following adjustments before operation:
 - 1. Close drain valves, hydrants, and hose bibbs.
 - 2. Open shutoff valves to fully open position.
 - 3. Remove plugs used during testing of piping and for temporary sealing of piping during installation.

4. Remove and clean strainer screens. Close drain valves and replace drain plugs.
5. Check plumbing specialties and verify proper settings, adjustments, and operation.

3.14 PIPING SCHEDULE

- A. Transition and special fittings with pressure ratings at least equal to piping rating may be used in applications below unless otherwise indicated.
- B. Flanges and unions may be used for aboveground piping joints unless otherwise indicated.
- C. Fitting Option: Extruded-tee connections and brazed joints may be used on aboveground copper tubing.
- D. Aboveground domestic water piping, NPS 2 and smaller, shall be one of the following:
 1. Galvanized-steel pipe and nipples; galvanized, gray-iron threaded fittings; and threaded joints.
 2. Hard copper tube, ASTM B 88, Type L; cast- or wrought- copper solder-joint fittings; and soldered joints.
 3. Hard copper tube, ASTM B 88, Type L; copper pressure-seal-joint fittings; and pressure-sealed joints.
 4. Hard copper tube, ASTM B 88, Type L; copper push-on-joint fittings; and push-on joints.

3.15 VALVE SCHEDULE

- A. Drawings indicate valve types to be used. Where specific valve types are not indicated, the following requirements apply:
 1. Shutoff Duty: Use ball or gate valves for piping NPS 2 and smaller.
 2. Drain Duty: Hose-end drain valves.
- B. Use check valves to maintain correct direction of domestic water flow to and from equipment.
- C. Iron grooved-end valves may be used with grooved-end piping.

END OF SECTION 22 11 16

SECTION 230500

BASIC MECHANICAL MATERIALS AND METHODS

PART 1 - GENERAL

1.1 SUMMARY

- A. Work Included: Provide basic mechanical materials and methods in accordance with the Contract Documents. The "General Conditions Governing All Contracts" shall apply to all work under the contract. The work of this section shall include, but not be limited to, the following:
 - 1. HVAC demolition.
 - 2. Equipment installation requirements common to equipment sections.
 - 3. Painting and finishing.
 - 4. Concrete bases.
 - 5. Supports and anchorages.

1.2 DEFINITIONS

- A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct chases, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspaces, and tunnels.
- B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.
- C. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.
- D. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and chases.
- E. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.

PART 2 - EXECUTION

2.1 HVAC DEMOLITION

- A. Disconnect, demolish, and remove HVAC systems, equipment, and components indicated to be removed.
 - 1. Ducts to Be Removed: Remove portion of ducts indicated to be removed and plug remaining ducts with same or compatible ductwork material.
 - 2. Ducts to Be Abandoned in Place: Cap or plug ducts with same or compatible ductwork material.
 - 3. Equipment to Be Removed: Disconnect and cap services and remove equipment.
 - 4. Equipment to Be Removed and Reinstalled: Disconnect and cap services and remove, clean, and store equipment; when appropriate, reinstall, reconnect, and make equipment operational.

5. Equipment to Be Removed and Salvaged: Disconnect and cap services and remove equipment and deliver to owner.

- B. If pipe, insulation, or equipment to remain is damaged in appearance or is unserviceable, remove damaged or unserviceable portions and replace with new products of equal capacity and quality.

2.2 EQUIPMENT INSTALLATION - COMMON REQUIREMENTS

- A. Install equipment to allow maximum possible headroom unless specific mounting heights are not indicated.
- B. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, unless otherwise indicated.
- C. Install HVAC equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting, with minimum interference to other installations. Extend grease fittings to accessible locations.
- D. Install equipment to allow right of way for piping installed at required slope.

2.3 PAINTING

- A. Painting of HVAC systems, equipment, and components is specified in Division 9 Sections "Interior Painting" and "Exterior Painting."
- B. Damage and Touchup: Repair marred and damaged factory-painted finishes with materials and procedures to match original factory finish.

2.4 CONCRETE BASES

- A. Concrete Bases: Anchor equipment to concrete base according to equipment manufacturer's written instructions and according to seismic codes at Project.
 1. Construct concrete bases of dimensions indicated, but not less than 4 inches (100 mm) larger in both directions than supported unit.
 2. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch (450-mm) centers around the full perimeter of the base.
 3. Install epoxy-coated anchor bolts for supported equipment that extend through concrete base, and anchor into structural concrete floor.
 4. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 5. Install anchor bolts to elevations required for proper attachment to supported equipment.
 6. Install anchor bolts according to anchor-bolt manufacturer's written instructions.
 7. Use 3000-psi (20.7-MPa) 28-day compressive-strength concrete and reinforcement as specified in Division 3 Section "Cast-in-Place Concrete."

2.5 ERECTION OF METAL SUPPORTS AND ANCHORAGES

- A. Refer to Division 5 Section "Metal Fabrications" for structural steel.

- B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor HVAC materials and equipment.
- C. Field Welding: Comply with AWS D1.1.

2.6 ERECTION OF WOOD SUPPORTS AND ANCHORAGES

- A. Cut, fit, and place wood grounds, nailers, blocking, and anchorages to support, and anchor HVAC materials and equipment.
- B. Select fastener sizes that will not penetrate members if opposite side will be exposed to view or will receive finish materials. Tighten connections between members. Install fasteners without splitting wood members.
- C. Attach to substrates as required to support applied loads.

END OF SECTION

SECTION 230519 - METERS AND GAGES FOR HVAC PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Liquid-in-glass thermometers.
 - 2. Thermowells.
 - 3. Dial-type pressure gages.
 - 4. Gage attachments.
 - 5. Test plugs.
 - 6. Test-plug kits.
 - 7. Turbine flowmeters.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.

1.4 INFORMATIONAL SUBMITTALS

- A. Product Certificates: For each type of meter and gage, from manufacturer.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For meters and gages to include in operation and maintenance manuals.

PART 2 - PRODUCTS

2.1 LIQUID-IN-GLASS THERMOMETERS

- A. Metal-Case, Industrial-Style, Liquid-in-Glass Thermometers:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Flo Fab Inc.

- b. Miljoco Corporation.
 - c. Palmer Wahl Instrumentation Group.
 - d. Weiss Instruments, Inc.
 - e. Winters Instruments - U.S.
2. Standard: ASME B40.200.
3. Case: Cast aluminum; 9-inch nominal size unless otherwise indicated.
4. Case Form: Adjustable angle unless otherwise indicated.
5. Tube: Glass with magnifying lens and blue or red organic liquid.
6. Tube Background: Nonreflective aluminum with permanently etched scale markings graduated in deg F.
7. Window: Glass or plastic.
8. Stem: Aluminum and of length to suit installation.
 - a. Design for Thermowell Installation: Bare stem.
9. Connector: 1-1/4 inches, with ASME B1.1 screw threads.
10. Accuracy: Plus or minus 1 percent of scale range or one scale division, to a maximum of 1.5 percent of scale range.

2.2 THERMOWELLS

A. Thermowells:

1. Standard: ASME B40.200.
2. Description: Pressure-tight, socket-type fitting made for insertion into piping tee fitting.
3. Material for Use with Copper Tubing: CNR or CUNI.
4. Material for Use with Steel Piping: CRES or CSA.
5. Type: Stepped shank unless straight or tapered shank is indicated.
6. External Threads: NPS 1/2, NPS 3/4, or NPS 1, ASME B1.20.1 pipe threads.
7. Internal Threads: 1/2, 3/4, and 1 inch, with ASME B1.1 screw threads.
8. Bore: Diameter required to match thermometer bulb or stem.
9. Insertion Length: Length required to match thermometer bulb or stem.
10. Lagging Extension: Include on thermowells for insulated piping and tubing.
11. Bushings: For converting size of thermowell's internal screw thread to size of thermometer connection.

B. Heat-Transfer Medium: Mixture of graphite and glycerin.

2.3 PRESSURE GAGES

A. Direct-Mounted, Metal-Case, Dial-Type Pressure Gages:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. AMETEK, Inc.; U.S. Gauge.
 - b. Miljoco Corporation.
 - c. Palmer Wahl Instrumentation Group.

- d. Watts Regulator Co.; a div. of Watts Water Technologies, Inc.
 - e. Weiss Instruments, Inc.
 - f. WIKA Instrument Corporation - USA.
 - g. Winters Instruments - U.S.
2. Standard: ASME B40.100.
 3. Case: Liquid-filled Sealed type(s); cast aluminum or drawn steel; 4-1/2-inch nominal diameter.
 4. Pressure-Element Assembly: Bourdon tube unless otherwise indicated.
 5. Pressure Connection: Brass, with NPS 1/4, ASME B1.20.1 pipe threads and bottom-outlet type unless back-outlet type is indicated.
 6. Movement: Mechanical, with link to pressure element and connection to pointer.
 7. Dial: Nonreflective aluminum with permanently etched scale markings graduated in psi.
 8. Pointer: Dark-colored metal.
 9. Window: Glass or plastic.
 10. Ring: Stainless steel.
 11. Accuracy: Grade A, plus or minus 1 percent of middle half of scale range.

2.4 GAGE ATTACHMENTS

- A. Snubbers: ASME B40.100, brass; with NPS 1/4 or NPS 1/2, ASME B1.20.1 pipe threads and piston or porous-metal-type surge-dampening device. Include extension for use on insulated piping.
- B. Siphons: Loop-shaped section of brass or stainless-steel pipe with NPS 1/4 or NPS 1/2 pipe threads.
- C. Valves: Brass or stainless-steel needle, with NPS 1/4 or NPS 1/2, ASME B1.20.1 pipe threads.

2.5 TEST PLUGS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Flow Design, Inc.
 2. Miljoco Corporation.
 3. National Meter, Inc.
 4. Sisco Manufacturing Company, Inc.
 5. Watts Regulator Co.; a div. of Watts Water Technologies, Inc.
 6. Weiss Instruments, Inc.
- B. Description: Test-station fitting made for insertion into piping tee fitting.
- C. Body: Brass or stainless steel with core inserts and gasketed and threaded cap. Include extended stem on units to be installed in insulated piping.
- D. Thread Size: NPS 1/4 or NPS 1/2, ASME B1.20.1 pipe thread.

- E. Minimum Pressure and Temperature Rating: 500 psig at 200 deg F.
- F. Core Inserts: Chlorosulfonated polyethylene synthetic and EPDM self-sealing rubber.

2.6 TEST-PLUG KITS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Flow Design, Inc.
 - 2. Miljoco Corporation.
 - 3. National Meter, Inc.
 - 4. Sisco Manufacturing Company, Inc.
 - 5. Watts Regulator Co.; a div. of Watts Water Technologies, Inc.
 - 6. Weiss Instruments, Inc.
- B. Furnish one test-plug kit(s) containing two thermometer(s), one pressure gage and adapter, and carrying case. Thermometer sensing elements, pressure gage, and adapter probes shall be of diameter to fit test plugs and of length to project into piping.
- C. Low-Range Thermometer: Small, bimetallic insertion type with 1- to 2-inch- diameter dial and tapered-end sensing element. Dial range shall be at least 25 to 125 deg F.
- D. High-Range Thermometer: Small, bimetallic insertion type with 1- to 2-inch- diameter dial and tapered-end sensing element. Dial range shall be at least 100 to 220 deg F.
- E. Pressure Gage: Small, Bourdon-tube insertion type with 2- to 3-inch- diameter dial and probe. Dial range shall be at least 0 to 160 psig.
- F. Carrying Case: Metal or plastic, with formed instrument padding.

2.7 FLOWMETERS

- A. Turbine Flowmeters:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. ABB; Instrumentation and Analytical.
 - b. EMCO Flow Systems; a division of Spirax Sarco, Inc.
 - c. Liquid Controls; a unit of IDEX Corporation.
 - d. Neptune
 - e. ONICON Incorporated.
 - 2. Description: Flowmeter with sensor and indicator.
 - 3. Flow Range: Sensor and indicator shall cover operating range of equipment or system served.
 - 4. Sensor: Impeller turbine; for inserting into pipe fitting or for installing in piping and measuring flow directly in gallons per minute.

- a. Design: Device or pipe fitting with inline turbine and integral direct-reading scale for water.
 - b. Construction: Bronze or stainless-steel body, with plastic turbine or impeller.
 - c. Minimum Pressure Rating: 150 psig.
5. Indicator: Hand-held meter; either an integral part of sensor or a separate meter.
 6. Accuracy: Plus or minus 1-1/2 percent.
 7. Display: Shows rate of flow, with register to indicate total volume in gallons.
 8. Operating Instructions: Include complete instructions with each flowmeter.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install thermowells with socket extending a minimum of 2 inches into fluid or to center of pipe and in vertical position in piping tees.
- B. Install thermowells of sizes required to match thermometer connectors. Include bushings if required to match sizes.
- C. Install thermowells with extension on insulated piping.
- D. Fill thermowells with heat-transfer medium.
- E. Install direct-mounted thermometers in thermowells and adjust vertical and tilted positions.
- F. Install direct-mounted pressure gages in piping tees with pressure gage located on pipe at the most readable position.
- G. Install valve and snubber in piping for each pressure gage for fluids (except steam).
- H. Install valve and syphon fitting in piping for each pressure gage for steam.
- I. Install test plugs in piping tees.
- J. Install flowmeter elements in accessible positions in piping systems.
- K. Install permanent indicators on walls or brackets in accessible and readable positions.
- L. Install connection fittings in accessible locations for attachment to portable indicators.
- M. Install thermometers in the following locations:
 1. Inlet and outlet of each hydronic coil in duct and air-handling units.
 2. Inlet and outlet of each HW boiler.
- N. Install pressure gages in the following locations:
 1. Suction and discharge of each HW pump.

- 2. Inlet and outlet of each hydronic coil in duct and air-handling units
 - 3. Steam boiler supply header
- O. Install test plugs in the following locations:
 - 1. Inlet and outlet of each hydronic coil in duct and air-handling units
- P. Provide one (1) test plug kit.

3.2 CONNECTIONS

- A. Install meters and gages adjacent to machines and equipment to allow service and maintenance of meters, gages, machines, and equipment.

3.3 ADJUSTING

- A. After installation, calibrate meters according to manufacturer's written instructions.
- B. Adjust faces of meters and gages to proper angle for best visibility.

3.4 THERMOMETER SCHEDULE

- A. Thermometers at inlet and outlet of each hydronic boiler shall be the following:
 - 1. Industrial-style, liquid-in-glass type.
- B. Thermometers at inlet and outlet of each hydronic coil in air-handling units and VAV HW coils shall be the following:
 - 1. Industrial-style, liquid-in-glass type.
- C. Thermometer stems shall be of length to match thermowell insertion length.

3.5 THERMOMETER SCALE-RANGE SCHEDULE

- A. Scale Range for Heating, Hot-Water Piping: 30 to 240 deg F.

3.6 PRESSURE-GAGE SCHEDULE

- A. Pressure gages at suction and discharge of each pump shall be the following:
 - 1. Liquid-filled Sealed, direct-mounted, metal case.
- B. Pressure gages at inlet and outlet of each hydronic coil in duct and air-handling units shall be the following:
 - 1. Liquid-filled Sealed, direct-mounted, metal case.
- C. Pressure gages at steam boiler supply header shall be the following:

1. Liquid-filled Sealed, direct-mounted, metal case.

3.7 PRESSURE-GAGE SCALE-RANGE SCHEDULE

- A. Scale Range for Heating, Hot-Water Piping: 0 to 160 psi.
- B. Scale Range for Steam Piping: 30 in. Hg to 15 psi.

3.8 FLOWMETER SCHEDULE

- A. Meter for water supply to HW boiler: Turbine type.

END OF SECTION 230519

SECTION 230523 - GENERAL-DUTY VALVES FOR HVAC PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:

- 1. Bronze angle valves.
 - 2. Bronze ball valves.
 - 3. Iron ball valves.
 - 4. High-performance butterfly valves.
 - 5. Bronze swing check valves.
 - 6. Iron gate valves.
 - 7. Chainwheels.

- B. Related Sections:

- 1. Section 230553 "Identification for HVAC Piping and Equipment" for valve tags and schedules.

1.3 DEFINITIONS

- A. CWP: Cold working pressure.
- B. EPDM: Ethylene propylene copolymer rubber.
- C. NBR: Acrylonitrile-butadiene, Buna-N, or nitrile rubber.
- D. NRS: Nonrising stem.
- E. OS&Y: Outside screw and yoke.
- F. RS: Rising stem.
- G. SWP: Steam working pressure.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of valve indicated.

1.5 QUALITY ASSURANCE

- A. Source Limitations for Valves: Obtain each type of valve from single source from single manufacturer.
- B. ASME Compliance:
 - 1. ASME B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.
 - 2. ASME B31.1 for power piping valves.
 - 3. ASME B31.9 for building services piping valves.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Prepare valves for shipping as follows:
 - 1. Protect internal parts against rust and corrosion.
 - 2. Protect threads, flange faces, grooves, and weld ends.
 - 3. Set angle, gate, and globe valves closed to prevent rattling.
 - 4. Set ball and plug valves open to minimize exposure of functional surfaces.
 - 5. Set butterfly valves closed or slightly open.
 - 6. Block check valves in either closed or open position.
- B. Use the following precautions during storage:
 - 1. Maintain valve end protection.
 - 2. Store valves indoors and maintain at higher than ambient dew point temperature. If outdoor storage is necessary, store valves off the ground in watertight enclosures.
- C. Use sling to handle large valves; rig sling to avoid damage to exposed parts. Do not use handwheels or stems as lifting or rigging points.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR VALVES

- A. Refer to HVAC valve schedule articles for applications of valves.
- B. Valve Pressure and Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.
- C. Valve Sizes: Same as upstream piping unless otherwise indicated.
- D. Valve Actuator Types:
 - 1. Gear Actuator: For quarter-turn valves NPS 8 and larger.
 - 2. Handwheel: For valves other than quarter-turn types.

3. Handlever: For quarter-turn valves NPS 6 and smaller.
 4. Wrench: For plug valves with square heads. Furnish Owner with 1 wrench for every plug valves, for each size square plug-valve head.
 5. Chainwheel: Device for attachment to valve handwheel, stem, or other actuator; of size and with chain for mounting height, as indicated in the "Valve Installation" Article.
- E. Valves in Insulated Piping: With 2-inch stem extensions and the following features:
1. Gate Valves: With rising stem.
 2. Ball Valves: With extended operating handle of non-thermal-conductive material, and protective sleeve that allows operation of valve without breaking the vapor seal or disturbing insulation.
 3. Butterfly Valves: With extended neck.
- F. Valve-End Connections:
1. Flanged: With flanges according to ASME B16.1 for iron valves.
 2. Threaded: With threads according to ASME B1.20.1.
- G. Valve Bypass and Drain Connections: MSS SP-45.
- 2.2 BRONZE BALL VALVES
- A. Two-Piece, Full-Port, Bronze Ball Valves with Bronze Trim:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. American Valve, Inc.
 - b. Conbraco Industries, Inc.; Apollo Valves.
 - c. Crane Co.; Crane Valve Group; Crane Valves.
 - d. Hammond Valve.
 - e. Lance Valves; a division of Advanced Thermal Systems, Inc.
 - f. Legend Valve.
 - g. Milwaukee Valve Company.
 - h. NIBCO INC.
 - i. Red-White Valve Corporation.
 - j. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
 - k. .
 2. Description:
 - a. Standard: MSS SP-110.
 - b. SWP Rating: 150 psig.
 - c. CWP Rating: 600 psig.
 - d. Body Design: Two piece.
 - e. Body Material: Bronze.
 - f. Ends: Threaded.
 - g. Seats: PTFE or TFE.

- h. Stem: Bronze.
- i. Ball: Chrome-plated brass.
- j. Port: Full.

B. Two-Piece, Full-Port, Bronze Ball Valves with Stainless-Steel Trim:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Conbraco Industries, Inc.; Apollo Valves.
 - b. Crane Co.; Crane Valve Group; Crane Valves.
 - c. Hammond Valve.
 - d. Lance Valves; a division of Advanced Thermal Systems, Inc.
 - e. Milwaukee Valve Company.
 - f. NIBCO INC.
 - g. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
2. Description:
 - a. Standard: MSS SP-110.
 - b. SWP Rating: 150 psig.
 - c. CWP Rating: 600 psig.
 - d. Body Design: Two piece.
 - e. Body Material: Bronze.
 - f. Ends: Threaded.
 - g. Seats: PTFE or TFE.
 - h. Stem: Stainless steel.
 - i. Ball: Stainless steel, vented.
 - j. Port: Full.

2.3 IRON BALL VALVES

A. Class 150, Iron Ball Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. American Valve, Inc.
 - b. Conbraco Industries, Inc.; Apollo Valves.
 - c. Kitz Corporation.
 - d. Sure Flow Equipment Inc.
 - e. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
2. Description:
 - a. Standard: MSS SP-72.
 - b. CWP Rating: 200 psig.
 - c. Body Design: Split body.
 - d. Body Material: ASTM A 126, gray iron.
 - e. Ends: Flanged.

- f. Seats: PTFE or TFE.
- g. Stem: Stainless steel.
- h. Ball: Stainless steel.
- i. Port: Full.

2.4 HIGH-PERFORMANCE BUTTERFLY VALVES

A. Class 150, Single-Flange, High-Performance Butterfly Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Cooper Cameron Valves; a division of Cooper Cameron Corp.
 - b. Crane Co.; Crane Valve Group; Flowseal.
 - c. Hammond Valve.
 - d. Milwaukee Valve Company.
 - e. NIBCO INC.
 - f. Tyco Valves & Controls; a unit of Tyco Flow Control.
 - g. Xomox Corporation.
 - h. Victaulic Corp.
 - i. Quadax.
2. Description:
 - a. Standard: MSS SP-68.
 - b. CWP Rating: 285 psig at 100 deg F.
 - c. Body Design: Lug type; suitable for bidirectional dead-end service at rated pressure without use of downstream flange.
 - d. Body Material: Carbon steel, cast iron, ductile iron, or stainless steel.
 - e. Seat: Reinforced PTFE or metal.
 - f. Stem: Stainless steel; offset from seat plane.
 - g. Disc: Carbon steel.
 - h. Service: Bidirectional.

B. Class 300, Single-Flange, High-Performance Butterfly Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. ABZ Valve and Controls; a division of ABZ Manufacturing, Inc.
 - b. Bray Controls; a division of Bray International.
 - c. Cooper Cameron Valves; a division of Cooper Cameron Corp.
 - d. Crane Co.; Crane Valve Group; Flowseal.
 - e. Crane Co.; Crane Valve Group; Stockham Division.
 - f. DeZurik Water Controls.
 - g. Hammond Valve.
 - h. Jamesbury; a subsidiary of Metso Automation.
 - i. Milwaukee Valve Company.
 - j. NIBCO INC.
 - k. Process Development & Control, Inc.
 - l. Tyco Valves & Controls; a unit of Tyco Flow Control.

- m. Xomox Corporation.
- 2. Description:
 - a. Standard: MSS SP-68.
 - b. CWP Rating: 720 psig at 100 deg F.
 - c. Body Design: Lug type; suitable for bidirectional dead-end service at rated pressure without use of downstream flange.
 - d. Body Material: Carbon steel, cast iron, or ductile iron.
 - e. Seat: Reinforced PTFE or metal.
 - f. Stem: Stainless steel; offset from seat plane.
 - g. Disc: Carbon steel.
 - h. Service: Bidirectional.

2.5 BRONZE SWING CHECK VALVES

A. Class 125, Bronze Swing Check Valves with Bronze Disc:

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. American Valve, Inc.
 - b. Crane Co.; Crane Valve Group; Crane Valves.
 - c. Crane Co.; Crane Valve Group; Jenkins Valves.
 - d. Crane Co.; Crane Valve Group; Stockham Division.
 - e. Hammond Valve.
 - f. Kitz Corporation.
 - g. Milwaukee Valve Company.
 - h. NIBCO INC.
 - i. Powell Valves.
 - j. Red-White Valve Corporation.
 - k. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
 - l. Zy-Tech Global Industries, Inc.
- 2. Description:
 - a. Standard: MSS SP-80, Type 3.
 - b. CWP Rating: 200 psig.
 - c. Body Design: Horizontal flow.
 - d. Body Material: ASTM B 62, bronze.
 - e. Ends: Threaded.
 - f. Disc: Bronze.

B. Class 125, Bronze Swing Check Valves with Nonmetallic Disc:

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Crane Co.; Crane Valve Group; Crane Valves.
 - b. Crane Co.; Crane Valve Group; Jenkins Valves.

- c. Crane Co.; Crane Valve Group; Stockham Division.
- d. Milwaukee Valve Company.
- e. NIBCO INC.
- f. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Description:

- a. Standard: MSS SP-80, Type 4.
- b. CWP Rating: 200 psig.
- c. Body Design: Horizontal flow.
- d. Body Material: ASTM B 62, bronze.
- e. Ends: Threaded.
- f. Disc: PTFE or TFE.

C. Class 150, Bronze Swing Check Valves with Bronze Disc:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. American Valve, Inc.
- b. Crane Co.; Crane Valve Group; Stockham Division.
- c. Kitz Corporation.
- d. Milwaukee Valve Company.
- e. NIBCO INC.

2. Description:

- a. Standard: MSS SP-80, Type 3.
- b. CWP Rating: 300 psig.
- c. Body Design: Horizontal flow.
- d. Body Material: ASTM B 62, bronze.
- e. Ends: Threaded.
- f. Disc: Bronze.

D. Class 150, Bronze Swing Check Valves with Nonmetallic Disc:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. Crane Co.; Crane Valve Group; Crane Valves.
- b. Crane Co.; Crane Valve Group; Jenkins Valves.
- c. Hammond Valve.
- d. Milwaukee Valve Company.
- e. NIBCO INC.
- f. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Description:

- a. Standard: MSS SP-80, Type 4.
- b. CWP Rating: 300 psig.
- c. Body Design: Horizontal flow.

- d. Body Material: ASTM B 62, bronze.
- e. Ends: Threaded.
- f. Disc: PTFE or TFE.

2.6 IRON SWING CHECK VALVES

A. Class 125, Iron Swing Check Valves with Metal Seats:

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Crane Co.; Crane Valve Group; Stockham Division.
 - b. Hammond Valve.
 - c. Legend Valve.
 - d. Milwaukee Valve Company.
 - e. NIBCO INC.
 - f. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
- 2. Description:
 - a. Standard: MSS SP-71, Type I.
 - b. NPS 2-1/2 to NPS 12, CWP Rating: 200 psig.
 - c. NPS 14 to NPS 24, CWP Rating: 150 psig.
 - d. Body Design: Clear or full waterway.
 - e. Body Material: ASTM A 126, gray iron with bolted bonnet.
 - f. Ends: Flanged.
 - g. Trim: Bronze.
 - h. Gasket: Asbestos free.

B. Class 125, Iron Swing Check Valves with Nonmetallic-to-Metal Seats:

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Crane Co.; Crane Valve Group; Crane Valves.
 - b. Crane Co.; Crane Valve Group; Stockham Division.
- 2. Description:
 - a. Standard: MSS SP-71, Type I.
 - b. NPS 2-1/2 to NPS 12, CWP Rating: 200 psig.
 - c. NPS 14 to NPS 24, CWP Rating: 150 psig.
 - d. Body Design: Clear or full waterway.
 - e. Body Material: ASTM A 126, gray iron with bolted bonnet.
 - f. Ends: Flanged.
 - g. Trim: Composition.
 - h. Seat Ring: Bronze.
 - i. Disc Holder: Bronze.
 - j. Disc: PTFE or TFE.
 - k. Gasket: Asbestos free.

C. Class 250, Iron Swing Check Valves with Metal Seats:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Crane Co.; Crane Valve Group; Stockham Division.
 - b. Hammond Valve.
 - c. Milwaukee Valve Company.
 - d. NIBCO INC.
 - e. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
2. Description:
 - a. Standard: MSS SP-71, Type I.
 - b. NPS 2-1/2 to NPS 12, CWP Rating: 500 psig.
 - c. NPS 14 to NPS 24, CWP Rating: 300 psig.
 - d. Body Design: Clear or full waterway.
 - e. Body Material: ASTM A 126, gray iron with bolted bonnet.
 - f. Ends: Flanged.
 - g. Trim: Bronze.
 - h. Gasket: Asbestos free.

2.7 BRONZE GATE VALVES

A. Class 125, NRS Bronze Gate Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. American Valve, Inc.
 - b. Crane Co.; Crane Valve Group; Stockham Division.
 - c. Hammond Valve.
 - d. Milwaukee Valve Company.
 - e. NIBCO INC.
 - f. Powell Valves.
 - g. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
2. Description:
 - a. Standard: MSS SP-80, Type 1.
 - b. CWP Rating: 200 psig.
 - c. Body Material: ASTM B 62, bronze with integral seat and screw-in bonnet.
 - d. Ends: Threaded[**or solder joint**].
 - e. Stem: Bronze.
 - f. Disc: Solid wedge; bronze.
 - g. Packing: Asbestos free.
 - h. Handwheel: Malleable iron.

B. Class 125, RS Bronze Gate Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. American Valve, Inc.
 - b. Crane Co.; Crane Valve Group; Crane Valves.
 - c. Crane Co.; Crane Valve Group; Jenkins Valves.
 - d. Crane Co.; Crane Valve Group; Stockham Division.
 - e. Hammond Valve.
 - f. Kitz Corporation.
 - g. Milwaukee Valve Company.
 - h. NIBCO INC.
 - i. Powell Valves.
 - j. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
 - k. Zy-Tech Global Industries, Inc.
2. Description:
 - a. Standard: MSS SP-80, Type 2.
 - b. CWP Rating: 200 psig.
 - c. Body Material: ASTM B 62, bronze with integral seat and screw-in bonnet.
 - d. Ends: Threaded.
 - e. Stem: Bronze.
 - f. Disc: Solid wedge; bronze.
 - g. Packing: Asbestos free.
 - h. Handwheel: Malleable iron.

C. Class 150, NRS Bronze Gate Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Hammond Valve.
 - b. Kitz Corporation.
 - c. Milwaukee Valve Company.
 - d. NIBCO INC.
 - e. Powell Valves.
 - f. Red-White Valve Corporation.
 - g. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
 - h. .
2. Description:
 - a. Standard: MSS SP-80, Type 1.
 - b. CWP Rating: 300 psig.
 - c. Body Material: ASTM B 62, bronze with integral seat and union-ring bonnet.
 - d. Ends: Threaded.
 - e. Stem: Bronze.
 - f. Disc: Solid wedge; bronze.
 - g. Packing: Asbestos free.
 - h. Handwheel: Malleable iron.

D. Class 150, RS Bronze Gate Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Crane Co.; Crane Valve Group; Crane Valves.
 - b. Crane Co.; Crane Valve Group; Stockham Division.
 - c. Hammond Valve.
 - d. Kitz Corporation.
 - e. Milwaukee Valve Company.
 - f. NIBCO INC.
 - g. Powell Valves.
 - h. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
 - i. Zy-Tech Global Industries, Inc.
2. Description:
 - a. Standard: MSS SP-80, Type 2.
 - b. CWP Rating: 300 psig.
 - c. Body Material: ASTM B 62, bronze with integral seat and union-ring bonnet.
 - d. Ends: Threaded.
 - e. Stem: Bronze.
 - f. Disc: Solid wedge; bronze.
 - g. Packing: Asbestos free.
 - h. Handwheel: Malleable iron.

2.8 IRON GATE VALVES

A. Class 125, NRS, Iron Gate Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Crane Co.; Crane Valve Group; Crane Valves.
 - b. Crane Co.; Crane Valve Group; Jenkins Valves.
 - c. Crane Co.; Crane Valve Group; Stockham Division.
 - d. Flo Fab Inc.
 - e. Hammond Valve.
 - f. Kitz Corporation.
 - g. Legend Valve.
 - h. Milwaukee Valve Company.
 - i. NIBCO INC.
 - j. Powell Valves.
 - k. Red-White Valve Corporation.
 - l. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
 - m. Zy-Tech Global Industries, Inc.
2. Description:

- a. Standard: MSS SP-70, Type I.
- b. NPS 2-1/2 to NPS 12, CWP Rating: 200 psig.
- c. NPS 14 to NPS 24, CWP Rating: 150 psig.
- d. Body Material: ASTM A 126, gray iron with bolted bonnet.
- e. Ends: Flanged.
- f. Trim: Bronze.
- g. Disc: Solid wedge.
- h. Packing and Gasket: Asbestos free.

B. Class 125, OS&Y, Iron Gate Valves:

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Crane Co.; Crane Valve Group; Crane Valves.
 - b. Crane Co.; Crane Valve Group; Jenkins Valves.
 - c. Crane Co.; Crane Valve Group; Stockham Division.
 - d. Flo Fab Inc.
 - e. Hammond Valve.
 - f. Kitz Corporation.
 - g. Legend Valve.
 - h. Milwaukee Valve Company.
 - i. NIBCO INC.
 - j. Powell Valves.
 - k. Red-White Valve Corporation.
 - l. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
 - m. Zy-Tech Global Industries, Inc.
- 2. Description:
 - a. Standard: MSS SP-70, Type I.
 - b. NPS 2-1/2 to NPS 12, CWP Rating: 200 psig.
 - c. NPS 14 to NPS 24, CWP Rating: 150 psig.
 - d. Body Material: ASTM A 126, gray iron with bolted bonnet.
 - e. Ends: Flanged.
 - f. Trim: Bronze.
 - g. Disc: Solid wedge.
 - h. Packing and Gasket: Asbestos free.

C. Class 250, NRS, Iron Gate Valves:

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Crane Co.; Crane Valve Group; Crane Valves.
 - b. Crane Co.; Crane Valve Group; Stockham Division.
 - c. NIBCO INC.
- 2. Description:
 - a. Standard: MSS SP-70, Type I.

- b. NPS 2-1/2 to NPS 12, CWP Rating: 500 psig.
- c. NPS 14 to NPS 24, CWP Rating: 300 psig.
- d. Body Material: ASTM A 126, gray iron with bolted bonnet.
- e. Ends: Flanged.
- f. Trim: Bronze.
- g. Disc: Solid wedge.
- h. Packing and Gasket: Asbestos free.

D. Class 250, OS&Y, Iron Gate Valves:

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Crane Co.; Crane Valve Group; Crane Valves.
 - b. Crane Co.; Crane Valve Group; Stockham Division.
 - c. Hammond Valve.
 - d. Milwaukee Valve Company.
 - e. NIBCO INC.
 - f. Powell Valves.
 - g. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
- 2. Description:
 - a. Standard: MSS SP-70, Type I.
 - b. NPS 2-1/2 to NPS 12, CWP Rating: 500 psig.
 - c. NPS 14 to NPS 24, CWP Rating: 300 psig.
 - d. Body Material: ASTM A 126, gray iron with bolted bonnet.
 - e. Ends: Flanged.
 - f. Trim: Bronze.
 - g. Disc: Solid wedge.
 - h. Packing and Gasket: Asbestos free.

2.9 CHAINWHEELS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Babbitt Steam Specialty Co.
 - 2. Roto Hammer Industries.
 - 3. Trumbull Industries.
- B. Description: Valve actuation assembly with sprocket rim, brackets, and chain.
 - 1. Brackets: Type, number, size, and fasteners required to mount actuator on valve.
 - 2. Attachment: For connection to ball and butterfly valve stems.
 - 3. Sprocket Rim with Chain Guides: Ductile iron, of type and size required for valve.
 - 4. Chain: Hot-dip, galvanized steel, of size required to fit sprocket rim.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine valve interior for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks, used to prevent disc movement during shipping and handling.
- B. Operate valves in positions from fully open to fully closed. Examine guides and seats made accessible by such operations.
- C. Examine threads on valve and mating pipe for form and cleanliness.
- D. Examine mating flange faces for conditions that might cause leakage. Check bolting for proper size, length, and material. Verify that gasket is of proper size, that its material composition is suitable for service, and that it is free from defects and damage.
- E. Do not attempt to repair defective valves; replace with new valves.

3.2 VALVE INSTALLATION

- A. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.
- B. Locate valves for easy access and provide separate support where necessary.
- C. Install valves in horizontal piping with stem at or above center of pipe.
- D. Install valves in position to allow full stem movement.
- E. Install chainwheels on operators for valves NPS 4 and larger and more than 96 inches above floor. Extend chains to 60 inches above finished floor.
- F. Install check valves for proper direction of flow and as follows:
 - 1. Swing Check Valves: In horizontal position with hinge pin level.

3.3 ADJUSTING

- A. Adjust or replace valve packing after piping systems have been tested and put into service but before final adjusting and balancing. Replace valves if persistent leaking occurs.

3.4 GENERAL REQUIREMENTS FOR VALVE APPLICATIONS

- A. If valves with specified SWP classes or CWP ratings are not available, the same types of valves with higher SWP classes or CWP ratings may be substituted.
- B. Select valves, except wafer types, with the following end connections:

1. For Copper Tubing, NPS 2 and Smaller: Threaded ends.
2. For Copper Tubing, NPS 2-1/2 to NPS 4: Flanged ends except where threaded valve-end option is indicated in valve schedules below.
3. For Copper Tubing, NPS 5 and Larger: Flanged ends.
4. For Steel Piping, NPS 2 and Smaller: Threaded ends.
5. For Steel Piping, NPS 2-1/2 to NPS 4: Flanged ends except where threaded valve-end option is indicated in valve schedules below.
6. For Steel Piping, NPS 5 and Larger: Flanged ends.

3.5 HEATING-WATER VALVE SCHEDULE

A. Pipe NPS 2 and Smaller:

1. Bronze Valves: threaded ends.
2. Bronze Angle Valves: Class 150, bronze disc.
3. Ball Valves: Two piece, full port, bronze with bronze trim.
4. Bronze Swing Check Valves: Class 150, bronze disc.

B. Pipe NPS 2-1/2 and Larger:

1. Iron Valves, NPS 2-1/2 to NPS 4: May be provided with threaded ends instead of flanged ends.
2. Iron Ball Valves, NPS 2-1/2 to NPS 10: Class 150.
3. High-Performance Butterfly Valves: Class 150, single flange.
4. Iron Swing Check Valves: Class 250, nonmetallic-to-metal seats.

END OF SECTION 230523

SECTION 230529 - HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:

1. Metal pipe hangers and supports.
2. Trapeze pipe hangers.
3. Metal framing systems.
4. Thermal-hanger shield inserts.
5. Fastener systems.
6. Equipment supports.

- B. Related Sections:

1. Section 055000 "Metal Fabrications" for structural-steel shapes and plates for trapeze hangers for pipe and equipment supports.
2. Section 233113 "Metal Ducts" for duct hangers and supports.

1.3 DEFINITIONS

- A. MSS: Manufacturers Standardization Society of The Valve and Fittings Industry Inc.

1.4 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Design trapeze pipe hangers and equipment supports, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
- B. Structural Performance: Hangers and supports for HVAC piping and equipment shall withstand the effects of gravity loads and stresses within limits and under conditions indicated according to ASCE/SEI 7.
 1. Design supports for multiple pipes, including pipe stands, capable of supporting combined weight of supported systems, system contents, and test water.
 2. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.

1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: Signed and sealed by a qualified professional engineer. Show fabrication and installation details and include calculations for the following; include Product Data for components:
 - 1. Trapeze pipe hangers.
- C. Delegated-Design Submittal: For trapeze hangers indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
 - 1. Detail fabrication and assembly of trapeze hangers.
 - 2. Design Calculations: Calculate requirements for designing trapeze hangers.

1.6 INFORMATIONAL SUBMITTALS

- A. Welding certificates.

1.7 QUALITY ASSURANCE

- A. Structural Steel Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- B. Pipe Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.

PART 2 - PRODUCTS

2.1 METAL PIPE HANGERS AND SUPPORTS

- A. Carbon-Steel Pipe Hangers and Supports:
 - 1. Description: MSS SP-58, Types 1 through 58, factory-fabricated components.
 - 2. Galvanized Metallic Coatings: Pregalvanized or hot dipped.
 - 3. Nonmetallic Coatings: Plastic coating, jacket, or liner.
 - 4. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion to support bearing surface of piping.
 - 5. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel.
- B. Copper Pipe Hangers:
 - 1. Description: MSS SP-58, Types 1 through 58, copper-coated-steel, factory-fabricated components.

2. Hanger Rods: Continuous-thread rod, nuts, and washer made of copper-coated steel.

2.2 TRAPEZE PIPE HANGERS

- A. Description: MSS SP-69, Type 59, shop- or field-fabricated pipe-support assembly made from structural carbon-steel shapes with MSS SP-58 carbon-steel hanger rods, nuts, saddles, and U-bolts.

2.3 METAL FRAMING SYSTEMS

A. MFMA Manufacturer Metal Framing Systems:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Cooper B-Line, Inc.
 - b. Flex-Strut Inc.
 - c. Unistrut Corporation; Tyco International, Ltd.
 - d. Wesanco, Inc.
2. Description: Shop- or field-fabricated pipe-support assembly for supporting multiple parallel pipes.
3. Standard: MFMA-4.
4. Channels: Continuous slotted steel channel with intumed lips.
5. Channel Nuts: Formed or stamped steel nuts or other devices designed to fit into channel slot and, when tightened, prevent slipping along channel.
6. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel.
7. Metallic Coating: Electroplated zinc or Hot-dipped galvanized.

B. Non-MFMA Manufacturer Metal Framing Systems:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Anvil International; a subsidiary of Mueller Water Products Inc.
 - b. Empire Industries, Inc.
 - c. NIBCO INC.
 - d. PHD Manufacturing, Inc.
 - e. PHS Industries, Inc.
2. Description: Shop- or field-fabricated pipe-support assembly made of steel channels, accessories, fittings, and other components for supporting multiple parallel pipes.
3. Standard: Comply with MFMA-4.
4. Channels: Continuous slotted steel channel with intumed lips.
5. Channel Nuts: Formed or stamped steel nuts or other devices designed to fit into channel slot and, when tightened, prevent slipping along channel.
6. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel.

7. Coating: Zinc.

2.4 THERMAL-HANGER SHIELD INSERTS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. ERICO International Corporation.
 2. Pipe Shields, Inc.; a subsidiary of Piping Technology & Products, Inc.
 3. Piping Technology & Products, Inc.
 4. Rilco Manufacturing Co., Inc.
- B. Insulation-Insert Material for Cold Piping: ASTM C 552, Type II cellular glass with 100-psig minimum compressive strength and vapor barrier.
- C. Insulation-Insert Material for Hot Piping: Water-repellent treated, ASTM C 533, Type I calcium silicate with 100-psig minimum compressive strength.
- D. For Trapeze or Clamped Systems: Insert and shield shall cover entire circumference of pipe.
- E. For Clevis or Band Hangers: Insert and shield shall cover lower 180 degrees of pipe.
- F. Insert Length: Extend 2 inches beyond sheet metal shield for piping operating below ambient air temperature.

2.5 FASTENER SYSTEMS

- A. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.
- B. Mechanical-Expansion Anchors: Insert-wedge-type, zinc-coated steel anchors, for use in hardened portland cement concrete; with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

2.6 EQUIPMENT SUPPORTS

- A. Description: Welded, shop- or field-fabricated equipment support made from structural carbon-steel shapes.

2.7 MISCELLANEOUS MATERIALS

- A. Structural Steel: ASTM A 36/A 36M, carbon-steel plates, shapes, and bars; black and galvanized.

- B. Grout: ASTM C 1107, factory-mixed and -packaged, dry, hydraulic-cement, nonshrink and nonmetallic grout; suitable for interior and exterior applications.
 - 1. Properties: Nonstaining, noncorrosive, and nongaseous.
 - 2. Design Mix: 5000-psi, 28-day compressive strength.

PART 3 - EXECUTION

3.1 HANGERS AND SUPPORT INSTALLATION

- A. Metal Pipe-Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Install hangers, supports, clamps, and attachments as required to properly support piping from the building structure.
- B. Metal Trapeze Pipe-Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Arrange for grouping of parallel runs of horizontal piping, and support together on field-fabricated trapeze pipe hangers.
 - 1. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size or install intermediate supports for smaller diameter pipes as specified for individual pipe hangers.
 - 2. Field fabricate from ASTM A 36/A 36M, carbon-steel shapes selected for loads being supported. Weld steel according to AWS D1.1/D1.1M.
- C. Metal Framing System Installation: Arrange for grouping of parallel runs of piping, and support together on field-assembled metal framing systems.
- D. Thermal-Hanger Shield Installation: Install in pipe hanger or shield for insulated piping.
- E. Fastener System Installation:
 - 1. Install powder-actuated fasteners for use in lightweight concrete or concrete slabs less than 4 inches thick in concrete after concrete is placed and completely cured. Use operators that are licensed by powder-actuated tool manufacturer. Install fasteners according to powder-actuated tool manufacturer's operating manual.
 - 2. Install mechanical-expansion anchors in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.
- F. Install hangers and supports complete with necessary attachments, inserts, bolts, rods, nuts, washers, and other accessories.
- G. Equipment Support Installation: Fabricate from welded-structural-steel shapes.
- H. Install hangers and supports to allow controlled thermal and seismic movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.

- I. Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads, including valves, flanges, and strainers, NPS 2-1/2 and larger and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten inserts to forms and install reinforcing bars through openings at top of inserts.
- J. Load Distribution: Install hangers and supports so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.
- K. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and to not exceed maximum pipe deflections allowed by ASME B31.9 for building services piping.
- L. Insulated Piping:
 - 1. Attach clamps and spacers to piping.
 - a. Piping Operating above Ambient Air Temperature: Clamp may project through insulation.
 - b. Piping Operating below Ambient Air Temperature: Use thermal-hanger shield insert with clamp sized to match OD of insert.
 - c. Do not exceed pipe stress limits allowed by ASME B31.9 for building services piping.
 - 2. Install MSS SP-58, Type 39, protection saddles if insulation without vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation.
 - a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.
 - 3. Install MSS SP-58, Type 40, protective shields on cold piping with vapor barrier. Shields shall span an arc of 180 degrees.
 - a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.
 - 4. Shield Dimensions for Pipe: Not less than the following:
 - a. NPS 1/4 to NPS 3-1/2: 12 inches long and 0.048 inch thick.
 - b. NPS 4: 12 inches long and 0.06 inch thick.
 - c. NPS 5 and NPS 6: 18 inches long and 0.06 inch thick.
 - d. NPS 8 to NPS 14: 24 inches long and 0.075 inch thick.
 - e.
 - 5. Pipes NPS 8 and Larger: Include wood or reinforced calcium-silicate-insulation inserts of length at least as long as protective shield.
 - 6. Thermal-Hanger Shields: Install with insulation same thickness as piping insulation.

3.2 EQUIPMENT SUPPORTS

- A. Fabricate structural-steel stands to suspend equipment from structure overhead or to support equipment above floor.
- B. Grouting: Place grout under supports for equipment and make bearing surface smooth.
- C. Provide lateral bracing, to prevent swaying, for equipment supports.

3.3 METAL FABRICATIONS

- A. Cut, drill, and fit miscellaneous metal fabrications for trapeze pipe hangers and equipment supports.
- B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.
- C. Field Welding: Comply with AWS D1.1/D1.1M procedures for shielded, metal arc welding; appearance and quality of welds; and methods used in correcting welding work; and with the following:
 - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 - 2. Obtain fusion without undercut or overlap.
 - 3. Remove welding flux immediately.
 - 4. Finish welds at exposed connections so no roughness shows after finishing and so contours of welded surfaces match adjacent contours.

3.4 ADJUSTING

- A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.
- B. Trim excess length of continuous-thread hanger and support rods to 1-1/2 inches.

3.5 PAINTING

- A. Touchup: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.
 - 1. Apply paint by brush or spray to provide a minimum dry film thickness of 2.0 mils.
- B. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

3.6 HANGER AND SUPPORT SCHEDULE

- A. Specific hanger and support requirements are in Sections specifying piping systems and equipment.
- B. Comply with MSS SP-69 for pipe-hanger selections and applications that are not specified in piping system Sections.
- C. Use hangers and supports with galvanized metallic coatings for piping and equipment that will not have field-applied finish.
- D. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.
- E. Use carbon-steel pipe hangers and supports, metal trapeze pipe hangers and metal framing systems and attachments for general service applications.
- F. Use copper-plated pipe hangers and copper attachments for copper piping and tubing.
- G. Use padded hangers for piping that is subject to scratching.
- H. Use thermal-hanger shield inserts for insulated piping and tubing.
- I. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
 - 1. Adjustable, Steel Clevis Hangers (MSS Type 1): For suspension of noninsulated or insulated, stationary pipes NPS 1/2 to NPS 30.
 - 2. Yoke-Type Pipe Clamps (MSS Type 2): For suspension of up to 1050 deg F, pipes NPS 4 to NPS 24, requiring up to 4 inches of insulation.
 - 3. Carbon- or Alloy-Steel, Double-Bolt Pipe Clamps (MSS Type 3): For suspension of pipes NPS 3/4 to NPS 36, requiring clamp flexibility and up to 4 inches of insulation.
 - 4. Steel Pipe Clamps (MSS Type 4): For suspension of cold and hot pipes NPS 1/2 to NPS 24 if little or no insulation is required.
 - 5. Pipe Hangers (MSS Type 5): For suspension of pipes NPS 1/2 to NPS 4, to allow off-center closure for hanger installation before pipe erection.
 - 6. Adjustable, Swivel Split- or Solid-Ring Hangers (MSS Type 6): For suspension of noninsulated, stationary pipes NPS 3/4 to NPS 8.
 - 7. Adjustable, Steel Band Hangers (MSS Type 7): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.
 - 8. Adjustable Band Hangers (MSS Type 9): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.
 - 9. Adjustable, Swivel-Ring Band Hangers (MSS Type 10): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.
 - 10. Split Pipe Ring with or without Turnbuckle Hangers (MSS Type 11): For suspension of noninsulated, stationary pipes NPS 3/8 to NPS 8.
 - 11. Extension Hinged or Two-Bolt Split Pipe Clamps (MSS Type 12): For suspension of noninsulated, stationary pipes NPS 3/8 to NPS 3.
 - 12. U-Bolts (MSS Type 24): For support of heavy pipes NPS 1/2 to NPS 30.

13. Clips (MSS Type 26): For support of insulated pipes not subject to expansion or contraction.
 14. Pipe Saddle Supports (MSS Type 36): For support of pipes NPS 4 to NPS 36, with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate.
 15. Pipe Stanchion Saddles (MSS Type 37): For support of pipes NPS 4 to NPS 36, with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate, and with U-bolt to retain pipe.
 16. Adjustable Pipe Saddle Supports (MSS Type 38): For stanchion-type support for pipes NPS 2-1/2 to NPS 36 if vertical adjustment is required, with steel-pipe base stanchion support and cast-iron floor flange.
 17. Single-Pipe Rolls (MSS Type 41): For suspension of pipes NPS 1 to NPS 30, from two rods if longitudinal movement caused by expansion and contraction might occur.
 18. Adjustable Roller Hangers (MSS Type 43): For suspension of pipes NPS 2-1/2 to NPS 24, from single rod if horizontal movement caused by expansion and contraction might occur.
 19. Complete Pipe Rolls (MSS Type 44): For support of pipes NPS 2 to NPS 42 if longitudinal movement caused by expansion and contraction might occur but vertical adjustment is not necessary.
 20. Pipe Roll and Plate Units (MSS Type 45): For support of pipes NPS 2 to NPS 24 if small horizontal movement caused by expansion and contraction might occur and vertical adjustment is not necessary.
 21. Adjustable Pipe Roll and Base Units (MSS Type 46): For support of pipes NPS 2 to NPS 30 if vertical and lateral adjustment during installation might be required in addition to expansion and contraction.
- J. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers NPS 3/4 to NPS 24.
 2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers NPS 3/4 to NPS 24 if longer ends are required for riser clamps.
- K. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel Turnbuckles (MSS Type 13): For adjustment up to 6 inches for heavy loads.
 2. Steel Clevises (MSS Type 14): For 120 to 450 deg F piping installations.
 3. Swivel Turnbuckles (MSS Type 15): For use with MSS Type 11, split pipe rings.
 4. Malleable-Iron Sockets (MSS Type 16): For attaching hanger rods to various types of building attachments.
 5. Steel Weldless Eye Nuts (MSS Type 17): For 120 to 450 deg F piping installations.
- L. Building Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel or Malleable Concrete Inserts (MSS Type 18): For upper attachment to suspend pipe hangers from concrete ceiling.

2. Top-Beam C-Clamps (MSS Type 19): For use under roof installations with bar-joist construction, to attach to top flange of structural shape.
 3. Side-Beam or Channel Clamps (MSS Type 20): For attaching to bottom flange of beams, channels, or angles.
 4. Center-Beam Clamps (MSS Type 21): For attaching to center of bottom flange of beams.
 5. Welded Beam Attachments (MSS Type 22): For attaching to bottom of beams if loads are considerable and rod sizes are large.
 6. C-Clamps (MSS Type 23): For structural shapes.
 7. Top-Beam Clamps (MSS Type 25): For top of beams if hanger rod is required tangent to flange edge.
 8. Side-Beam Clamps (MSS Type 27): For bottom of steel I-beams.
 9. Steel-Beam Clamps with Eye Nuts (MSS Type 28): For attaching to bottom of steel I-beams for heavy loads.
 10. Linked-Steel Clamps with Eye Nuts (MSS Type 29): For attaching to bottom of steel I-beams for heavy loads, with link extensions.
 11. Malleable-Beam Clamps with Extension Pieces (MSS Type 30): For attaching to structural steel.
 12. Welded-Steel Brackets: For support of pipes from below or for suspending from above by using clip and rod. Use one of the following for indicated loads:
 - a. Light (MSS Type 31): 750 lb.
 - b. Medium (MSS Type 32): 1500 lb.
 - c. Heavy (MSS Type 33): 3000 lb.
 13. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.
 14. Plate Lugs (MSS Type 57): For attaching to steel beams if flexibility at beam is required.
 15. Horizontal Travelers (MSS Type 58): For supporting piping systems subject to linear horizontal movement where headroom is limited.
- M. Saddles and Shields: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel-Pipe-Covering Protection Saddles (MSS Type 39): To fill interior voids with insulation that matches adjoining insulation.
 2. Protection Shields (MSS Type 40): Of length recommended in writing by manufacturer to prevent crushing insulation.
 3. Thermal-Hanger Shield Inserts: For supporting insulated pipe.
- N. Spring Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Restraint-Control Devices (MSS Type 47): Where indicated to control piping movement.
 2. Spring Cushions (MSS Type 48): For light loads if vertical movement does not exceed 1-1/4 inches.
 3. Spring-Cushion Roll Hangers (MSS Type 49): For equipping Type 41, roll hanger with springs.

4. Spring Sway Braces (MSS Type 50): To retard sway, shock, vibration, or thermal expansion in piping systems.
 5. Variable-Spring Hangers (MSS Type 51): Preset to indicated load and limit variability factor to 25 percent to allow expansion and contraction of piping system from hanger.
 6. Variable-Spring Base Supports (MSS Type 52): Preset to indicated load and limit variability factor to 25 percent to allow expansion and contraction of piping system from base support.
 7. Variable-Spring Trapeze Hangers (MSS Type 53): Preset to indicated load and limit variability factor to 25 percent to allow expansion and contraction of piping system from trapeze support.
 8. Constant Supports: For critical piping stress and if necessary to avoid transfer of stress from one support to another support, critical terminal, or connected equipment. Include auxiliary stops for erection, hydrostatic test, and load-adjustment capability. These supports include the following types:
 - a. Horizontal (MSS Type 54): Mounted horizontally.
 - b. Vertical (MSS Type 55): Mounted vertically.
 - c. Trapeze (MSS Type 56): Two vertical-type supports and one trapeze member.
- O. Comply with MSS SP-69 for trapeze pipe-hanger selections and applications that are not specified in piping system Sections.
- P. Comply with MFMA-103 for metal framing system selections and applications that are not specified in piping system Sections.
- Q. Use powder-actuated fasteners or mechanical-expansion anchors instead of building attachments where required in concrete construction.

END OF SECTION 230529

SECTION 23 0548

VIBRATION CONTROLS FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

- A. Work Included: Provide vibration controls for HVAC piping and equipment in accordance with the Contract Documents. The "General Conditions Governing All Contracts" shall apply to all work under the contract. The work of this section shall include, but not be limited to, the following:
 - 1. Isolation pads.
 - 2. Isolation mounts.
 - 3. Freestanding spring isolators.
 - 4. Elastomeric hangers.
 - 5. Spring hangers.

1.2 SUBMITTALS

- A. Product Data: For the following:
 - 1. Include rated load, rated deflection, and overload capacity for each vibration isolation device.
- B. Shop Drawings: Include the following:
 - 1. Design Calculations: Calculate requirements for selecting vibration isolators and for designing vibration isolation bases.
 - 2. Vibration Isolation Base Details: Detail fabrication, including anchorages and attachments to structure and to supported equipment. Include auxiliary motor slides and rails, base weights, equipment static loads, power transmission, component misalignment, and cantilever loads.
- C. Welding certificates.
- D. Field quality-control test reports.

1.3 QUALITY ASSURANCE

- A. Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

PART 2 - PRODUCTS

- A. Delegated-Design Submittal:
 - 1. For each wind-load protection device, that is required by this Section or is indicated on Drawings, submit the following:

- a. Wind-Load Restraint, and Vibration Isolation Base Selection: Select vibration isolators, wind-load restraints, and vibration isolation bases complying with performance requirements, design criteria, and analysis data.
 - b. Riser Supports: Include riser diagrams and calculations showing anticipated expansion and contraction at each support point, initial and final loads on building structure, spring deflection changes, and seismic loads. Include certification by professional engineer that riser system was examined for excessive stress and that none exists.
 - c. Concrete Anchors and Inserts: Include calculations showing anticipated seismic and wind loads. Include certification that device is approved by an NRTL for seismic reinforcement use.
 - d. Wind-Load Design Calculations: Submit all static and dynamic loading calculations prepared under "Wind-Load Design Calculations" Paragraph in "Performance Requirements" Article.
 - e. Qualified Professional Engineer: All designated-design submittals for seismic- and wind-restraint calculations are to be signed and sealed by qualified professional engineer responsible for their preparation.
2. Wind Restraint Detail Drawing:
- a. Design Analysis: To support selection and arrangement of wind restraints. Include calculations of combined tensile and shear loads.
 - b. Details: Indicate fabrication and arrangement. Detail attachments of restraints to restrained items and to the structure. Show attachment locations, methods, and spacings. Identify components, list their strengths, and indicate directions and values of forces transmitted to the structure during seismic events. Indicate association with vibration isolation devices.
 - c. Coordinate seismic-restraint and vibration isolation details with wind-restraint details required for equipment mounted outdoors. Comply also with requirements in other Sections for equipment mounted outdoors.
3. All delegated-design submittals for wind-restraint detail Drawings are to be signed and sealed by qualified professional engineer responsible for their preparation.
4. Design Calculations for Vibration Isolation Devices: Calculate static and dynamic loading due to equipment weight and operating forces required to select proper vibration isolators, and to design vibration isolation bases.
5. Riser Supports: Include riser diagrams and calculations showing anticipated expansion and contraction at each support point, initial and final loads on building structure, and spring deflection changes. Include certification that riser system was examined for excessive stress and that none exists.

2.2 VIBRATION ISOLATORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Ace Mountings Co., Inc.
 2. Amber/Booth Company, Inc.
 3. Isolation Technology, Inc.
 4. Kinetics Noise Control.
 5. Mason Industries.

6. Vibration Mountings & Controls, Inc.
 - B. Pads: Arranged in single or multiple layers of sufficient stiffness for uniform loading over pad area, molded with a nonslip pattern and galvanized-steel baseplates, and factory cut to sizes that match requirements of supported equipment.
 1. Resilient Material: Oil- and water-resistant neoprene or rubber.
 - C. Mounts: Double-deflection type, with molded, oil-resistant rubber, hermetically sealed compressed fiberglass, or neoprene isolator elements with factory-drilled, encapsulated top plate for bolting to equipment and with baseplate for bolting to structure. Color-code or otherwise identify to indicate capacity range.
 1. Materials: Cast-ductile-iron or welded steel housing containing two separate and opposing, oil-resistant rubber or neoprene elements that prevent central threaded element and attachment hardware from contacting the housing during normal operation.
 2. Neoprene: Shock-absorbing materials compounded according to the standard for bridge-bearing neoprene as defined by AASHTO.
 - D. Spring Isolators: Freestanding, laterally stable, open-spring isolators.
 1. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
 2. Minimum Additional Travel: 50 percent of the required deflection at rated load.
 3. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
 4. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
 5. Baseplates: Factory drilled for bolting to structure and bonded to 1/4-inch- thick, rubber isolator pad attached to baseplate underside. Baseplates shall limit floor load to 500 psig.
 6. Top Plate and Adjustment Bolt: Threaded top plate with adjustment bolt and cap screw to fasten and level equipment.
 - E. Elastomeric Hangers: Single or double-deflection type, fitted with molded, oil-resistant elastomeric isolator elements bonded to steel housings with threaded connections for hanger rods. Color-code or otherwise identify to indicate capacity range.
 - F. Spring Hangers: Combination coil-spring and elastomeric-insert hanger with spring and insert in compression.
 1. Frame: Steel, fabricated for connection to threaded hanger rods and to allow for a maximum of 30 degrees of angular hanger-rod misalignment without binding or reducing isolation efficiency.
 2. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
 3. Minimum Additional Travel: 50 percent of the required deflection at rated load.
 4. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
 5. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
 6. Elastomeric Element: Molded, oil-resistant rubber or neoprene. Steel-washer-reinforced cup to support spring and bushing projecting through bottom of frame.

7. Self-centering hanger rod cap to ensure concentricity between hanger rod and support spring coil.

2.3 FACTORY FINISHES

- A. Finish: Manufacturer's standard paint applied to factory-assembled and -tested equipment before shipping.
 1. Powder coating on springs and housings.
 2. All hardware shall be galvanized. Hot-dip galvanize metal components for exterior use.
 3. Baked enamel or powder coat for metal components on isolators for interior use.
 4. Color-code or otherwise mark vibration isolation devices to indicate capacity range.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and equipment to receive vibration isolation devices for compliance with requirements for installation tolerances and other conditions affecting performance.
- B. Examine roughing-in of reinforcement and cast-in-place anchors to verify actual locations before installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 APPLICATIONS

- A. Strength of Support Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static loads within specified loading limits.

3.3 VIBRATION-CONTROL DEVICE INSTALLATION

- A. Attachment to Structure: If specific attachment is not indicated, anchor bracing to structure at flanges of beams, at upper truss chords of bar joists, or at concrete members.
- B. Drilled-in Anchors:
 1. Identify position of reinforcing steel and other embedded items prior to drilling holes for anchors. Do not damage existing reinforcing or embedded items during coring or drilling. Notify the Commissioner if reinforcing steel or other embedded items are encountered during drilling. Locate and avoid prestressed tendons, electrical and telecommunications conduit, and gas lines.
 2. Do not drill holes in concrete or masonry until concrete, mortar, or grout has achieved full design strength.
 3. Wedge Anchors: Protect threads from damage during anchor installation. Heavy-duty sleeve anchors shall be installed with sleeve fully engaged in the structural element to which anchor is to be fastened.
 4. Adhesive Anchors: Clean holes to remove loose material and drilling dust prior to installation of adhesive. Place adhesive in holes proceeding from the bottom of the hole and progressing toward the surface in such a manner as to avoid introduction of air pockets in the adhesive.
 5. Set anchors to manufacturer's recommended torque, using a torque wrench.

6. Install zinc-coated steel anchors for interior and stainless-steel anchors for exterior applications.

3.4 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Tests and Inspections:
 1. Measure isolator deflection.
 2. If a device fails test, modify all installations of same type and retest until satisfactory results are achieved.
- C. Remove and replace malfunctioning units and retest as specified above.
- D. Prepare test and inspection reports.

3.5 ADJUSTING

- A. Adjust isolators after piping system is at operating weight.
- B. Adjust active height of spring isolators.

END OF SECTION

SECTION 230553 - IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Equipment labels.
 - 2. Warning signs and labels.
 - 3. Pipe labels.
 - 4. Stencils.
 - 5. Valve tags.
 - 6. Warning tags.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Samples: For color, letter style, and graphic representation required for each identification material and device.
- C. Equipment Label Schedule: Include a listing of all equipment to be labeled with the proposed content for each label.
- D. Valve numbering scheme.
- E. Valve Schedules: For each piping system to include in maintenance manuals.

1.4 COORDINATION

- A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.
- B. Coordinate installation of identifying devices with locations of access panels and doors.
- C. Install identifying devices before installing acoustical ceilings and similar concealment.

PART 2 - PRODUCTS

2.1 EQUIPMENT LABELS

A. Plastic Labels for Equipment:

1. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch thick, and having predrilled holes for attachment hardware.
2. Letter Color: White.
3. Background Color: Black.
4. Maximum Temperature: Able to withstand temperatures up to 160 deg F.
5. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
6. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
7. Fasteners: Stainless-steel rivets or self-tapping screws.
8. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

B. Label Content: Include equipment's Drawing designation or unique equipment number, Drawing numbers where equipment is indicated (plans, details, and schedules), plus the Specification Section number and title where equipment is specified.

C. Equipment Label Schedule: For each item of equipment to be labeled, on 8-1/2-by-11-inch bond paper. Tabulate equipment identification number and identify Drawing numbers where equipment is indicated (plans, details, and schedules), plus the Specification Section number and title where equipment is specified. Equipment schedule shall be included in operation and maintenance data.

2.2 WARNING SIGNS AND LABELS

A. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch thick, and having predrilled holes for attachment hardware.

B. Letter Color: White.

C. Background Color: Red.

D. Maximum Temperature: Able to withstand temperatures up to 160 deg F.

E. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.

F. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.

- G. Fasteners: Stainless-steel rivets or self-tapping screws.
- H. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- I. Label Content: Include caution and warning information, plus emergency notification instructions.

2.3 PIPE LABELS

- A. General Requirements for Manufactured Pipe Labels: Preprinted, color-coded, with lettering indicating service, and showing flow direction.
- B. Pretensioned Pipe Labels: Precoiled, semirigid plastic formed to cover full circumference of pipe and to attach to pipe without fasteners or adhesive.
- C. Self-Adhesive Pipe Labels: Printed plastic with contact-type, permanent-adhesive backing.
- D. Pipe Label Contents: Include identification of piping service using same designations or abbreviations as used on Drawings, pipe size, and an arrow indicating flow direction.
 - 1. Flow-Direction Arrows: Integral with piping system service lettering to accommodate both directions, or as separate unit on each pipe label to indicate flow direction.
 - 2. Lettering Size: At least 1-1/2 inches high.

2.4 DUCT LABELS

- A. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/16 inch thick, and having predrilled holes for attachment hardware.
- B. Letter Color: Black
- C. Background Color: White
- D. Maximum Temperature: Able to withstand temperatures up to 160 deg F.
- E. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
- F. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
- G. Fasteners: Stainless-steel rivets or self-tapping screws
- H. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

- I. Duct Label Contents: Include identification of duct service using same designations or abbreviations as used on Drawings, duct size, and an arrow indicating flow direction. Duct service identification shall include air handler or fan that ducts are connected to and whether supply, return, etc.
 1. Flow-Direction Arrows: Integral with duct system service lettering to accommodate both directions, or as separate unit on each duct label to indicate flow direction.
 2. Lettering Size: At least 1-1/2 inches high.

2.5 STENCILS

- A. Stencils: Prepared with letter sizes according to ASME A13.1 for piping; minimum letter height of 1-1/4 inches for ducts; and minimum letter height of 3/4 inch for access panel and door labels, equipment labels, and similar operational instructions.
 1. Stencil Material: Fiberboard or metal.
 2. Stencil Paint: Exterior, gloss, acrylic enamel black unless otherwise indicated. Paint may be in pressurized spray-can form.
 3. Identification Paint: Exterior, acrylic enamel in colors according to ASME A13.1 unless otherwise indicated.

2.6 VALVE TAGS

- A. Valve Tags: Stamped or engraved with 1/4-inch letters for piping system abbreviation and 1/2-inch numbers.
 1. Tag Material: Brass, 0.032-inch minimum thickness, and having predrilled or stamped holes for attachment hardware.
 2. Fasteners: Brass wire-link or beaded chain; or S-hook.
- B. Valve Schedules: For each piping system, on 8-1/2-by-11-inch bond paper. Tabulate valve number, piping system, system abbreviation (as shown on valve tag), location of valve (room or space), normal-operating position (open, closed, or modulating), and variations for identification. Mark valves for emergency shutoff and similar special uses.
 1. Valve-tag schedule shall be included in operation and maintenance data.

2.7 WARNING TAGS

- A. Warning Tags: Preprinted or partially preprinted, accident-prevention tags, of plasticized card stock with matte finish suitable for writing.
 1. Size: Approximately 4 by 7 inches.
 2. Fasteners: Brass grommet and wire.
 3. Nomenclature: Large-size primary caption such as "DANGER," "CAUTION," or "DO NOT OPERATE."
 4. Color: Yellow background with black lettering.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Clean piping and equipment surfaces of substances that could impair bond of identification devices, including dirt, oil, grease, release agents, and incompatible primers, paints, and encapsulants.

3.2 EQUIPMENT LABEL INSTALLATION

- A. Install or permanently fasten labels on each major item of mechanical equipment.
- B. Locate equipment labels where accessible and visible.

3.3 PIPE LABEL INSTALLATION

- A. Stenciled Pipe Label Option: Stenciled labels may be provided instead of manufactured pipe labels, at Installer's option. Install stenciled pipe labels with painted, color-coded bands or rectangles, complying with ASME A13.1, on each piping system.

- 1. Identification Paint: Use for contrasting background.
- 2. Stencil Paint: Use for pipe marking.

- B. Locate pipe labels where piping is exposed or above accessible ceilings in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior exposed locations as follows:

- 1. Near each valve and control device.
- 2. Near each branch connection, excluding short takeoffs for fixtures and terminal units. Where flow pattern is not obvious, mark each pipe at branch.
- 3. Near penetrations through walls, floors, ceilings, and inaccessible enclosures.
- 4. At access doors, manholes, and similar access points that permit view of concealed piping.
- 5. Near major equipment items and other points of origination and termination.
- 6. Spaced at maximum intervals of 50 feet along each run. Reduce intervals to 25 feet in areas of congested piping and equipment.
- 7. On piping above removable acoustical ceilings. Omit intermediately spaced labels.

- C. Pipe Label Color Schedule:

- 1. Heating Water Piping:
 - a. Background Color: Green
 - b. Letter Color: White
- 2. Makeup Water Piping:
 - a. Follow existing plant standard

3. Nat. Gas Piping:
 - a. Follow existing plant standard

3.4 DUCT LABEL INSTALLATION

- A. Locate stencils near points where ducts enter into concealed spaces and at maximum intervals of 50 feet in each space where ducts are exposed or concealed by removable ceiling system.

3.5 VALVE-TAG INSTALLATION

- A. Install tags on valves and control devices in piping systems, except check valves; valves within factory-fabricated equipment units; shutoff valves; faucets; convenience and lawn-watering hose connections; and HVAC terminal devices and similar roughing-in connections of end-use fixtures and units. List tagged valves in a valve schedule.
- B. Valve-Tag Application Schedule: Tag valves according to size, shape, and color scheme and with captions similar to those indicated in the following subparagraphs:
 1. Valve-Tag Size and Shape:
 - a. Hot Water: 2 inches, round.
 - b. Gas: 2 inches, round.
 2. Valve-Tag Color:
 - a. Hot Water: Green.
 - b. Gas: Yellow.
 3. Letter Color:
 - a. Hot Water: White.
 - b. Gas: Black.

3.6 WARNING-TAG INSTALLATION

- A. Write required message on, and attach warning tags to, equipment and other items where required.

END OF SECTION 230553

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes testing, adjusting, and balancing HVAC systems to produce design objectives, including the following:
 - 1. Balancing water flow within distribution systems, including submains, branches, and terminals, to indicated quantities according to specified tolerances.
 - 2. Adjusting total HVAC systems to provide indicated quantities.
 - 3. Measuring electrical performance of HVAC equipment.
 - 4. Setting quantitative performance of HVAC equipment.
 - 5. Verifying that automatic control devices are functioning properly.
 - 6. Measuring sound and vibration.
 - 7. Reporting results of the activities and procedures specified in this Section.
- B. Related Sections include the following:
 - 1. Testing and adjusting requirements unique to particular systems and equipment are included in the Sections that specify those systems and equipment.
 - 2. Field quality-control testing to verify that workmanship quality for system and equipment installation is specified in system and equipment Sections.
- C. Work Included: Provide testing, adjusting, and balancing for HVAC in accordance with the Contract Documents. The "General Conditions Governing All Contracts" shall apply to all work under the contract. The work of this section shall include, but not be limited to, the following:
 - 1. Balancing Hydronic Piping Systems:
 - Variable-flow hydronic systems.

1.3 DEFINITIONS

- A. Adjust: To regulate fluid flow rate and air patterns at the terminal equipment, such as to reduce fan speed or adjust a damper.
- B. Balance: To proportion flows within the distribution system, including submains, branches, and terminals, according to design quantities.

- C. Draft: A current of air, when referring to localized effect caused by one or more factors of high air velocity, low ambient temperature, or direction of airflow, whereby more heat is withdrawn from a person's skin than is normally dissipated.
- D. Procedure: An approach to and execution of a sequence of work operations to yield repeatable results.
- E. Report Forms: Test data sheets for recording test data in logical order.
- F. Static Head: The pressure due to the weight of the fluid above the point of measurement. In a closed system, static head is equal on both sides of the pump.
- G. Suction Head: The height of fluid surface above the centerline of the pump on the suction side.
- H. System Effect: A phenomenon that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system.
- I. System Effect Factors: Allowances used to calculate a reduction of the performance ratings of a fan when installed under conditions different from those presented when the fan was performance tested.
- J. Terminal: A point where the controlled medium, such as fluid or energy, enters or leaves the distribution system.
- K. Test: A procedure to determine quantitative performance of a system or equipment.
- L. Testing, Adjusting, and Balancing Agent: The entity responsible for performing and reporting the testing, adjusting, and balancing procedures.
- M. AABC: Associated Air Balance Council.
- N. AMCA: Air Movement and Control Association.
- O. NEBB: National Environmental Balancing Bureau.
- P. SMACNA: Sheet Metal and Air Conditioning Contractors' National Association.

1.4 SUBMITTALS

- A. Quality-Assurance Submittals: Within 30 days from the Contractor's Notice to Proceed, submit 2 copies of evidence that the testing, adjusting, and balancing Agent and this Project's testing, adjusting, and balancing team members meet the qualifications specified in the "Quality Assurance" Article below.
- B. Contract Documents Examination Report: Within 45 days from the Contractor's Notice to Proceed, submit 2 copies of the Contract Documents review report as specified in Part 3 of this Section.
- C. Strategies and Procedures Plan: Within 60 days from the Contractor's Notice to Proceed, submit 2 copies of the testing, adjusting, and balancing strategies and step-by-step procedures as

specified in Part 3 "Preparation" Article below. Include a complete set of report forms intended for use on this Project.

- D. Certified Testing, Adjusting, and Balancing Reports: Submit 2 copies of reports prepared, as specified in this Section, on approved forms certified by the testing, adjusting, and balancing Agent.
- E. Sample Report Forms: Submit 2 sets of sample testing, adjusting, and balancing report forms.
- F. Warranty: Submit 2 copies of special warranty specified in the "Warranty" Article below.

1.5 QUALITY ASSURANCE

- A. Agent Qualifications: Engage a testing, adjusting, and balancing agent certified by either AABC or NEBB.
- B. Testing, Adjusting, and Balancing Conference: Meet with the Owner's and the Architect's representatives on approval of the testing, adjusting, and balancing strategies and procedures plan to develop a mutual understanding of the details. Ensure the participation of testing, adjusting, and balancing team members, equipment manufacturers' authorized service representatives, HVAC controls Installer, and other support personnel. Provide 7 days' advance notice of scheduled meeting time and location.
 - 1. Agenda Items: Include at least the following:
 - a. Submittal distribution requirements.
 - b. Contract Documents examination report.
 - c. Testing, adjusting, and balancing plan.
 - d. Work schedule and Project site access requirements.
 - e. Coordination and cooperation of trades and subcontractors.
 - f. Coordination of documentation and communication flow.
- C. Certification of Testing, Adjusting, and Balancing Reports: Certify the testing, adjusting, and balancing field data reports. This certification includes the following:
 - 1. Review field data reports to validate accuracy of data and to prepare certified testing, adjusting, and balancing reports.
 - 2. Certify that the testing, adjusting, and balancing team complied with the approved testing, adjusting, and balancing plan and the procedures specified and referenced in this Specification.
- D. Testing, Adjusting, and Balancing Reports: Use standard forms from SMACNA's "HVAC Systems--Testing, Adjusting, and Balancing."
- E. Instrumentation Type, Quantity, and Accuracy: As described in AABC national standards, or as described in NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems," Section II, "Required Instrumentation for NEBB Certification."
- F. Instrumentation Calibration: Calibrate instruments at least every 6 months or more frequently if required by the instrument manufacturer.

1.6 PROJECT CONDITIONS

- A. Full Owner Occupancy: The Owner will occupy the site and existing building during the entire testing, adjusting, and balancing period. Cooperate with the Owner during testing, adjusting, and balancing operations to minimize conflicts with the Owner's operations.

1.7 COORDINATION

- A. Coordinate the efforts of factory-authorized service representatives for systems and equipment, HVAC controls installers, and other mechanics to operate HVAC systems and equipment to support and assist testing, adjusting, and balancing activities.
- B. Notice: Provide 7 days' advance notice for each test. Include scheduled test dates and times.
- C. Perform testing, adjusting, and balancing after leakage and pressure tests on and water distribution systems have been satisfactorily completed.

1.8 WARRANTY

- A. General Warranty: The national project performance guarantee specified in this Article shall not deprive the Owner of other rights the Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by the Contractor under requirements of the Contract Documents.
- B. National Project Performance Guarantee: Provide a guarantee on AABC'S "National Standards" forms stating that AABC will assist in completing the requirements of the Contract Documents if the testing, adjusting, and balancing Agent fails to comply with the Contract Documents. Guarantee includes the following provisions:
 - 1. The certified Agent has tested and balanced systems according to the Contract Documents.
 - 2. Systems are balanced to optimum performance capabilities within design and installation limits.
- C. Special Guarantee: Provide a guarantee on NEBB forms stating that NEBB will assist in completing the requirements of the Contract Documents if the testing, adjusting, and balancing Agent fails to comply with the Contract Documents. Guarantee includes the following provisions:
 - 1. The certified Agent has tested and balanced systems according to the Contract Documents.
 - 2. Systems are balanced to optimum performance capabilities within design and installation limits.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine Contract Documents to become familiar with project requirements and to discover conditions in systems' designs that may preclude proper testing, adjusting, and balancing of systems and equipment.
 - 1. Contract Documents are defined in the General and Supplementary Conditions of the Contract.
 - 2. Verify that balancing devices, such as test ports, gage cocks, thermometer wells, flow-control devices, balancing valves and fittings, and manual volume dampers, are required by the Contract Documents. Verify that quantities and locations of these balancing devices are accessible and appropriate for effective balancing and for efficient system and equipment operation.
- B. Examine approved submittal data of HVAC systems and equipment.
- C. Examine project record documents described in Division 1 Section "Project Record Documents."
- D. Examine Architect's and Engineer's design data, including HVAC system descriptions, statements of design assumptions for environmental conditions and systems' output, and statements of philosophies and assumptions about HVAC system and equipment controls.
- E. Examine equipment performance data, including fan and pump curves. Relate performance data to project conditions and requirements, including system effects that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system. Calculate system effect factors to reduce the performance ratings of HVAC equipment when installed under conditions different from those presented when the equipment was performance tested at the factory. To calculate system effects for air systems, use tables and charts found in AMCA 201, "Fans and Systems," Sections 7 through 10; or in SMACNA's "HVAC Systems--Duct Design," Sections 5 and 6. Compare this data with the design data and installed conditions.
- F. Examine system and equipment installations to verify that they are complete and that testing, cleaning, adjusting, and commissioning specified in individual Specification Sections have been performed.
- G. Examine system and equipment test reports.
- H. Examine HVAC system and equipment installations to verify that indicated balancing devices, such as test ports, gage cocks, thermometer wells, flow-control devices, balancing valves and fittings, and manual volume dampers, are properly installed, and their locations are accessible and appropriate for effective balancing and for efficient system and equipment operation.
- I. Examine systems for functional deficiencies that cannot be corrected by adjusting and balancing.
- J. Examine strainers for clean screens and proper perforations.
- K. Examine 3-way valves for proper installation for their intended function of diverting or mixing fluid flows.

- L. Examine heat-transfer coils for correct piping connections and for clean and straight fins.
- M. Examine open-piping-system pumps to ensure absence of entrained air in the suction piping.
- N. Examine equipment for installation and for properly operating safety interlocks and controls.
- O. Examine automatic temperature system components to verify the following:
 - 1. Integrity of valves and dampers for free and full operation and for tightness of fully closed and fully open positions. This includes dampers in multizone units, mixing boxes, and variable-air-volume terminals.
 - 2. Automatic modulating and shutoff valves, including 2-way valves and 3-way mixing and diverting valves, are properly connected.
 - 3. Thermostats and humidistats are located to avoid adverse effects of sunlight, drafts, and cold walls.
 - 4. Sensors are located to sense only the intended conditions.
 - 5. Sequence of operation for control modes is according to the Contract Documents.
 - 6. Controller set points are set at design values. Observe and record system reactions to changes in conditions. Record default set points if different from design values.
 - 7. Interlocked systems are operating.
 - 8. Changeover from heating to cooling mode occurs according to design values.
- P. Report deficiencies discovered before and during performance of testing, adjusting, and balancing procedures.

3.2 PREPARATION

- A. Prepare a testing, adjusting, and balancing plan that includes strategies and step-by-step procedures.
- B. Complete system readiness checks and prepare system readiness reports. Verify the following:
 - 1. Permanent electrical power wiring is complete.
 - 2. Hydronic systems are filled, clean, and free of air.
 - 3. Automatic temperature-control systems are operational.
 - 4. Equipment and duct access doors are securely closed.
 - 5. Balance, smoke, and fire dampers are open.
 - 6. Isolating and balancing valves are open and control valves are operational.
 - 7. Ceilings are installed in critical areas where air-pattern adjustments are required and access to balancing devices is provided.
 - 8. Windows and doors can be closed so design conditions for system operations can be met.

3.3 GENERAL TESTING AND BALANCING PROCEDURES

- A. Cut insulation, ducts, pipes, and equipment cabinets for installation of test probes to the minimum extent necessary to allow adequate performance of procedures. After testing and balancing, close probe holes and patch insulation with new materials identical to those removed. Restore vapor barrier and finish according to the insulation Specifications for this Project.

- B. Mark equipment settings with paint or other suitable, permanent identification material, including damper-control positions, valve indicators, fan-speed-control levers, and similar controls and devices, to show final settings.

3.4 FUNDAMENTAL PROCEDURES FOR HYDRONIC SYSTEMS

- A. Prepare test reports with pertinent design data and number in sequence starting at pump to end of system. Check the sum of branch-circuit flows against approved pump flow rate. Correct variations that exceed plus or minus 5 percent.
- B. Prepare schematic diagrams of systems' "as-built" piping layouts.
- C. Prepare hydronic systems for testing and balancing according to the following, in addition to the general preparation procedures specified above:
 - 1. Open all manual valves for maximum flow.
 - 2. Check expansion tank liquid level.
 - 3. Check makeup-water-station pressure gage for adequate pressure for highest vent.
 - 4. Check flow-control valves for specified sequence of operation and set at design flow.
 - 5. Set differential-pressure control valves at the specified differential pressure. Do not set at fully closed position when pump is positive-displacement type, unless several terminal valves are kept open.
 - 6. Set system controls so automatic valves are wide open to heat exchangers.
 - 7. Check pump-motor load. If motor is overloaded, throttle main flow-balancing device so motor nameplate rating is not exceeded.
 - 8. Check air vents for a forceful liquid flow exiting from vents when manually operated.

3.5 HYDRONIC SYSTEMS' BALANCING PROCEDURES

- A. Determine water flow at pumps. Use the following procedures, except for positive-displacement pumps:
 - 1. Verify impeller size by operating the pump with the discharge valve closed. Verify with the pump manufacturer that this will not damage pump. Read pressure differential across the pump. Convert pressure to head and correct for differences in gage heights. Note the point on the manufacturer's pump curve at zero flow and confirm that the pump has the intended impeller size.
 - 2. Check system resistance. With all valves open, read pressure differential across the pump and mark the pump manufacturer's head-capacity curve. Adjust pump discharge valve until design water flow is achieved.
 - 3. Verify pump-motor brake horsepower. Calculate the intended brake horsepower for the system based on the pump manufacturer's performance data. Compare calculated brake horsepower with nameplate data on the pump motor. Report conditions where actual amperage exceeds motor nameplate amperage.
 - 4. Report flow rates that are not within plus or minus 5 percent of design.
- B. Set calibrated balancing valves, if installed, at calculated pre-settings.
- C. Measure flow at all stations and adjust, where necessary, to obtain first balance.

1. System components that have Cv rating or an accurately cataloged flow-pressure-drop relationship may be used as a flow-indicating device.
- D. Measure pump flow rate and make final measurements of pump amperage, voltage, rpm, pump heads, and systems' pressures and temperatures, including outdoor-air temperature.
- E. Measure the differential-pressure control valve settings existing at the conclusions of balancing.

3.6 MOTORS

- A. Motors, 1/2 HP and Larger: Test at final balanced conditions and record the following data:
 1. Manufacturer, model, and serial numbers.
 2. Motor horsepower rating.
 3. Motor rpm.
 4. Efficiency rating if high-efficiency motor.
 5. Nameplate and measured voltage, each phase.
 6. Nameplate and measured amperage, each phase.
 7. Starter thermal-protection-element rating.
- B. Motors Driven by Variable-Frequency Controllers: Test for proper operation at speeds varying from minimum to maximum. Test the manual bypass for the controller to prove proper operation. Record observations, including controller manufacturer, model and serial numbers, and nameplate data.

3.7 TEMPERATURE TESTING

- A. During testing, adjusting, and balancing, report need for adjustment in temperature regulation within the automatic temperature-control system.
- B. Measure indoor wet- and dry-bulb temperatures every other hour for a period of 2 successive 8-hour days, in each separately controlled zone, to prove correctness of final temperature settings. Measure when the building or zone is occupied.
- C. Measure outside-air, wet- and dry-bulb temperatures.

3.8 TEMPERATURE-CONTROL VERIFICATION

- A. Verify that controllers are calibrated and commissioned.
- B. Check transmitter and controller locations and note conditions that would adversely affect control functions.
- C. Record controller settings and note variances between set points and actual measurements.
- D. Verify operation of limiting controllers (i.e., high- and low-temperature controllers).
- E. Verify free travel and proper operation of control devices such as damper and valve operators.

- F. Verify sequence of operation of control devices. Note air pressures and device positions and correlate with airflow and water-flow measurements. Note the speed of response to input changes.
- G. Confirm interaction of electrically operated switch transducers.
- H. Confirm interaction of interlock and lockout systems.
- I. Verify main control supply-air pressure and observe compressor and dryer operations.
- J. Record voltages of power supply and controller output. Determine if the system operates on a grounded or nongrounded power supply.
- K. Note operation of electric actuators using spring return for proper fail-safe operations.

3.9 TOLERANCES

- A. Set HVAC system airflow and water flow rates within the following tolerances:
 - 1. Heating-Water Flow Rate: 0 to minus 10 percent.

3.10 REPORTING

- A. Initial Construction-Phase Report: Based on examination of the Contract Documents as specified in "Examination" Article above, prepare a report on the adequacy of design for systems' balancing devices. Recommend changes and additions to systems' balancing devices to facilitate proper performance measuring and balancing. Recommend changes and additions to HVAC systems and general construction to allow access for performance measuring and balancing devices.
- B. Status Reports: As Work progresses, prepare reports to describe completed procedures, procedures in progress, and scheduled procedures. Include a list of deficiencies and problems found in systems being tested and balanced. Prepare a separate report for each system and each building floor for systems serving multiple floors.

3.11 FINAL REPORT

- A. General: Typewritten, or computer printout in letter-quality font, on standard bond paper, in 3-ring binder, tabulated and divided into sections by tested and balanced systems.
- B. Include a certification sheet in front of binder signed and sealed by the certified testing and balancing engineer.
 - 1. Include a list of the instruments used for procedures, along with proof of calibration.
- C. Final Report Contents: In addition to the certified field report data, include the following:
 - 1. Pump curves.
 - 2. Fan curves.

3. Manufacturers' test data.
 4. Field test reports prepared by system and equipment installers.
 5. Other information relative to equipment performance, but do not include approved Shop Drawings and Product Data.
- D. General Report Data: In addition to the form titles and entries, include the following data in the final report, as applicable:
1. Title page.
 2. Name and address of testing, adjusting, and balancing Agent.
 3. Project name.
 4. Project location.
 5. Architect's name and address.
 6. Engineer's name and address.
 7. Contractor's name and address.
 8. Report date.
 9. Signature of testing, adjusting, and balancing Agent who certifies the report.
 10. Summary of contents, including the following:
 - a. Design versus final performance.
 - b. Notable characteristics of systems.
 - c. Description of system operation sequence if it varies from the Contract Documents.
 11. Nomenclature sheets for each item of equipment.
 12. Data for terminal units, including manufacturer, type size, and fittings.
 13. Notes to explain why certain final data in the body of reports vary from design values.
- E. System Diagrams: Include schematic layouts of air and hydronic distribution systems. Present with single-line diagrams and include the following:
1. Water flow rates.
 2. Duct, outlet, and inlet sizes.
 3. Pipe and valve sizes and locations.
 4. Terminal units.
 5. Balancing stations.
- F. Pump Test Reports: For pumps, include the following data. Calculate impeller size by plotting the shutoff head on pump curves.
1. Unit Data: Include the following:
 - a. Unit identification.
 - b. Location.
 - c. Service.
 - d. Make and size.
 - e. Model and serial numbers.
 - f. Water flow rate in gpm.
 - g. Water pressure differential in feet of head or psig.
 - h. Required net positive suction head in feet of head or psig.
 - i. Pump rpm.
 - j. Impeller diameter in inches.

- k. Motor make and frame size.
 - l. Motor horsepower and rpm.
 - m. Voltage at each connection.
 - n. Amperage for each phase.
 - o. Full-load amperage and service factor.
 - p. Seal type.
2. Test Data: Include design and actual values for the following:
- a. Static head in feet of head or psig.
 - b. Pump shutoff pressure in feet of head or psig.
 - c. Actual impeller size in inches.
 - d. Full-open flow rate in gpm.
 - e. Full-open pressure in feet of head or psig.
 - f. Final discharge pressure in feet of head or psig.
 - g. Final suction pressure in feet of head or psig.
 - h. Final total pressure in feet of head or psig.
 - i. Final water flow rate in gpm.
 - j. Voltage at each connection.
 - k. Amperage for each phase.

G. Instrument Calibration Reports: For instrument calibration, include the following:

1. Report Data: Include the following:
- a. Instrument type and make.
 - b. Serial number.
 - c. Application.
 - d. Dates of use.
 - e. Dates of calibration.

3.12 ADDITIONAL TESTS

- A. Within 90 days of completing testing, adjusting, and balancing, perform additional testing and balancing to verify that balanced conditions are being maintained throughout and to correct unusual conditions.
- B. Seasonal Periods: If initial testing, adjusting, and balancing procedures were not performed during near-peak summer and winter conditions, perform additional inspections, testing, and adjusting during near-peak summer and winter conditions.

END OF SECTION 230593

SECTION 230719 - HVAC PIPING AND EQUIPMENT INSULATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes insulating the following HVAC piping systems:

1. Condensate drain piping, indoors.
2. Heating hot-water piping, indoors.
3. Air separators, Expansion Tanks

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include thermal conductivity, water-vapor permeance thickness, and jackets (both factory and field applied if any).
- B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
 1. Detail application of protective shields, saddles, and inserts at hangers for each type of insulation and hanger.
 2. Detail attachment and covering of heat tracing inside insulation.
 3. Detail insulation application at elbows, fittings, flanges, valves, and specialties for each type of insulation.
 4. Detail removable insulation at piping specialties.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified Installer.
- B. Field quality-control reports.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program certified by the Department of Labor, Bureau of Apprenticeship and Training.

- B. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products according to ASTM E 84, by a testing and inspecting agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing agency.

- 1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Packaging: Insulation material containers shall be marked by manufacturer with appropriate ASTM standard designation, type and grade, and maximum use temperature.

1.7 COORDINATION

- A. Coordinate sizes and locations of supports, hangers, and insulation shields specified in Section 230529 "Hangers and Supports for HVAC Piping and Equipment."
- B. Coordinate clearance requirements with piping Installer for piping insulation application. Before preparing piping Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.
- C. Coordinate installation and testing of heat tracing.

1.8 SCHEDULING

- A. Schedule insulation application after pressure testing systems and, where required, after installing and testing heat tracing. Insulation application may begin on segments that have satisfactory test results.
- B. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.

PART 2 - PRODUCTS

2.1 INSULATION MATERIALS

- A. Comply with requirements in "Piping Insulation Schedule, General," "Indoor Piping Insulation Schedule," "Outdoor, Aboveground Piping Insulation Schedule," and "Outdoor, Underground Piping Insulation Schedule" articles for where insulating materials shall be applied.
- B. Products shall not contain asbestos, lead, mercury, or mercury compounds.

- C. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871.
- D. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.
- E. Mineral or Glass-Fiber, Preformed Pipe Insulation:
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Fibrex Insulations Inc.; Coreplus 1200.
 - b. Johns Manville; Micro-Lok.
 - c. Knauf Insulation; 1000-Degree Pipe Insulation.
 - d. Manson Insulation Inc.; Alley-K.
 - e. Owens Corning; Fiberglas Pipe Insulation.
 - 2. Type I, 850 deg F Materials: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 547, Type I, Grade A, with factory-applied ASJ. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
- F. Mineral-Fiber, Pipe and Tank Insulation: Mineral or glass fibers bonded with a thermosetting resin. Semirigid board material with factory-applied ASJ complying with ASTM C 1393, Type II or Type IIIA Category 2, or with properties similar to ASTM C 612, Type IB. Nominal density is 2.5 lb/cu. ft. or more. Thermal conductivity (k-value) at 100 deg F is 0.29 Btu x in./h x sq. ft. x deg F or less. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. CertainTeed Corp.; CrimpWrap.
 - b. Johns Manville; MicroFlex.
 - c. Knauf Insulation; Pipe and Tank Insulation.
 - d. Manson Insulation Inc.; AK Flex.
 - e. Owens Corning; Fiberglas Pipe and Tank Insulation.

2.2 INSULATING CEMENTS

- A. Mineral-Fiber Insulating Cement: Comply with ASTM C 195.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Ramco Insulation, Inc.; Super-Stik.
- B. Expanded or Exfoliated Vermiculite Insulating Cement: Comply with ASTM C 196.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Ramco Insulation, Inc.; Thermokote V.

- C. Mineral-Fiber, Hydraulic-Setting Insulating and Finishing Cement: Comply with ASTM C 449.

1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Ramco Insulation, Inc.; Ramcote 1200 and Quik-Cote.

2.3 ADHESIVES

- A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated unless otherwise indicated.

- B. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.

1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-127.
 - b. Eagle Bridges - Marathon Industries; 225.
 - c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 85-60/85-70.
 - d. Mon-Eco Industries, Inc.; 22-25.

- C. ASJ Adhesive, and FSK and PVDC Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.

1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-82.
 - b. Eagle Bridges - Marathon Industries; 225.
 - c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 85-50.
 - d. Mon-Eco Industries, Inc.; 22-25.

- D. PVC Jacket Adhesive: Compatible with PVC jacket.

1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Dow Corning Corporation; 739, Dow Silicone.
 - b. Johns Manville; Zeston Perma-Weld, CEEL-TITE Solvent Welding Adhesive.
 - c. P.I.C. Plastics, Inc.; Welding Adhesive.
 - d. Speedline Corporation; Polyco VP Adhesive.

2.4 LAGGING ADHESIVES

- A. Description: Comply with MIL-A-3316C, Class I, Grade A and shall be compatible with insulation materials, jackets, and substrates.

1. For indoor applications, use lagging adhesives that have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
2. Products: Subject to compliance with requirements, provide one of the following:
 - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-50 AHV2.
 - b. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 30-36.
 - c. Vimasco Corporation; 713 and 714.
3. Fire-resistant, water-based lagging adhesive and coating for use indoors to adhere fire-resistant lagging cloths over pipe insulation.
4. Service Temperature Range: 0 to plus 180 deg F.
5. Color: White.

2.5 SEALANTS

A. Joint Sealants:

1. Joint Sealants for Cellular-Glass Products: Subject to compliance with requirements, provide one of the following:
 - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-76.
 - b. Eagle Bridges - Marathon Industries; 405.
 - c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 30-45.
 - d. Mon-Eco Industries, Inc.; 44-05.
 - e. Pittsburgh Corning Corporation; Pittseal 444.
2. Materials shall be compatible with insulation materials, jackets, and substrates.
3. Permanently flexible, elastomeric sealant.
4. Service Temperature Range: Minus 100 to plus 300 deg F.
5. Color: White or gray.

B. ASJ Flashing Sealants and PVC Jacket Flashing Sealants:

1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-76.
2. Materials shall be compatible with insulation materials, jackets, and substrates.
3. Fire- and water-resistant, flexible, elastomeric sealant.
4. Service Temperature Range: Minus 40 to plus 250 deg F.
5. Color: White.

2.6 FACTORY-APPLIED JACKETS

- A. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:
 - 1. ASJ: White, kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C 1136, Type I.
 - 2. ASJ-SSL: ASJ with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C 1136, Type I.

2.7 FIELD-APPLIED JACKETS

- A. Field-applied jackets shall comply with ASTM C 921, Type I, unless otherwise indicated.
- B. PVC Jacket: High-impact-resistant, UV-resistant PVC complying with ASTM D 1784, Class 16354-C; thickness as scheduled; roll stock ready for shop or field cutting and forming. Thickness is indicated in field-applied jacket schedules.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Johns Manville; Zeston.
 - b. P.I.C. Plastics, Inc.; FG Series.
 - c. Proto Corporation; LoSmoke.
 - d. Speedline Corporation; SmokeSafe.
 - 2. Adhesive: As recommended by jacket material manufacturer.
 - 3. Color: White.
 - 4. Factory-fabricated fitting covers to match jacket if available; otherwise, field fabricate.
 - a. Shapes: 45- and 90-degree, short- and long-radius elbows, tees, valves, flanges, unions, reducers, end caps, soil-pipe hubs, traps, mechanical joints, and P-trap and supply covers for lavatories.

2.8 TAPES

- A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. ABI, Ideal Tape Division; 428 AWF ASJ.
 - b. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0836.
 - c. Compac Corporation; 104 and 105.
 - d. Venture Tape; 1540 CW Plus, 1542 CW Plus, and 1542 CW Plus/SQ.
 - 2. Width: 3 inches.
 - 3. Thickness: 11.5 mils.

4. Adhesion: 90 ounces force/inch in width.
 5. Elongation: 2 percent.
 6. Tensile Strength: 40 lbf/inch in width.
 7. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.
- B. PVC Tape: White vapor-retarder tape matching field-applied PVC jacket with acrylic adhesive; suitable for indoor and outdoor applications.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. ABI, Ideal Tape Division; 370 White PVC tape.
 - b. Compac Corporation; 130.
 - c. Venture Tape; 1506 CW NS.
 2. Width: 2 inches.
 3. Thickness: 6 mils.
 4. Adhesion: 64 ounces force/inch in width.
 5. Elongation: 500 percent.
 6. Tensile Strength: 18 lbf/inch in width.

2.9 SECUREMENTS

- A. Bands:
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. ITW Insulation Systems; Gerrard Strapping and Seals.
 - b. RPR Products, Inc.; Insul-Mate Strapping, Seals, and Springs.
 2. Stainless Steel: ASTM A 167 or ASTM A 240/A 240M, Type 304 or Type 316; 0.015 inch thick, 1/2 inch wide with closed seal.
 3. Aluminum: ASTM B 209, Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch thick, 1/2 inch wide with closed seal.
 4. Springs: Twin spring set constructed of stainless steel with ends flat and slotted to accept metal bands. Spring size determined by manufacturer for application.
- B. Staples: Outward-clinching insulation staples, nominal 3/4-inch-wide, stainless steel or Monel.
- C. Wire: 0.080-inch nickel-copper alloy or 0.062-inch soft-annealed, stainless steel.
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. C & F Wire.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of insulation application.
 - 1. Verify that systems to be insulated have been tested and are free of defects.
 - 2. Verify that surfaces to be insulated are clean and dry.
 - 3. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.
- B. Coordinate insulation installation with the trade installing heat tracing. Comply with requirements for heat tracing that apply to insulation.
- C. Mix insulating cements with clean potable water; if insulating cements are to be in contact with stainless-steel surfaces, use demineralized water.

3.3 GENERAL INSTALLATION REQUIREMENTS

- A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of piping including fittings, valves, and specialties.
- B. Install insulation materials, forms, vapor barriers or retarders, jackets, and thicknesses required for each item of pipe system as specified in insulation system schedules.
- C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.
- D. Install insulation with longitudinal seams at top and bottom of horizontal runs.
- E. Install multiple layers of insulation with longitudinal and end seams staggered.
- F. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.
- G. Keep insulation materials dry during application and finishing.
- H. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.
- I. Install insulation with least number of joints practical.

- J. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.
- K. Install insulation with factory-applied jackets as follows:
 - 1. Draw jacket tight and smooth.
 - 2. Cover circumferential joints with 3-inch-wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches o.c.
 - 3. Overlap jacket longitudinal seams at least 1-1/2 inches. Install insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 4 inches o.c.
 - a. For below-ambient services, apply vapor-barrier mastic over staples.
 - 4. Cover joints and seams with tape, according to insulation material manufacturer's written instructions, to maintain vapor seal.
 - 5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to pipe flanges and fittings.
- L. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.
- M. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.
- N. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.
- O. For above-ambient services, do not install insulation to the following:
 - 1. Vibration-control devices.
 - 2. Testing agency labels and stamps.
 - 3. Nameplates and data plates.
 - 4. Manholes.
 - 5. Handholes.
 - 6. Cleanouts.

3.4 PENETRATIONS

- A. Insulation Installation at Underground Exterior Wall Penetrations: Terminate insulation flush with sleeve seal. Seal terminations with flashing sealant.
- B. Insulation Installation at Aboveground Exterior Wall Penetrations: Install insulation continuously through wall penetrations.
 - 1. Seal penetrations with flashing sealant.
 - 2. For applications requiring only indoor insulation, terminate insulation inside wall surface and seal with joint sealant. For applications requiring indoor and outdoor

- insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
- 3. Extend jacket of outdoor insulation outside wall flashing and overlap wall flashing at least 2 inches.
- 4. Seal jacket to wall flashing with flashing sealant.
- C. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.
- D. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Install insulation continuously through penetrations of fire-rated walls and partitions.
 - 1. Comply with requirements in Section 078413 "Penetration Firestopping" for firestopping and fire-resistive joint sealers.
- E. Insulation Installation at Floor Penetrations:
 - 1. Pipe: Install insulation continuously through floor penetrations.
 - 2. Seal penetrations through fire-rated assemblies. Comply with requirements in Section 078413 "Penetration Firestopping."

3.5 GENERAL PIPE INSULATION INSTALLATION

- A. Requirements in this article generally apply to all insulation materials except where more specific requirements are specified in various pipe insulation material installation articles.
- B. Insulation Installation on Fittings, Valves, Strainers, Flanges, and Unions:
 - 1. Install insulation over fittings, valves, strainers, flanges, unions, and other specialties with continuous thermal and vapor-retarder integrity unless otherwise indicated.
 - 2. Insulate pipe elbows using preformed fitting insulation or mitered fittings made from same material and density as adjacent pipe insulation. Each piece shall be butted tightly against adjoining piece and bonded with adhesive. Fill joints, seams, voids, and irregular surfaces with insulating cement finished to a smooth, hard, and uniform contour that is uniform with adjoining pipe insulation.
 - 3. Insulate tee fittings with preformed fitting insulation or sectional pipe insulation of same material and thickness as used for adjacent pipe. Cut sectional pipe insulation to fit. Butt each section closely to the next and hold in place with tie wire. Bond pieces with adhesive.
 - 4. Insulate valves using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. For valves, insulate up to and including the bonnets, valve stuffing-box studs, bolts, and nuts. Fill joints, seams, and irregular surfaces with insulating cement.
 - 5. Insulate strainers using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Fill joints, seams, and irregular surfaces with

- insulating cement. Insulate strainers so strainer basket flange or plug can be easily removed and replaced without damaging the insulation and jacket. Provide a removable reusable insulation cover. For below-ambient services, provide a design that maintains vapor barrier.
6. Insulate flanges and unions using a section of oversized preformed pipe insulation. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker.
 7. Cover segmented insulated surfaces with a layer of finishing cement and coat with a mastic. Install vapor-barrier mastic for below-ambient services and a breather mastic for above-ambient services. Reinforce the mastic with fabric-reinforcing mesh. Trowel the mastic to a smooth and well-shaped contour.
 8. For services not specified to receive a field-applied jacket except for flexible elastomeric and polyolefin, install fitted PVC cover over elbows, tees, strainers, valves, flanges, and unions. Terminate ends with PVC end caps. Tape PVC covers to adjoining insulation facing using PVC tape.
 9. Stencil or label the outside insulation jacket of each union with the word "union." Match size and color of pipe labels.
- C. Insulate instrument connections for thermometers, pressure gages, pressure temperature taps, test connections, flow meters, sensors, switches, and transmitters on insulated pipes. Shape insulation at these connections by tapering it to and around the connection with insulating cement and finish with finishing cement, mastic, and flashing sealant.
- D. Install removable insulation covers at locations indicated. Installation shall conform to the following:
1. Make removable flange and union insulation from sectional pipe insulation of same thickness as that on adjoining pipe. Install same insulation jacket as adjoining pipe insulation.
 2. When flange and union covers are made from sectional pipe insulation, extend insulation from flanges or union long at least two times the insulation thickness over adjacent pipe insulation on each side of flange or union. Secure flange cover in place with stainless-steel or aluminum bands. Select band material compatible with insulation and jacket.
 3. Construct removable valve insulation covers in same manner as for flanges, except divide the two-part section on the vertical center line of valve body.
 4. When covers are made from block insulation, make two halves, each consisting of mitered blocks wired to stainless-steel fabric. Secure this wire frame, with its attached insulation, to flanges with tie wire. Extend insulation at least 2 inches over adjacent pipe insulation on each side of valve. Fill space between flange or union cover and pipe insulation with insulating cement. Finish cover assembly with insulating cement applied in two coats. After first coat is dry, apply and trowel second coat to a smooth finish.
 5. Unless a PVC jacket is indicated in field-applied jacket schedules, finish exposed surfaces with a metal jacket.
- 3.6 INSTALLATION OF MINERAL-FIBER INSULATION
- A. Insulation Installation on Straight Pipes and Tubes:

1. Secure each layer of preformed pipe insulation to pipe with wire or bands and tighten bands without deforming insulation materials.
2. For insulation with factory-applied jackets on above-ambient surfaces, secure laps with outward-clinched staples at 6 inches o.c.
3. For insulation with factory-applied jackets on below-ambient surfaces, do not staple longitudinal tabs. Instead, secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant.

B. Insulation Installation on Pipe Flanges:

1. Install preformed pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with mineral-fiber blanket insulation.
4. Install jacket material with manufacturer's recommended adhesive, overlap seams at least 1 inch, and seal joints with flashing sealant.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install preformed sections of same material as straight segments of pipe insulation when available.
2. When preformed insulation elbows and fittings are not available, install mitered sections of pipe insulation, to a thickness equal to adjoining pipe insulation. Secure insulation materials with wire or bands.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed sections of same material as straight segments of pipe insulation when available.
2. When preformed sections are not available, install mitered sections of pipe insulation to valve body.
3. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
4. Install insulation to flanges as specified for flange insulation application.

3.7 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Tests and Inspections:

1. Inspect pipe, fittings, strainers, and valves, randomly selected by Commissioning Agent or Engineer, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to three locations of straight pipe, three locations of threaded fittings, three locations of welded fittings, two locations of threaded strainers, two locations of welded

strainers, three locations of threaded valves, and three locations of flanged valves for each pipe service defined in the "Piping Insulation Schedule, General" Article.

- C. All insulation applications including uninspected Work will be considered defective Work if sample inspection reveals noncompliance with requirements.

3.8 PIPING INSULATION SCHEDULE, GENERAL

- A. Acceptable preformed pipe and tubular insulation materials and thicknesses are identified for each piping system and pipe size range. If more than one material is listed for a piping system, selection from materials listed is Contractor's option.
- B. Items Not Insulated: Unless otherwise indicated, do not install insulation on the following:
 - 1. Drainage piping located in crawl spaces.
 - 2. Underground piping.
 - 3. Chrome-plated pipes and fittings unless there is a potential for personnel injury.

3.9 INDOOR PIPING INSULATION SCHEDULE

- A. Condensate and Equipment Drain Water below 60 Deg F:
 - 1. All Pipe Sizes: Insulation shall be the following:
 - a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick with factory applied ASJ and PVC fitting covers.
- B. Heating-Hot-Water Supply and Return, 200 Deg F and Below:
 - 1. NPS 1-1/4 and Smaller: Insulation shall be the following:
 - a. Mineral-Fiber, Preformed Pipe, Type I: 1-1/2 inches thick, with factory applied ASJ and PVC fitting covers.
 - 2. NPS 1-1/2 and Larger: Insulation shall be the following:
 - a. Mineral-Fiber, Preformed Pipe, Type I: 2 inches thick, with factory applied ASJ and PVC fitting covers.
- C. Air Separators, Expansion Tanks: Insulation shall be mineral-fiber, preformed pipe, type I or II, 2 inches thick with factory applied ASJ.

END OF SECTION 230719

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes control sequences for HVAC systems, subsystems, and equipment.
- B. Related Sections include the following:
 - i. Division 15 Section "HVAC Instrumentation and Controls" for control equipment and devices and submittal requirements.

1.3 SEQUENCE OF OPERATIONS – GENERAL

- A. The Contractor shall review the following sequences of operations, points lists, and Controls Drawings to ensure that all points, devices, and programming are included for proper operation as outlined herein. Any points, devices, work, or controls mentioned in the sequences of operations and/or shown on the Controls Drawings, but not listed on the points list, or vice versa, shall be provided without additional expense to the Owner.
- B. The BAS Contractor shall be responsible for full integration between the heating and cooling plant, all associated piping and controls, and existing HVAC equipment identified for tie-in. This includes, but is not limited to, all factory controls furnished by unitary equipment manufacturers. BAS contractor shall indentify features and capabilities of all factory controllers to ensure successful communication and integration with their products and user interface.
- C. With the exception of freeze protection thermostats, all temperature and humidity setpoints shall be adjustable.
- D. Lead/Lag Control: For all redundant water pumps, the control system shall:
 - i. Alternate operation of the equipment to maintain even wear
 - ii. Automatically start the lag equipment in the event the lead equipment fails.

1.4 DEFINITIONS

- A. DDC: Direct-digital controls.
- B. BAS: Building Automation System.

1.5 GRAPHICAL USER INTERFACE (GUI)

- A. Operator Workstation: Display the following data:
1. Dynamic system graphics.
 2. Hot water pump status and speed.
 3. Boiler firing rate.
 4. Boiler primary pump status and speed (TYP for 3).
 5. Secondary (system) pump status and speed (TYP for 3).
 6. Hot water supply temperature.
 7. Hot water supply temperature setpoint.
 8. Hot water return temperature.
 9. Outside air temperature.
- B. Floor plans shall include a data input/output temperature field for all zones. Floor plans shall display as Thermal Graphics. Temperatures shall display as white when space is within 2 deg F of setpoint and yellow when space temperature is more than 2 deg F from setpoint. Temperature field shall turn red when setpoint has been overridden by the user.
- C. Provide alarm limits for all temperature setpoints identified above. In addition, BAS shall pass along all common alarms from equipment possessing dedicated microprocessor controls, such as boilers, and VFDs. Common equipment alarms shall be accessible via dedicated menu or tab at GUI.

1.6 MECHANICAL PLANT CONTROL

A. BOILER CONTROL

1. Boiler controller shall modulate burner of lead boiler to maintain HW supply water temperature setpoint based (180 deg F, adj.). If HW supply water temp setpoint cannot be achieved for 15 continuous minutes, standby boiler shall start.

B. HOT WATER SYSTEM SEQUENCE

1. Boiler firing rates shall modulate to maintain HW supply temp setpoint of 180 deg F (adj.).
2. Lead boiler designation shall be alternately assigned based on run time. After a fixed run time (200 hours, adj.) standby boiler shall be designated at lead. Standby boiler shall start automatically in the event lead boiler to start.
3. Systems equipped with outdoor air supply water temperature reset shall use the following schedule. Applied linear interpolation for all outdoor air temperatures between defined setpoints.

OUTDOOR TEMP (deg F)	HW SUPPLY TEMP (deg F)
0	180
60	120

4. For zones equipped with perimeter radiation, BAS shall modulate HW control valve to maintain space temperature setpoint during a call for heat.

C. SECONDARY HOT WATER PUMPS (EXISTING)

1. Pumps shall follow existing sequence including lead-lag operation and variable speed control.

D. PRIMARY BOILER HOT WATER PUMPS

1. Dedicated boiler pump shall start when boiler is called to start. Flow shall be proven before burner starts. Pump speed shall vary based on 0-10VDC signal from burner.

E. HOT WATER UNIT HEATER

1. Unit heater fan shall start and control valve shall open when space heating temperature falls below setpoint. Fan shall stop when control valve shall close when setpoint is reached.

END OF SECTION 230993

SECTION 231123

FACILITY NATURAL GAS PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Pipes, tubes, and fittings.
 - 2. Piping specialties.
 - 3. Piping and tubing joining materials.
 - 4. Valves.
 - 5. Pressure regulators.
 - 6. Service meters.
 - 7. Concrete bases.

1.3 DEFINITIONS

- A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct shafts, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspace, and tunnels.
- B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.
- C. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.

1.4 PERFORMANCE REQUIREMENTS

- A. Minimum Operating Pressure Ratings:
 - 1. Piping and Valves: 125 psig minimum unless otherwise indicated.
 - 2. Service Regulators: 125 psig minimum unless otherwise indicated.
 - 3. Minimum Operating Pressure of Service Meter: 2 psig.
- B. Natural Gas System Pressure within Buildings: 0.5 PSIG but not more than 2 PSIG.
- C. Delegated Design: Design restraints and anchors for Natural Gas piping and equipment, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated, or as approved under requirements of the Fuel Gas Code of this jurisdiction and approving authority.

1.5 ACTION SUBMITTALS

- A. Product Data: For each type of the following:
 - 1. Piping specialties.
 - 2. Steel piping, corrugated stainless steel tubing, associated components.
 - 3. Valves. Include pressure rating, capacity, settings, and electrical connection data of selected models.
 - 4. Pressure regulators. Indicate pressure ratings and capacities.
 - 5. Service meters. Indicate pressure ratings and capacities. Include bypass fittings and meter bars.
 - 6. Dielectric fittings.
- B. Shop Drawings: For facility Natural Gas piping layout. Include plans, piping layout and elevations, sections, and details for fabrication of pipe anchors, hangers, supports for multiple pipes, alignment guides, expansion joints and loops, and attachments of the same to building structure. Detail location of anchors, alignment guides, and expansion joints and loops.
 - 1. Shop Drawing Scale: 1/4 inch per foot.
 - 2. Detail mounting, supports, and valve arrangements for service meter assembly and pressure regulator assembly.
- C. Delegated Design Submittal: For Natural Gas piping and equipment indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
 - 1. Detail fabrication and assembly of seismic restraints.
 - 2. Design Calculations: Calculate requirements for selecting seismic restraints.

1.6 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Plans and details, drawn to scale, on which Natural Gas piping is shown and coordinated with other installations, using input from installers of the items involved.
- B. Qualification Data: For qualified professional engineer.
- C. Welding certificates.
- D. Field quality-control reports.

1.7 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For pressure regulators and service meters to include in emergency, operation, and maintenance manuals.

1.8 QUALITY ASSURANCE

- A. Steel Support Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- B. Pipe Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.

- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Handling Flammable Liquids: Remove and dispose of liquids from existing Natural Gas piping according to requirements of authorities having jurisdiction.
- B. Deliver pipes and tubes with factory applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and to prevent entrance of dirt, debris, and moisture.
- C. Store and handle pipes and tubes having factory applied protective coatings to avoid damaging coating, and protect from direct sunlight.

1.10 PROJECT CONDITIONS

- A. Perform site survey, research public utility records, and verify existing utility locations. Contact utility-locating service for area where Project is located.
- B. Interruption of Existing Natural Gas Service: Do not interrupt Natural Gas service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide purging and startup of Natural Gas supply according to requirements indicated:
 - 1. Notify Owner no fewer than two days in advance of proposed interruption of Natural Gas service.
 - 2. Do not proceed with interruption of Natural Gas service without Owner's written permission.
 - 3. Notify the "Call Before You Dig" hotline prior to excavation to access existing below grade utility information and location.

PART 2 - PRODUCTS

2.1 PIPES, TUBES, AND FITTINGS

- A. Steel Pipe: ASTM A 53/A 53M, black steel, Schedule 40, Type E or S, Grade B.
 - 1. Malleable iron Threaded Fittings: ASME B16.3, Class 150, standard pattern.
 - 2. Wrought steel Welding Fittings: ASTM A 234/A 234M for butt welding and socket welding.
 - 3. Unions: ASME B16.39, Class 150, malleable iron with brass-to-iron seat, ground joint, and threaded ends.
 - 4. Forged-Steel Flanges and Flanged Fittings: ASME B16.5, minimum Class 150, including bolts, nuts, and gaskets of the following material group, end connections, and facings:
 - a. Material Group: 1.1.
 - b. End Connections: Threaded or butt welding to match pipe.
 - c. Lapped Face: Not permitted underground.
 - d. Gasket Materials: ASME B16.20, metallic, flat, asbestos free, aluminum o-rings, and spiral-wound metal gaskets.
 - e. Bolts and Nuts: ASME B18.2.1, carbon steel aboveground and stainless steel underground.
 - 5. Protective Coating for Underground Piping: Factory applied, three-layer coating of epoxy, adhesive, and PE.

- a. Joint Cover Kits: Epoxy paint, adhesive, and heat-shrink PE sleeves.
- 6. Mechanical Couplings:
 - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1) Dresser Piping Specialties; Division of Dresser, Inc.
 - 2) Smith-Blair, Inc.
 - b. Steel flanges and tube with epoxy finish.
 - c. Buna-nitrile seals.
 - d. Steel bolts, washers, and nuts.
 - e. Coupling shall be capable of joining PE pipe to PE pipe, steel pipe to PE pipe, or steel pipe to steel pipe.
- B. Corrugated, Stainless steel Tubing: Comply with ANSI/IAS LC 1.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. OmegaFlex, Inc.
 - b. Parker Hannifin Corporation; Parflex Division.
 - c. Titeflex.
 - d. Tru-Flex Metal Hose Corp.
 - 2. Tubing: ASTM A 240/A 240M, corrugated, Series 300 stainless steel.
 - 3. Coating: PE with flame retardant.
 - a. Surface-Burning Characteristics: As determined by testing identical products according to ASTM E 84 by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
 - 1) Flame Spread Index: 25 or less.
 - 2) Smoke Developed Index: 50 or less.
 - 4. Fittings: Copper-alloy mechanical fittings with ends made to fit and listed for use with corrugated stainless steel tubing and capable of metal-to-metal seal without gaskets. Include brazing socket or threaded ends complying with ASME B1.20.1.
 - 5. Striker Plates: Steel, designed to protect tubing from penetrations.
 - 6. Manifolds: Malleable iron or steel with factory applied protective coating. Threaded connections shall comply with ASME B1.20.1 for pipe inlet and corrugated tubing outlets.
 - 7. Operating Pressure Rating: 5 PSIG (34.5 kPa).

2.2 PIPING SPECIALTIES

A. Appliance Flexible Connectors:

- 1. Indoor, Fixed Appliance Flexible Connectors: Comply with ANSI Z21.24.
- 2. Indoor, Movable Appliance Flexible Connectors: Comply with ANSI Z21.69.
- 3. Outdoor, Appliance Flexible Connectors: Comply with ANSI Z21.75.
- 4. Corrugated stainless steel tubing with polymer coating.
- 5. Operating Pressure Rating: 0.5 PSIG - 2.0 PSIG.
- 6. End Fittings: Zinc coated steel.

7. Threaded Ends: Comply with ASME B1.20.1.
8. Maximum Length: 72 inches

B. Y-Pattern Strainers:

1. Body: ASTM A 126, Class B, cast iron with bolted cover and bottom drain connection.
2. End Connections: Threaded ends for NPS 2 (DN 50) and smaller; flanged ends for NPS 2-1/2 (DN 65) and larger.
3. Strainer Screen: 40/60-mesh startup strainer, and perforated stainless-steel basket with 50 percent free area.
4. CWP Rating: 125 psig (862 kPa).

C. Quick Disconnect Devices: Comply with ANSI Z21.41.

1. Copper alloy convenience outlet and matching plug connector.
2. Nitrile seals.
3. Hand operated with automatic shutoff when disconnected.
4. For indoor or outdoor applications.
5. Adjustable, retractable restraining cable.

D. Weatherproof Vent Cap: Cast- or malleable iron increaser fitting with corrosion resistant wire screen, with free area at least equal to cross-sectional area of connecting pipe and threaded-end connection.

2.3 JOINING MATERIALS

- A. Joint Compound and Tape: Suitable for natural gas.
- B. Welding Filler Metals: Comply with AWS D10.12/D10.12M for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.
- C. Brazing Filler Metals: Alloy with melting point greater than 1000 deg F (540 deg C) complying with AWS A5.8/A5.8M. Brazing alloys containing more than 0.05 percent phosphorus are prohibited.

2.4 MANUAL GAS SHUTOFF VALVES

- A. See "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles for where each valve type is applied in various services.
- B. General Requirements for Metallic Valves, NPS 2 (DN 50) and Smaller: Comply with ASME B16.33.
1. CWP Rating: 125 psig.
 2. Threaded Ends: Comply with ASME B1.20.1.
 3. Dryseal Threads on Flare Ends: Comply with ASME B1.20.3.
 4. Tamperproof Feature: Locking feature for valves indicated in "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.
 5. Listing: Listed and labeled by an NRTL acceptable to authorities having jurisdiction for valves 1 inch (25 mm) and smaller.
 6. Service Mark: Valves 1-1/4 inches (32 mm) to NPS 2 (DN 50) shall have initials "WOG" permanently marked on valve body.
- C. General Requirements for Metallic Valves, NPS 2-1/2 (DN 65) and Larger: Comply with ASME B16.38.
1. CWP Rating: 125 psig.

2. Flanged Ends: Comply with ASME B16.5 for steel flanges.
3. Tamperproof Feature: Locking feature for valves indicated in "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.
4. Service Mark: Initials "WOG" shall be permanently marked on valve body.

D. Bronze Plug Valves: MSS SP-78.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Lee Brass Company.
 - b. McDonald, A. Y. Mfg. Co.
2. Body: Bronze, complying with ASTM B 584.
3. Plug: Bronze.
4. Ends: Threaded, socket, or flanged as indicated in "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.
5. Operator: Square head or lug type with tamperproof feature where indicated.
6. Pressure Class: 125 psig (862 kPa).
7. Listing: Valves NPS 1 (DN 25) and smaller shall be listed and labeled by an NRTL acceptable to authorities having jurisdiction.
8. Service: Suitable for Natural Gas service with "WOG" indicated on valve body.

E. Cast Iron, Non-lubricated Plug Valves: MSS SP-78.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. McDonald, A. Y. Mfg. Co.
 - b. Mueller Co.; Gas Products Div.
 - c. Xomox Corporation; a Crane company.
2. Body: Cast iron, complying with ASTM A 126, Class B.
3. Plug: Bronze or nickel-plated cast iron.
4. Seat: Coated with thermoplastic.
5. Stem Seal: Compatible with natural gas.
6. Ends: Threaded or flanged as indicated in "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.
7. Operator: Square head or lug type with tamperproof feature where indicated.
8. Pressure Class: 125 psig (862 kPa).
9. Listing: Valves NPS 1 (DN 25) and smaller shall be listed and labeled by an NRTL acceptable to authorities having jurisdiction.
10. Service: Suitable for Natural Gas service with "WOG" indicated on valve body.

F. Cast Iron, Lubricated Plug Valves: MSS SP-78.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Flowserve.
 - b. Homestead Valve; a division of Olson Technologies, Inc.
 - c. McDonald, A. Y. Mfg. Co.
 - d. Milliken Valve Company.
 - e. Mueller Co.; Gas Products Div.

2. Body: Cast iron, complying with ASTM A 126, Class B.
3. Plug: Bronze or nickel-plated cast iron.
4. Seat: Coated with thermoplastic.
5. Stem Seal: Compatible with natural gas.
6. Ends: Threaded or flanged as indicated in "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.
7. Operator: Square head or lug type with tamperproof feature where indicated.
8. Pressure Class: 125 psig (862 kPa).
9. Listing: Valves NPS 1 (DN 25) and smaller shall be listed and labeled by an NRTL acceptable to authorities having jurisdiction.
10. Service: Suitable for Natural Gas service with "WOG" indicated on valve body.

2.5 PRESSURE REGULATORS

A. General Requirements:

1. Single stage and suitable for natural gas.
2. Steel jacket and corrosion resistant components.
3. Elevation compensator.
4. End Connections: Threaded for regulators NPS 2 (DN 50) and smaller; flanged for regulators NPS 2-1/2 (DN 65) and larger.

B. Line Pressure Regulators: Comply with ANSI Z21.80.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. American Meter Company.
 - b. Eclipse Combustion, Inc.
 - c. Fisher Control Valves and Regulators; Division of Emerson Process Management.
 - d. Maxitrol Company.
2. Body and Diaphragm Case: Cast iron or die cast aluminum.
3. Springs: Zinc plated steel; interchangeable.
4. Diaphragm Plate: Zinc plated steel.
5. Seat Disc: Nitrile rubber resistant to gas impurities, abrasion, and deformation at the valve port.
6. Orifice: Aluminum; interchangeable.
7. Seal Plug: Ultraviolet stabilized, mineral filled nylon.
8. Single port, self-contained regulator with orifice no larger than required at maximum pressure inlet, and no pressure sensing piping external to the regulator.
9. Pressure regulator shall maintain discharge pressure setting downstream, and not exceed 150 percent of design discharge pressure at shutoff.
10. Overpressure Protection Device: Factory mounted on pressure regulator.
11. Atmospheric Vent: Factory- or field installed, stainless steel screen in opening if not connected to vent piping.
12. Maximum Inlet Pressure: 2 PSIG (13.8 kPa).

C. Appliance Pressure Regulators: Comply with ANSI Z21.18.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Eaton Corporation; Controls Div.
 - b. Maxitrol Company.

2. Body and Diaphragm Case: Die cast aluminum.
3. Springs: Zinc plated steel; interchangeable.
4. Diaphragm Plate: Zinc plated steel.
5. Seat Disc: Nitrile rubber.
6. Seal Plug: Ultraviolet stabilized, mineral filled nylon.
7. Factory applied Finish: Minimum three-layer polyester and polyurethane paint finish.
8. Regulator may include vent limiting device, instead of vent connection, if approved by authorities having jurisdiction.
9. Maximum Inlet Pressure: 2 PSIG (13.8 kPa).

2.6 DIELECTRIC FITTINGS

- A. General Requirements: Assembly of copper alloy and ferrous materials with separating nonconductive insulating material. Include end connections compatible with pipes to be joined.
- B. Dielectric Unions:
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Hart Industries International, Inc.
 - b. Jomar International Ltd.
 - c. Matco-Norca, Inc.
 - d. McDonald, A. Y. Mfg. Co.
 - e. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
 2. Description:
 - a. Standard: ASSE 1079.
 - b. Pressure Rating: 125 PSIG (860 kPa) minimum at 180 deg F (82 deg C).
 - c. End Connections: Solder joint copper alloy and threaded ferrous.
- C. Dielectric Flanges:
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Matco-Norca, Inc.
 - b. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
 - c. Wilkins; a Zurn company.
 2. Description:
 - a. Standard: ASSE 1079.
 - b. Factory-fabricated, bolted, companion-flange assembly.
 - c. Pressure Rating: 125 PSIG (860 kPa) minimum at 180 deg F (82 deg C).
 - d. End Connections: Solder joint copper alloy and threaded ferrous; threaded Solder joint copper alloy and threaded ferrous.
- D. Dielectric Flange Insulating Kits:
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. Advance Products & Systems, Inc.
- b. Calpico, Inc.
- c. Central Plastics Company.
- d. Pipeline Seal and Insulator, Inc.

2. Description:

- a. Nonconducting materials for field assembly of companion flanges.
- b. Pressure Rating: 150 psig (1035 kPa).
- c. Gasket: Neoprene or phenolic.
- d. Bolt Sleeves: Phenolic or polyethylene.
- e. Washers: Phenolic with steel backing washers.

PART 3 - EXECUTION

3.1 INSTALLATION OF OUTDOOR PIPING

- A. Comply with the International Fuel Gas Code for installation and purging of natural-gas piping.
- B. Install underground, natural-gas piping buried at least 36 inches below finished grade. Comply with requirements in Section 312000 "Earth Moving" for excavating, trenching, and backfilling.
- C. Install underground, PE, natural-gas piping in accordance with ASTM D2513.

3.2 EXAMINATION

- A. Examine roughing-in for Natural Gas piping system to verify actual locations of piping connections before equipment installation.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.3 PREPARATION

- A. Close equipment shutoff valves before turning off natural gas to premises or piping section.
- B. Inspect Natural Gas piping according to The City of New York Fuel Gas Code to determine that Natural Gas utilization devices are turned off in piping section affected.
- C. Comply with The City of New York Fuel Gas Code requirements for prevention of accidental ignition.

3.4 INDOOR PIPING INSTALLATION

- A. Comply with The City of New York Fuel Gas Code for installation and purging of Natural Gas piping.
- B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements are used to size pipe and calculate friction loss, expansion, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.

- C. Arrange for pipe spaces, chases, slots, sleeves, and openings in building structure during progress of construction, to allow for mechanical installations.
- D. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.
- E. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- F. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- G. Locate valves for easy access.
- H. Install Natural Gas piping at uniform grade of 2 percent down toward drip and sediment traps.
- I. Install piping free of sags and bends.
- J. Install fittings for changes in direction and branch connections.
- K. Verify final equipment locations for roughing-in.
- L. Comply with requirements in Sections specifying gas fired appliances and equipment for roughing-in requirements.
- M. Drips and Sediment Traps: Install drips at points where condensate may collect, including service meter outlets. Locate where accessible to permit cleaning and emptying. Do not install where condensate is subject to freezing.
 - 1. Construct drips and sediment traps using tee fitting with bottom outlet plugged or capped. Use nipple a minimum length of 3 pipe diameters, but not less than 3 inches (75 mm) long and same size as connected pipe. Install with space below bottom of drip to allow removal plug or cap.
- N. Extend relief vent connections for service regulators, line regulators, and overpressure protection devices to outdoors and terminate with weatherproof vent cap.
- O. Conceal pipe installations in walls, pipe spaces, utility spaces, above ceilings, below grade or floors, and in floor channels unless indicated to be exposed to view.
- P. Concealed Location Installations: Except as specified below, install concealed Natural Gas piping and piping installed under the building in containment conduit constructed of steel pipe with welded joints as described in Part 2. Install a vent pipe from containment conduit to outdoors and terminate with weatherproof vent cap.
 - 1. Above Accessible Ceilings: Natural Gas piping, fittings, valves, and regulators may be installed in accessible spaces without containment conduit.
 - 2. In Floors: Install Natural Gas piping with welded or brazed joints and protective coating in cast-in-place concrete floors. Cover piping to be cast in concrete slabs with minimum of 1-1/2 inches (38 mm) of concrete. Piping may not be in physical contact with other metallic structures such as reinforcing rods or electrically neutral conductors. Do not embed piping in concrete slabs containing quick-set additives or cinder aggregate.
 - 3. In Floor Channels: Install Natural Gas piping in floor channels. Channels must have cover and be open to space above cover for ventilation.
 - 4. In Walls or Partitions: Protect tubing installed inside partitions or hollow walls from physical damage using steel striker barriers at rigid supports.

- a. Exception: Tubing passing through partitions or walls does not require striker barriers.
- 5. Prohibited Locations:
 - a. Do not install Natural Gas piping in or through circulating air ducts, clothes or trash chutes, chimneys or gas vents (flues), ventilating ducts, or dumbwaiter or elevator shafts.
 - b. Do not install Natural Gas piping in solid walls or partitions.
 - c. Do not install Natural Gas piping in egress corridors.
- Q. Use eccentric reducer fittings to make reductions in pipe sizes. Install fittings with level side down.
- R. Connect branch piping from top or side of horizontal piping.
- S. Install unions in pipes NPS 2 (DN 50) and smaller, adjacent to each valve, at final connection to each piece of equipment. Unions are not required at flanged connections.
- T. Do not use Natural Gas piping as grounding electrode.
- U. Install strainer on inlet of each line-pressure regulator and automatic or electrically operated valve.
- V. Install pressure gage downstream from each line regulator. Pressure gages are specified in Section 230519 "Meters and Gages for HVAC Piping."
- W. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 230517 "Sleeves and Sleeve Seals for HVAC Piping."
- X. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 230517 "Sleeves and Sleeve Seals for HVAC Piping."
- Y. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 230518 "Escutcheons for HVAC Piping."
- 3.5 VALVE INSTALLATION
 - A. Install manual gas shutoff valve for each gas appliance ahead of corrugated stainless steel tubing, corrugated aluminum tubing, or copper connector.
 - B. Install underground valves with valve boxes.
 - C. Install regulators and overpressure protection devices with maintenance access space adequate for servicing and testing.
 - D. Install anode for metallic valves in underground PE piping.
 - E. Do not install valves in return-air plenums.
- 3.6 PIPING JOINT CONSTRUCTION
 - A. Ream ends of pipes and tubes and remove burrs.
 - B. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
 - C. Threaded Joints:

1. Thread pipe with tapered pipe threads complying with ASME B1.20.1.
2. Cut threads full and clean using sharp dies.
3. Ream threaded pipe ends to remove burrs and restore full inside diameter of pipe.
4. Apply appropriate tape or thread compound to external pipe threads unless dryseal threading is specified.
5. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.

D. Welded Joints:

1. Construct joints according to AWS D10.12/D10.12M, using qualified processes and welding operators.
2. Bevel plain ends of steel pipe.
3. Patch factory applied protective coating as recommended by manufacturer at field welds and where damage to coating occurs during construction.

E. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter.

F. Flanged Joints: Install gasket material, size, type, and thickness appropriate for Natural Gas service. Install gasket concentrically positioned.

G. Flared Joints: Cut tubing with roll cutting tool. Flare tube end with tool to result in flare dimensions complying with SAE J513. Tighten finger tight, then use wrench. Do not over tighten.

3.7 HANGER AND SUPPORT INSTALLATION

A. Install seismic restraints on piping. Comply with requirements for seismic-restraint devices specified in Section 230548 "Vibration and Seismic Controls for HVAC."

B. Comply with requirements for pipe hangers and supports specified in Section 230529 "Hangers and Supports for HVAC Piping and Equipment."

C. Install hangers for horizontal steel piping with the following maximum spacing and minimum rod sizes:

1. NPS 1 and Smaller: Maximum span, 96 inches ; minimum rod size, 3/8 inch.
2. NPS 1-1/4: Maximum span, 108 inches; minimum rod size, 3/8 inch.
3. NPS 1-1/2 and NPS 2: Maximum span, 108 inches; minimum rod size, 3/8 inch.
4. NPS 2-1/2 to NPS 3-1/2: Maximum span, 10 feet; minimum rod size, 1/2 inch.
5. NPS 4 and Larger: Maximum span, 10 feet; minimum rod size, 5/8 inch.

D. Install hangers for horizontal, corrugated stainless steel tubing with the following maximum spacing and minimum rod sizes:

1. NPS 3/8: Maximum span, 48 inches; minimum rod size, 3/8 inch.
2. NPS 1/2: Maximum span, 72 inches; minimum rod size, 3/8 inch.
3. NPS 3/4 and Larger: Maximum span, 96 inches; minimum rod size, 3/8 inch.

3.8 CONNECTIONS

A. Connect to utility's gas main according to utility's procedures and requirements.

B. Install Natural Gas piping electrically continuous, and bonded to gas appliance equipment grounding conductor of the circuit powering the appliance according to NFPA 70.

- C. Install piping adjacent to appliances to allow service and maintenance of appliances.
- D. Connect piping to appliances using manual gas shutoff valves and unions. Install valve within 72 inches of each gas fired appliance and equipment. Install union between valve and appliances or equipment.
- E. Sediment Traps: Install tee fitting with capped nipple in bottom to form drip, as close as practical to inlet of each appliance.

3.9 LABELING AND IDENTIFYING

- A. Comply with requirements in NYS Fuel Gas Code section "401.5 Identification".
- B. Install detectable warning tape directly above underground gas piping 12 inches below finished grade, except 6 inches below subgrade under pavements and slabs.

3.10 OUTDOOR PIPING SCHEDULE

- A. Underground natural-gas piping is to be the following:
 - 1. PE pipe and fittings joined by heat fusion; service-line risers with tracer wire terminated in an accessible location.
 - 2. Steel pipe with wrought-steel fittings and welded joints. Coat pipe and fittings with protective coating for steel piping.

3.11 PAINTING

- A. Comply with requirements in Section 099113 "Exterior Painting" and Section 099123 "Interior Painting" for painting interior and exterior Natural Gas piping.
- B. Paint exposed, exterior metal piping, valves, service regulators, service meters and meter bars, earthquake valves, and piping specialties, except components, with factory applied paint or protective coating.
 - 1. Alkyd System: MPI EXT 5.1D.
 - a. Prime Coat: Alkyd anticorrosive metal primer.
 - b. Intermediate Coat: Exterior alkyd enamel matching topcoat.
 - c. Topcoat: Exterior alkyd enamel semigloss or gloss.
 - d. Color: Gray.
- C. Paint exposed, interior metal piping, valves, service regulators, service meters and meter bars, and piping specialties, except components with factory applied paint or protective coating.
 - 1. Latex Over Alkyd Primer System: MPI INT 5.1Q.
 - a. Prime Coat: Alkyd anticorrosive metal primer.
 - b. Intermediate Coat: Interior latex matching topcoat.
 - c. Topcoat: Interior latex (low sheen) or (semigloss).
 - d. Color: Gray.
 - 2. Alkyd System: MPI INT 5.1E.

- a. Prime Coat: Alkyd anticorrosive metal primer.
- b. Intermediate Coat: Interior alkyd matching topcoat.
- c. Topcoat: Interior alkyd (flat) or (semigloss).
- d. Color: Gray.

- D. Damage and Touchup: Repair marred and damaged factory applied finishes with materials and by procedures to match original factory finish.

3.12 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Tests and Inspections:
 - 1. Test, inspect, and purge natural gas according to The State of New York Fuel Gas Code and authorities having jurisdiction.
- C. Natural Gas piping will be considered defective if it does not pass tests and inspections.
- D. Prepare test and inspection reports.

3.13 DEMONSTRATION

- A. Engage a factory authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain earthquake valves.
- B. Aboveground Natural Gas piping shall be one of the following:
 - 1. Steel pipe with malleable iron fittings and threaded joints.
 - 2. Steel pipe with wrought steel fittings and welded joints.
- C. Containment Conduit: Steel pipe with wrought steel fittings and welded joints. Coat pipe and fittings with protective coating for steel piping.

3.14 INDOOR PIPING SCHEDULE FOR SYSTEM PRESSURES LESS THAN 0.5 PSIG

- A. Aboveground, branch piping NPS 1 and smaller shall be one of the following:
 - 1. Corrugated stainless steel tubing with mechanical fittings having socket or threaded ends to match adjacent piping.
 - 2. Aluminum tube with flared fittings and joints.
 - 3. Steel pipe with malleable iron fittings and threaded joints.
- B. Aboveground, distribution piping shall be one of the following:
 - 1. Steel pipe with malleable iron fittings and threaded joints.
 - 2. Steel pipe with wrought steel fittings and welded joints.
- C. Containment Conduit: Steel pipe with wrought steel fittings and welded joints. Coat pipe and fittings with protective coating for steel piping.

- D. Containment Conduit Vent Piping: Steel pipe with malleable iron fittings and threaded or wrought steel fittings with welded joints. Coat underground pipe and fittings with protective coating for steel piping.

3.15 INDOOR PIPING SCHEDULE FOR SYSTEM PRESSURES MORE THAN 0.5 PSIG AND LESS THAN 2 PSIG

- A. Aboveground, branch piping NPS 1 and smaller shall be one of the following:
 - 1. Corrugated stainless steel tubing with mechanical fittings having socket or threaded ends to match adjacent piping.
 - 2. Aluminum tube with flared fittings and joints.
 - 3. Steel pipe with malleable iron fittings and threaded joints.
- B. Aboveground, distribution piping shall be one of the following:
 - 1. Steel pipe with malleable iron fittings and threaded joints.
 - 2. Steel pipe with steel welding fittings and welded joints.
- C. Containment Conduit: Steel pipe with wrought steel fittings and welded joints. Coat underground pipe and fittings with protective coating for steel piping.
- D. Containment Conduit Vent Piping: Steel pipe with malleable iron fittings and threaded or wrought steel fittings with welded joints. Coat underground pipe and fittings with protective coating for steel piping.

3.16 BELOWGRADE MANUAL GAS SHUTOFF VALVE SCHEDULE

- A. See "Underground, Manual Gas Shutoff Valve Schedule" and "Aboveground, Manual Gas Shutoff Valve Schedule" articles for where each valve type is applied in various services.
- B. General Requirements for Metallic Valves, NPS 2 (DN 50) and Smaller: Comply with ASME B16.33.
 - 1. Tamperproof Feature: Locking feature for valves indicated in "Underground, Manual Gas Shutoff Valve Schedule" articles.

3.17 ABOVEGROUND MANUAL GAS SHUTOFF VALVE SCHEDULE

- A. Valves for pipe sizes NPS 2 and smaller at service meter shall be one of the following:
 - 1. Bronze plug valve.
- B. Valves for pipe sizes NPS 2-1/2 and larger at service meter shall be one of the following:
 - 1. Bronze plug valve.
 - 2. Cast Iron, non-lubricated plug valve.
- C. Distribution piping valves for pipe sizes NPS 2 and smaller shall be one of the following:
 - 1. Bronze plug valve.

- D. Distribution piping valves for pipe sizes NPS 2-1/2 (DN 65) and larger shall be one of the following:
 - 1. Bronze plug valve.
 - 2. Cast Iron, non-lubricated plug valve.
- E. Valves in branch piping for single appliance shall be of the following:
 - 1. Bronze plug valve.

END OF SECTION 231123

SECTION 232113 - HYDRONIC PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes pipe and fitting materials and joining methods for the following:
 - 1. Hot-water heating piping.
 - 2. Makeup-water piping.
 - 3. Condensate-drain piping.
 - 4. Air-vent piping.
 - 5. Safety-valve-inlet and -outlet piping.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of the following:
 - 1. Pressure-seal fittings.
 - 2. Chemical treatment.

1.4 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Piping layout, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
 - 1. Suspended ceiling components.
 - 2. Other building services.
 - 3. Structural members.
- B. Qualification Data: For Installer.
- C. Welding certificates.
- D. Field quality-control reports.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications:

- B. Steel Support Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- C. Pipe Welding: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code: Section IX.
 - 1. Comply with ASME B31.9, "Building Services Piping," for materials, products, and installation.
 - 2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Hydronic piping components and installation shall be capable of withstanding the following minimum working pressure and temperature unless otherwise indicated:
 - 1. Hot-Water Heating Piping: 175 psig at 250 deg F.
 - 2. Makeup-Water Piping: 150 psig at 120 deg F.
 - 3. Condensate-Drain Piping: 40 deg F.
 - 4. Blowdown-Drain Piping: 200 deg F.
 - 5. Air-Vent Piping: 200 deg F.
 - 6. Safety-Valve-Inlet and -Outlet Piping: Equal to the pressure of the piping system to which it is attached.

2.2 COPPER TUBE AND FITTINGS

- A. Drawn-Temper Copper Tubing: ASTM B 88, Type L.
- B. Annealed-Temper Copper Tubing: ASTM B 88, Type K.
- C. DWV Copper Tubing: ASTM B 306, Type DWV.
- D. Wrought-Copper Unions: ASME B16.22.

2.3 STEEL PIPE AND FITTINGS

- A. Steel Pipe: ASTM A 53/A 53M, black steel with plain ends; welded and seamless, Grade B, and wall thickness as indicated in "Piping Applications" Article.
- B. Cast-Iron Threaded Fittings: ASME B16.4; Classes 125 and 250 as indicated in "Piping Applications" Article.
- C. Malleable-Iron Threaded Fittings: ASME B16.3, Classes 150 and 300 as indicated in "Piping Applications" Article.

- D. Malleable-Iron Unions: ASME B16.39; Classes 150, 250, and 300 as indicated in "Piping Applications" Article.
- E. Cast-Iron Pipe Flanges and Flanged Fittings: ASME B16.1, Classes 25, 125, and 250; raised ground face, and bolt holes spot faced as indicated in "Piping Applications" Article.
- F. Wrought-Steel Fittings: ASTM A 234/A 234M, wall thickness to match adjoining pipe.
- G. Wrought Cast- and Forged-Steel Flanges and Flanged Fittings: ASME B16.5, including bolts, nuts, and gaskets of the following material group, end connections, and facings:
 - 1. Material Group: 1.1.
 - 2. End Connections: Butt welding.
 - 3. Facings: Raised face.
- H. Steel Pipe Nipples: ASTM A 733, made of same materials and wall thicknesses as pipe in which they are installed.
- I. Grooved Mechanical-Joint Fittings and Couplings:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Apollo Valves; a part of Aalberts Integrated Piping Systems.
 - b. GroovJoint.
 - c. Victaulic Company.
 - 2. Joint Fittings: ASTM A536, Grade 65-45-12 ductile iron; ASTM A47/A47M, Grade 32510 malleable iron; ASTM A53/A53M, Type F, E, or S, Grade B fabricated steel; or ASTM A106/A106M, Grade B steel fittings with grooves or shoulders constructed to accept grooved-end couplings; with nuts, bolts, locking pin, locking toggle, or lugs to secure grooved pipe and fittings.
 - 3. Couplings: Ductile- or malleable-iron housing and EPDM gasket of central cavity pressure-responsive design; with nuts, bolts, locking pin, locking toggle, or lugs to secure grooved pipe and fittings.

2.4 JOINING MATERIALS

- A. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.
 - 1. ASME B16.21, nonmetallic, flat, asbestos free, 1/8-inch maximum thickness unless otherwise indicated.
 - a. Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.
 - b. Narrow-Face Type: For raised-face, Class 250, cast-iron and steel flanges.
- B. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.

- C. Plastic, Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer unless otherwise indicated.
- D. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.
- E. Brazing Filler Metals: AWS A5.8/A5.8M, BCuP Series, copper-phosphorus alloys for joining copper with copper; or BA9-1, silver alloy for joining copper with bronze or steel.
- F. Welding Filler Metals: Comply with AWS D10.12M/D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.
- G. Gasket Material: Thickness, material, and type suitable for fluid to be handled and working temperatures and pressures.

2.5 DIELECTRIC FITTINGS

- A. General Requirements: Assembly of copper alloy and ferrous materials with separating nonconductive insulating material. Include end connections compatible with pipes to be joined.
- B. Dielectric Unions:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Hart Industries International, Inc.
 - b. Jomar International, Ltd.
 - c. Matco-Norca.
 - d. Watts Regulator Co.
 - e. Zurn Industries, LLC; AquaSpec Commercial Faucet Products.
 - 2. Description:
 - a. Standard: ASSE 1079.
 - b. Pressure Rating: 175 psig minimum at 250 deg F.
 - c. End Connections: Solder-joint copper alloy and threaded ferrous.
- C. Dielectric Flanges:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Capitol Manufacturing Company.
 - b. Matco-Norca.
 - c. Watts Regulator Co.
 - d. Zurn Industries, LLC; AquaSpec Commercial Faucet Products.
 - 2. Description:

- a. Standard: ASSE 1079.
- b. Factory-fabricated, bolted, companion-flange assembly.
- c. Pressure Rating: 175 psig minimum at 250 deg F.
- d. End Connections: Solder-joint copper alloy and threaded ferrous; threaded solder-joint copper alloy and threaded ferrous.

D. Dielectric-Flange Insulating Kits:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Advance Products & Systems, Inc.
 - b. Calpico, Inc.
 - c. Central Plastics Company.
 - d. Pipeline Seal and Insulator, Inc.
2. Description:
 - a. Nonconducting materials for field assembly of companion flanges.
 - b. Pressure Rating: 175 psig minimum at 250 deg F.
 - c. Gasket: Neoprene or phenolic.
 - d. Bolt Sleeves: Phenolic or polyethylene.
 - e. Washers: Phenolic with steel backing washers.

E. Dielectric Nipples:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Elster Perfection.
 - b. Grinnell Mechanical Products.
 - c. Matco-Norca.
 - d. Precision Plumbing Products, Inc.
 - e. Victaulic Company.
2. Description:
 - a. Standard: IAPMO PS 66.
 - b. Electroplated steel nipple, complying with ASTM F 1545.
 - c. Pressure Rating: 175 psig minimum at 250 deg F.
 - d. End Connections: Male threaded
 - e. Lining: Inert and noncorrosive, propylene.

2.6 BYPASS CHEMICAL FEEDER

- A. Description: Welded steel construction; 125-psig working pressure; 5-gal. capacity; with fill funnel and inlet, outlet, and drain valves.

1. Chemicals: Specially formulated, based on analysis of makeup water, to prevent accumulation of scale and corrosion in piping and connected equipment.

PART 3 - EXECUTION

3.1 PIPING APPLICATIONS

- A. Hot-water heating piping, aboveground, NPS 2 and smaller, shall be the following:
 1. Type L, drawn-temper copper tubing, wrought-copper fittings, and soldered or brazed joints.
- B. Hot-water heating piping, aboveground, NPS 3 to NPS 6, shall be the following:
 1. Schedule 40 steel pipe, wrought-steel fittings and wrought-cast or forged-steel flanges and flange fittings, grooved joints.
- C. Hot-water heating piping, aboveground, NPS 8 and larger, shall be the following:
 1. Schedule 40 steel pipe, wrought-steel fittings and wrought-cast or forged-steel flanges and flange fittings, and welded and flanged joints.
- D. Makeup-water piping installed aboveground shall be the following:
 1. Type L, drawn-temper copper tubing, wrought-copper fittings, and soldered joints.
- E. Makeup-Water Piping Installed Belowground and within Slabs: Type K, annealed-temper copper tubing, wrought-copper fittings, and soldered joints. Use the fewest possible joints.
- F. Condensate-Drain Piping: Type M or Type DWV, drawn-temper copper tubing, wrought-copper fittings, and soldered joints.
- G. Air-Vent Piping:
 1. Inlet: Same as service where installed.
 2. Outlet: Type K, annealed-temper copper tubing with soldered or flared joints.
- H. Safety-Valve-Inlet and -Outlet Piping for Hot-Water Piping: Same materials and joining methods as for piping specified for the service in which safety valve is installed.

3.2 PIPING INSTALLATIONS

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.
- B. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.

- C. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- D. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- E. Install piping to permit valve servicing.
- F. Install piping at indicated slopes.
- G. Install piping free of sags and bends.
- H. Install fittings for changes in direction and branch connections.
- I. Install piping to allow application of insulation.
- J. Select system components with pressure rating equal to or greater than system operating pressure.
- K. Install groups of pipes parallel to each other, spaced to permit applying insulation and servicing of valves.
- L. Install drains, consisting of a tee fitting, NPS 3/4 ball valve, and short NPS 3/4 threaded nipple with cap, at low points in piping system mains and elsewhere as required for system drainage.
- M. Install piping at a uniform grade of 0.2 percent upward in direction of flow.
- N. Reduce pipe sizes using eccentric reducer fitting installed with level side up.
- O. Install branch connections to mains using tee fittings in main pipe, with the branch connected to the bottom of the main pipe. For up-feed risers, connect the branch to the top of the main pipe.
- P. Install valves according to Section 230523 "General-Duty Valves for HVAC Piping."
- Q. Install unions in piping, NPS 2 and smaller, adjacent to valves, at final connections of equipment, and elsewhere as indicated.
- R. Install flanges in piping, NPS 2-1/2 and larger, at final connections of equipment and elsewhere as indicated.
- S. Install shutoff valve immediately upstream of each dielectric fitting.
- T. Comply with requirements in Section 230553 "Identification for HVAC Piping and Equipment" for identifying piping.

- U. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 230517 "Sleeves and Sleeve Seals for HVAC Piping."
- V. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 230517 "Sleeves and Sleeve Seals for HVAC Piping."
- W. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 230518 "Escutcheons for HVAC Piping."

3.3 DIELECTRIC FITTING INSTALLATION

- A. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.
- B. Dielectric Fittings for NPS 2 and Smaller: Use dielectric nipples or unions.
- C. Dielectric Fittings for NPS 2-1/2 to NPS 4: Use dielectric flanges or flange kits.
- D. Dielectric Fittings for NPS 5 and Larger: Use dielectric flange kits.

3.4 HANGERS AND SUPPORTS

- A. Comply with requirements in Section 230529 "Hangers and Supports for HVAC Piping and Equipment" for hanger, support, and anchor devices. Comply with the following requirements for maximum spacing of supports.
- B. Comply with requirements in Section 230548 "Vibration and Seismic Controls for HVAC" for seismic restraints.
- C. Install the following pipe attachments:
 - 1. Adjustable steel clevis hangers for individual horizontal piping less than 20 feet long.
 - 2. Adjustable roller hangers and spring hangers for individual horizontal piping 20 feet or longer.
 - 3. Pipe Roller: MSS SP-58, Type 44 for multiple horizontal piping 20 feet or longer, supported on a trapeze.
 - 4. Spring hangers to support vertical runs.
 - 5. Provide copper-clad hangers and supports for hangers and supports in direct contact with copper pipe.
 - 6. On plastic pipe, install pads or cushions on bearing surfaces to prevent hanger from scratching pipe.
- D. Install hangers for steel piping with the following maximum spacing and minimum rod sizes:

1. NPS 3/4: Maximum span, 7 feet.
 2. NPS 1: Maximum span, 7 feet.
 3. NPS 1-1/2: Maximum span, 9 feet.
 4. NPS 2: Maximum span, 10 feet.
 5. NPS 2-1/2: Maximum span, 11 feet.
 6. NPS 3 and Larger: Maximum span, 12 feet.
- E. Install hangers for drawn-temper copper piping with the following maximum spacing and minimum rod sizes:
1. NPS 3/4: Maximum span, 5 feet; minimum rod size, 1/4 inch.
 2. NPS 1: Maximum span, 6 feet; minimum rod size, 1/4 inch.
 3. NPS 1-1/4: Maximum span, 7 feet; minimum rod size, 3/8 inch.
 4. NPS 1-1/2: Maximum span, 8 feet; minimum rod size, 3/8 inch.
 5. NPS 2: Maximum span, 8 feet; minimum rod size, 3/8 inch.
 6. NPS 2-1/2: Maximum span, 9 feet; minimum rod size, 3/8 inch.
 7. NPS 3 and Larger: Maximum span, 10 feet; minimum rod size, 3/8 inch.
- F. Fiberglass Piping Hanger Spacing: Space hangers according to pipe manufacturer's written instructions for service conditions. Avoid point loading. Space and install hangers with the fewest practical rigid anchor points.
- G. Support vertical runs at roof, at each floor, and at 10-foot intervals between floors.

3.5 PIPE JOINT CONSTRUCTION

- A. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- B. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
- C. Soldered Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy complying with ASTM B 32.
- D. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter, using copper-phosphorus brazing filler metal complying with AWS A5.8/A5.8M.
- E. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.

- F. Welded Joints: Construct joints according to AWS D10.12M/D10.12, using qualified processes and welding operators according to "Quality Assurance" Article.
- G. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.
- H. Grooved Joints: Assemble joints with coupling and gasket, lubricant, and bolts. Cut or roll grooves in ends of pipe based on pipe and coupling manufacturer's written instructions for pipe wall thickness. Use grooved-end fittings and rigid, grooved-end-pipe couplings.

3.6 TERMINAL EQUIPMENT CONNECTIONS

- A. Sizes for supply and return piping connections shall be the branch pipe size indicated on drawings.
- B. Install control valves in accessible locations close to connected equipment.
- C. Install bypass piping with calibrated balance valve around control valve. If parallel control valves are installed, only one bypass is required.
- D. Install ports for pressure gages and thermometers at coil inlet and outlet connections. Comply with requirements in Section 230519 "Meters and Gages for HVAC Piping."
- E. Install bypass chemical feeders in hot water system.
 - 1. Install in upright position with top of funnel not more than 48 inches above the floor.
 - 2. Install feeder in minimum NPS 3/4 bypass line, from main with full-size, full-port, ball valve in the main between bypass connections.
 - 3. Install NPS 3/4 pipe from chemical feeder drain to nearest equipment drain and include a full-size, full-port, ball valve.
- F. Fill system with fresh water and add liquid alkaline compound with emulsifying agents and detergents to remove grease and petroleum products from piping. Circulate solution for a minimum of 24 hours, drain, clean strainer screens, and refill with fresh water.
- G. Add initial chemical treatment and maintain water quality in ranges noted above for the first year of operation.
- H. Fill systems that have antifreeze or glycol solutions with the following concentrations:
 - 1. Chilled-Water Piping: Minimum of 30 percent propylene glycol.

3.7 FIELD QUALITY CONTROL

- A. Prepare hydronic piping according to ASME B31.9 and as follows:

1. Leave joints, including welds, uninsulated and exposed for examination during test.
2. Provide temporary restraints for expansion joints that cannot sustain reactions due to test pressure. If temporary restraints are impractical, isolate expansion joints from testing.
3. Flush hydronic piping systems with clean water; then remove and clean or replace strainer screens.
4. Isolate equipment from piping. If a valve is used to isolate equipment, its closure shall be capable of sealing against test pressure without damage to valve. Install blinds in flanged joints to isolate equipment.
5. Install safety valve, set at a pressure no more than one-third higher than test pressure, to protect against damage by expanding liquid or other source of overpressure during test.

B. Perform the following tests on hydronic piping:

1. Use ambient temperature water as a testing medium unless there is risk of damage due to freezing. Another liquid that is safe for workers and compatible with piping may be used.
2. While filling system, use vents installed at high points of system to release air. Use drains installed at low points for complete draining of test liquid.
3. Isolate expansion tanks and determine that hydronic system is full of water.
4. Subject piping system to hydrostatic test pressure that is not less than 1.5 times the system's working pressure. Test pressure shall not exceed maximum pressure for any vessel, pump, valve, or other component in system under test. Verify that stress due to pressure at bottom of vertical runs does not exceed 90 percent of specified minimum yield strength or 1.7 times the "SE" value in Appendix A in ASME B31.9, "Building Services Piping."
5. After hydrostatic test pressure has been applied for at least 10 minutes, examine piping, joints, and connections for leakage. Eliminate leaks by tightening, repairing, or replacing components, and repeat hydrostatic test until there are no leaks.
6. Prepare written report of testing.

C. Perform the following before operating the system:

1. Open manual valves fully.
2. Inspect pumps for proper rotation.
3. Set makeup pressure-reducing valves for required system pressure.
4. Inspect air vents at high points of system and determine if all are installed and operating freely (automatic type), or bleed air completely (manual type).
5. Set temperature controls so all coils are calling for full flow.
6. Inspect and set operating temperatures of hydronic equipment, such as boilers, chillers, cooling towers, to specified values.
7. Verify lubrication of motors and bearings.

END OF SECTION 232113

SECTION 232116 - HYDRONIC PIPING SPECIALTIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes special-duty valves and specialties for the following:

1. Hot-water heating piping.
2. Makeup-water piping.
3. Condensate-drain piping.
4. Air-vent piping.
5. Safety-valve-inlet and -outlet piping.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of the following:

1. Valves: Include flow and pressure drop curves based on manufacturer's testing for calibrated-orifice balancing valves and automatic flow-control valves.
2. Air-control devices.
3. Hydronic specialties.

1.4 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For air-control devices, hydronic specialties, and special-duty valves to include in emergency, operation, and maintenance manuals.

1.5 MAINTENANCE MATERIAL SUBMITTALS

- A. Differential Pressure Meter: For each type of balancing valve and automatic flow control valve, include flowmeter, probes, hoses, flow charts, and carrying case.

1.6 QUALITY ASSURANCE

- A. Pipe Welding: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code: Section IX.

1. Safety valves and pressure vessels shall bear the appropriate ASME label. Fabricate and stamp air separators and expansion tanks to comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Hydronic piping components and installation shall be capable of withstanding the following minimum working pressure and temperature unless otherwise indicated:
 1. Hot-Water Heating Piping: 175 psig at 250 deg F.
 2. Makeup-Water Piping: 150 psig) at 120 deg F.
 3. Condensate-Drain Piping: 40 deg F.
 4. Blowdown-Drain Piping: 200 deg F.
 5. Air-Vent Piping: 200 deg F.
 6. Safety-Valve-Inlet and -Outlet Piping: Equal to the pressure of the piping system to which it is attached.

2.2 VALVES

- A. Gate, Check, Ball, and Butterfly Valves: Comply with requirements specified in Section 230523 "General-Duty Valves for HVAC Piping."Section 15112 "General-Duty Valves for HVAC Piping."
- B. Bronze, Calibrated-Orifice, Balancing Valves:
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Armstrong Pumps, Inc.
 - b. Bell & Gossett Domestic Pump.
 - c. Flow Design Inc.
 - d. Gerand Engineering Co.
 - e. Griswold Controls.
 - f. Nexus Valve, Inc.
 - g. Taco.
 - h. Tour & Andersson; available through Victaulic Company.
 2. Body: Bronze, ball or plug type with calibrated orifice or venturi.
 3. Ball: Brass or stainless steel.
 4. Plug: Resin.
 5. Seat: PTFE.
 6. End Connections: Threaded or socket.
 7. Pressure Gage Connections: Integral seals for portable differential pressure meter.
 8. Handle Style: Lever, with memory stop to retain set position.
 9. CWP Rating: Minimum 125 psig (860 kPa).
 10. Maximum Operating Temperature: 250 deg F (121 deg C).

C. Cast-Iron or Steel, Calibrated-Orifice, Balancing Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Armstrong Pumps, Inc.
 - b. Bell & Gossett Domestic Pump.
 - c. Flow Design Inc.
 - d. Gerand Engineering Co.
 - e. Griswold Controls.
 - f. Nexus Valve, Inc.
 - g. Taco.
 - h. Tour & Andersson.
2. Body: Cast-iron or steel body, ball, plug, or globe pattern with calibrated orifice or venturi.
3. Ball: Brass or stainless steel.
4. Stem Seals: EPDM O-rings.
5. Disc: Glass and carbon-filled PTFE.
6. Seat: PTFE.
7. Pressure Gage Connections: Integral seals for portable differential pressure meter.
8. Handle Style: Lever, with memory stop to retain set position.
9. CWP Rating: Minimum 125 psig (860 kPa).
10. Maximum Operating Temperature: 250 deg F (121 deg C).

D. Diaphragm-Operated, Pressure-Reducing Valves: ASME labeled.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. AMTROL, Inc.
 - b. Armstrong Pumps, Inc.
 - c. Bell & Gossett Domestic Pump.
 - d. Conbraco Industries, Inc.
 - e. Spence Engineering Company, Inc.
 - f. Watts Regulator Co.
2. Body: Bronze or brass.
3. Disc: Glass and carbon-filled PTFE.
4. Seat: Brass.
5. Stem Seals: EPDM O-rings.
6. Diaphragm: EPT.
7. Low inlet-pressure check valve.
8. Inlet Strainer: removable without system shutdown.
9. Valve Seat and Stem: Noncorrosive.
10. Valve Size, Capacity, and Operating Pressure: Selected to suit system in which installed, with operating pressure and capacity factory set and field adjustable.

E. Diaphragm-Operated Safety Valves: ASME labeled.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. AMTROL, Inc.
 - b. Armstrong Pumps, Inc.
 - c. Bell & Gossett Domestic Pump.
 - d. Conbraco Industries, Inc.
 - e. Spence Engineering Company, Inc.
 - f. Watts Regulator Co.
2. Body: Bronze or brass.
3. Disc: Glass and carbon-filled PTFE.
4. Seat: Brass.
5. Stem Seals: EPDM O-rings.
6. Diaphragm: EPT.
7. Wetted, Internal Work Parts: Brass and rubber.
8. Inlet Strainer: removable without system shutdown.
9. Valve Seat and Stem: Noncorrosive.
10. Valve Size, Capacity, and Operating Pressure: Comply with ASME Boiler and Pressure Vessel Code: Section IV, and selected to suit system in which installed, with operating pressure and capacity factory set and field adjustable.

F. Automatic Flow-Control Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Flow Design Inc.
 - b. Griswold Controls.
 - c. Nexus Valve, Inc.
2. Body: Brass or ferrous metal.
3. Piston and Spring Assembly: Stainless steel, tamper proof, self-cleaning, and removable.
4. Combination Assemblies: Include bronze or brass-alloy ball valve.
5. Identification Tag: Marked with zone identification, valve number, and flow rate.
6. Size: Same as pipe in which installed.
7. Performance: Maintain constant flow, plus or minus 5 percent over system pressure fluctuations.
8. Minimum CWP Rating: 175 psig.
9. Maximum Operating Temperature: 250 deg F.

2.3 AIR-CONTROL DEVICES

A. Manual Air Vents:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. AMTROL, Inc.

- b. Armstrong Pumps, Inc.
 - c. Bell & Gossett Domestic Pump.
 - d. Nexus Valve, Inc.
 - e. Taco, Inc.
2. Body: Bronze.
 3. Internal Parts: Nonferrous.
 4. Operator: Screwdriver or thumbscrew.
 5. Inlet Connection: NPS 1/2 (DN 15).
 6. Discharge Connection: NPS 1/8 (DN 6).
 7. CWP Rating: 150 psig (1035 kPa).
 8. Maximum Operating Temperature: 225 deg F (107 deg C).

B. Automatic Air Vents:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. AMTROL, Inc.
 - b. Armstrong Pumps, Inc.
 - c. Bell & Gossett Domestic Pump.
 - d. Nexus Valve, Inc.
 - e. Taco, Inc.
2. Body: Bronze or cast iron.
3. Internal Parts: Nonferrous.
4. Operator: Noncorrosive metal float.
5. Inlet Connection: NPS 1/2 (DN 15).
6. Discharge Connection: NPS 1/4 (DN 8).
7. CWP Rating: 150 psig (1035 kPa).
8. Maximum Operating Temperature: 240 deg F (116 deg C).

C. Expansion Tanks:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. AMTROL, Inc.
 - b. Armstrong Pumps, Inc.
 - c. Bell & Gossett Domestic Pump.
 - d. Taco, Inc.
2. Tank: Welded steel, rated for 125-psig (860-kPa) working pressure and 375 deg F (191 deg C) maximum operating temperature, with taps in bottom of tank for tank fitting and taps in end of tank for gage glass. Tanks shall be factory tested after taps are fabricated and shall be labeled according to ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.
3. Air-Control Tank Fitting: Cast-iron body, copper-plated tube, brass vent tube plug, and stainless-steel ball check, 100-gal. (379-L) unit only; sized for compression-tank diameter. Provide tank fittings for 125-psig (860-kPa) working pressure and 250 deg F (121 deg C) maximum operating temperature.

4. Tank Drain Fitting: Brass body, nonferrous internal parts; 125-psig (860-kPa) working pressure and 240 deg F (116 deg C) maximum operating temperature; constructed to admit air to compression tank, drain water, and close off system.
5. Gage Glass: Full height with dual manual shutoff valves, 3/4-inch- (20-mm-) diameter gage glass, and slotted-metal glass guard.

D. Bladder-Type Expansion Tanks:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. AMTROL, Inc.
 - b. Armstrong Pumps, Inc.
 - c. Bell & Gossett Domestic Pump.
 - d. Taco, Inc.
2. Tank: Welded steel, rated for 125-psig (860-kPa) working pressure and 375 deg F (191 deg C) maximum operating temperature. Factory test after taps are fabricated and supports installed and are labeled according to ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.
3. Bladder: Securely sealed into tank to separate air charge from system water to maintain required expansion capacity.
4. Air-Charge Fittings: Schrader valve, stainless steel with EPDM seats.

E. Tangential-Type Air Separators:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. AMTROL, Inc.
 - b. Armstrong Pumps, Inc.
 - c. Bell & Gossett Domestic Pump.
 - d. Taco, Inc.
2. Tank: Welded steel; ASME constructed and labeled for 125-psig (860-kPa) minimum working pressure and 375 deg F (191 deg C) maximum operating temperature.
3. Air Collector Tube: Perforated stainless steel, constructed to direct released air into expansion tank.
4. Tangential Inlet and Outlet Connections: Threaded for NPS 2 (DN 50) and smaller; flanged connections for NPS 2-1/2 (DN 65) and larger.
5. Blowdown Connection: Threaded.
6. Size: Match system flow capacity.

F. In-Line Air Separators:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. AMTROL, Inc.
 - b. Armstrong Products, Inc.

- c. Bell & Gossett Domestic Pump.
- d. Taco, Inc.
- 2. Tank: One-piece cast iron with an integral weir constructed to decelerate system flow to maximize air separation.
- 3. Maximum Working Pressure: Up to 175 psig (1207 kPa).
- 4. Maximum Operating Temperature: Up to 300 deg F (149 deg C).

G. Air Purgers:

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. AMTROL, Inc.
 - b. Armstrong Pumps, Inc.
 - c. Bell & Gossett Domestic Pump.
 - d. Taco, Inc.
- 2. Body: Cast iron with internal baffles that slow the water velocity to separate the air from solution and divert it to the vent for quick removal.
- 3. Maximum Working Pressure: 150 psig (1035 kPa).
- 4. Maximum Operating Temperature: 250 deg F (121 deg C).

2.4 HYDRONIC PIPING SPECIALTIES

A. Y-Pattern Strainers:

- 1. Body: ASTM A 126, Class B, cast iron with bolted cover and bottom drain connection.
- 2. End Connections: Threaded ends for NPS 2 (DN 50) and smaller; flanged ends for NPS 2-1/2 (DN 65) and larger.
- 3. Strainer Screen: Stainless-steel mesh strainer, or perforated stainless-steel basket.
- 4. CWP Rating: 125 psig (860 kPa).

B. Basket Strainers:

- 1. Body: ASTM A 126, Class B, high-tensile cast iron with bolted cover and bottom drain connection.
- 2. End Connections: Threaded ends for NPS 2 (DN 50) and smaller; flanged ends for NPS 2-1/2 (DN 65) and larger.
- 3. Strainer Screen: 60 mesh startup strainer, and perforated stainless-steel basket with 50 percent free area.
- 4. CWP Rating: 125 psig (860 kPa).

C. T-Pattern Strainers:

- 1. Body: Ductile or malleable iron with removable access coupling and end cap for strainer maintenance.
- 2. Strainer Screen: 60-mesh startup strainer, and perforated stainless-steel basket with 57 percent free area.

3. CWP Rating: 750 psig (5170 kPa).

D. Stainless-Steel Bellow, Flexible Connectors:

1. Body: Stainless-steel bellows with woven, flexible, bronze, wire-reinforcing protective jacket.
2. End Connections: Threaded or flanged to match equipment connected.
3. Performance: Capable of 3/4-inch (20-mm) misalignment.
4. CWP Rating: 150 psig (1035 kPa).
5. Maximum Operating Temperature: 250 deg F (121 deg C).

E. Spherical, Rubber, Flexible Connectors:

1. Body: Fiber-reinforced rubber body.
2. End Connections: Steel flanges drilled to align with Classes 150 and 300 steel flanges.
3. Performance: Capable of misalignment.
4. CWP Rating: 150 psig (1035 kPa).
5. Maximum Operating Temperature: 250 deg F (121 deg C).

PART 3 - EXECUTION

3.1 VALVE APPLICATIONS

- A. Install shutoff-duty valves at each branch connection to supply mains and at supply connection to each piece of equipment.
- B. Install calibrated-orifice, balancing valves at each branch connection to return main.
- C. Install calibrated-orifice, balancing valves in the return pipe of each heating or cooling terminal.
- D. Install check valves at each pump discharge and elsewhere as required to control flow direction.
- E. Install safety valves at hot-water generators and elsewhere as required by ASME Boiler and Pressure Vessel Code. Install drip-pan elbow on safety-valve outlet and pipe without valves to the outdoors; pipe drain to nearest floor drain or as indicated on Drawings. Comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1, for installation requirements.
- F. Install pressure-reducing valves at makeup-water connection to regulate system fill pressure.

3.2 HYDRONIC SPECIALTIES INSTALLATION

- A. Install automatic air vents at high points of system piping in mechanical equipment rooms only. Install manual vents at heat-transfer coils and elsewhere as required for air venting.

- B. Install piping from boiler air outlet, air separator, or air purger to expansion tank with a 2 percent upward slope toward tank.
- C. Install tangential air separator in pump suction. Install blowdown piping with gate or full-port ball valve; extend full size to nearest floor drain.
- D. Install expansion tanks on the floor. Vent and purge air from hydronic system, and ensure that tank is properly charged with air to suit system Project requirements.

END OF SECTION 232116

SECTION 232123 - WET MOTOR PUMPS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Wet-rotor pumps.

1.2 DEFINITIONS

- A. ECM: Electronically commutated motor.
- B. EPDM: Ethylene propylene diene monomer.
- C. EPR: Ethylene propylene rubber.
- D. EPT: Ethylene propylene terpolymer.
- E. FKM: Fluoroelastomer polymer.
- F. HI: Hydraulic Institute.
- G. NBR: Nitrile rubber or Buna-N.
- H. ODP: Open, drip proof.
- I. TEFC: Totally enclosed, fan-cooled.
- J. TENV: Totally enclosed, non-ventilated.
- K. VFD: Variable-frequency controller.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of pump.
 - 1. Include published performance curves and rated capacities, operating characteristics, furnished specialties, final impeller dimensions, and accessories for each type of product indicated.
 - 2. Indicate pump's operating point on curves.
- B. Shop Drawings: For each pump.

1. Show pump layout and connections.
2. Include setting drawings with templates for installing foundation and anchor bolts and other anchorages.
3. Include diagrams for power, signal, and control wiring.

C. Delegated Design Submittal: For each pump.

1. Design calculations and vibration isolation base details, signed and sealed by a qualified professional engineer.
 - a. Design Calculations: Calculate requirements for selecting vibration isolators and seismic restraints and for designing vibration isolation bases.
 - b. Vibration Isolation Base Details: Detail fabrication, including anchorages and attachments to structure and to supported equipment. Include adjustable motor bases, rails, and frames for equipment mounting.

1.4 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Plans, or BIM model, drawn to scale, showing the items described in this Section, and coordinated with all building trades.
- B. Seismic Qualification Data: Certificates for pumps, accessories, and components.
 1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
 2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
 3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
- C. Field quality-control reports.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For pumps to include in operation, and maintenance manuals.

1.6 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish spare parts that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 1. Seal Kit: One mechanical seal kit(s) for each pump.
 2. Bearings.
 3. Gaskets.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Provide pumps and associated equipment that are in compliance with energy conservation guidelines published in 2020 by the U.S. Department of Energy Rulemaking Committee for commercial and industrial pumps.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- C. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design vibration isolation and seismic restraints.
- D. Seismic Performance: Pumps to withstand the effects of earthquake motions determined in accordance with ASCE/SEI 7.
 - 1. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."
 - 2. Component Importance Factor: 1.5.

2.2 Wet Rotor Pumps

- A. Basis-of-Design Product: Subject to compliance with requirements, provide Taco Comfort Solutions, Inc.; VR30 Series or comparable product by one of the following:
 - 1. Bell & Gossett.
 - 2. Grundfos Co. Inc.
- B. Source Limitations: Obtain pumps from single source from single manufacturer.
- C. Description: Factory-assembled and -tested, wet-rotor pump. Pump and motor to form an integral unit with bearings lubricated by the pumped liquid.
- D. Pump Construction:
 - 1. Body: Cast iron.
 - 2. Impeller: Type 304 stainless steel.
 - 3. Pump Shaft: Stainless steel.
 - 4. Bearings. Metal-impregnated carbon.
- E. Motor: Variable speed.

1. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by an NRTL, and marked for intended location and use.
 2. Comply with NEMA designation, temperature rating, service factor, and efficiency requirements for motors specified in Section 230513 "Common Motor Requirements for HVAC Equipment."
 3. ECM type.
- F. Capacities and Characteristics:
- a. As per Drawing Schedules.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine equipment foundations and anchor-bolt locations for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine roughing-in for piping systems to verify actual locations of piping connections before pump installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PUMP INSTALLATION

- A. Comply with HI 14.4 and HI 2.4.
- B. Install pumps to provide access for periodic maintenance including removing motors, impellers, couplings, and accessories.
- C. Where required, Independently support pumps and piping so weight of piping is not supported by pumps and weight of pumps is not supported by piping.
- D. Equipment Mounting:
 1. Comply with requirements for vibration isolation and seismic-control devices specified in Section 230548 "Vibration and Seismic Controls for HVAC."
 2. Comply with requirements for vibration isolation devices specified in Section 230548.13 "Vibration Controls for HVAC."
- E. Equipment Mounting: Install in-line pumps with continuous-thread hanger rods and spring hangers with vertical-limit stop of size required to support weight of in-line pumps.
 1. Comply with requirements for seismic-restraint devices specified in Section 230548 "Vibration and Seismic Controls for HVAC."
 2. Comply with requirements for hangers and supports specified in Section 230529 "Hangers and Supports for HVAC Piping and Equipment."

3.3 ALIGNMENT

- A. Engage a service representative to perform alignment service.
- B. Perform alignment service. When required by manufacturer to maintain warranty coverage, engage a factory-authorized service representative to perform it.
- C. Comply with pump and coupling manufacturers' written instructions.
- D. After alignment is correct, tighten foundation bolts evenly but not too firmly. Completely fill baseplate with nonshrink, nonmetallic grout while metal blocks and shims or wedges are in place. After grout has cured, fully tighten foundation bolts.

3.4 PIPING CONNECTIONS

- A. Where installing piping adjacent to pump, allow space for service and maintenance.
- B. Connect piping to pumps. Install valves that are same size as piping connected to pumps.
- C. Install suction and discharge pipe sizes equal to or greater than diameter of pump nozzles.
- D. Install triple-duty valve on discharge side of pumps.
- E. Install Y-type strainer and shutoff valve on suction side of pumps.
 - 1. Use startup strainer for initial system startup. Install permanent strainer element before turnover of system to Owner.
- F. Install pressure gauges on pump suction and discharge or at integral pressure-gauge tapping, or install single gauge with multiple-input selector valve.
- G. Install check valve on each condensate pump unit discharge unless unit has a factory-installed check valve.

3.5 ELECTRICAL CONNECTIONS

- A. Connect wiring in accordance with Section 260519 "Low-Voltage Electrical Power Conductors and Cables."
- B. Ground equipment in accordance with Section 260526 "Grounding and Bonding for Electrical Systems."
- C. Install electrical devices furnished by manufacturer, but not factory mounted, in accordance with NFPA 70 and NECA 1.
- D. Install nameplate for each electrical connection, indicating electrical equipment designation and circuit number feeding connection.

1. Nameplate to be laminated acrylic or melamine plastic signs, as specified in Section 260553 "Identification for Electrical Systems."
2. Nameplate to be laminated acrylic or melamine plastic signs with a black background and engraved white letters at least 1/2 inch high.

3.6 CONTROL CONNECTIONS

- A. Install control and electrical power wiring to field-mounted control devices.
- B. Connect control wiring in accordance with Section 260523 "Control-Voltage Electrical Power Cables."

3.7 STARTUP SERVICE

- A. Engage a factory-authorized service representative to perform startup service.
 1. Complete installation and startup checks in accordance with manufacturer's written instructions.
 2. Check piping connections for tightness.
 3. Clean strainers on suction piping. Use startup strainer for initial startup.
 4. Perform the following startup checks for each pump before starting:
 - a. Verify bearing lubrication.
 - b. Verify that pump is free to rotate by hand and that pump for handling hot liquid is free to rotate with pump hot and cold. If pump is bound or drags, do not operate until cause of trouble is determined and corrected.
 - c. Verify that pump is rotating in correct direction.
 5. Prime pump by opening suction valves and closing drains, and prepare pump for operation.
 6. Start motor.
 7. Open discharge valve slowly.

3.8 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- B. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.
- C. Perform tests and inspections with the assistance of a factory-authorized service representative.
- D. Hydronic pumps will be considered defective if they do not pass tests and inspections.
- E. Prepare test and inspection reports.

3.9 DEMONSTRATION

- A. Train Owner's maintenance personnel to adjust, operate, and maintain hydronic pumps.

END OF SECTION 232123

SECTION 235100 – FACTORY BREECHINGS AND ACCESSORIES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Factory metal breechings.

1.2 REFERENCES

B. Underwriters Laboratories (UL):

- 1.1 UL1738

C. National Fire Protection Association (NFPA):

- 1.1 NFPA 54 – National Fuel Gas Code
- 1.2 NFPA 211 – Standard for Chimneys, fireplaces, Vents, and Solid Fuel-Burning Appliances.

1.3 WARRANTY

- D. Condensing Appliance vent listed to UL1738 shall have a limited lifetime warranty to begin at the date of installation. Any portion of the vent repaired or replaced under warranty shall be warranted for the remainder of the original warranty period.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For breechings.

1. Include plans, elevations, sections, and attachment details.
2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
3. Detail fabrication and assembly of hangers and seismic restraints.

1.2 INFORMATIONAL SUBMITTALS

A. Sample Warranty: For special warranty.

1.3 QUALITY ASSURANCE

A. Welding Qualifications: Qualify procedures and personnel according to the following:

1. AWS D1.1/D1.1M, "Structural Welding Code - Steel," for hangers and supports.
 2. AWS D9.1/D9.1M, "Sheet Metal Welding Code," for shop and field welding of joints and seams in breechings.
- B. Certified Sizing Calculations: Manufacturer shall certify venting system sizing calculations.

PART 2 - PRODUCTS

2.1.1 AVAILABLE MANUFACTURERS

- A. Model FCSSW as manufactured by Metal-Fab, Inc.
- B. Duravent Group.

2.1.2 LISTED VENTING FOR CONDENSING APPLIANCES

- A. The condensing appliance vent shall be single-wall construction for use with Category II natural draft appliances and Category III or IV positive pressure appliances.
- B. Maximum temperature shall not exceed 550° F.
- C. Vent shall be listed for an internal static pressure of 15 inches w.g. and tested to 37.5 inches w.g. for diameters 3 to 36 inch.
- D. Vent shall be constructed of UNS S44735 AL29-4C material tested to UL1738, .015 inch thickness for 6 inch to 12 inch diameters, .024 inch thickness for 14 inch to 24 inch diameters, and .035 inch thickness for 26 inch to 36 inch diameters.
- E. Joint assembly utilizes flanged mating surfaces, with a self-guiding 1" sleeve for diameters 6 inch - 24 inch. P077 sealant will be used on the flange surface and in the vee band. Flanges are joined with a vee band secured by tightening draw bolts. Manufacturers and products listed in SpecAgent and Masterworks Paragraph Builder are neither recommended nor endorsed by the AIA or Deltek. Before inserting names, verify that manufacturers and products listed there comply with requirements retained or revised in descriptions and are both available and suitable for the intended applications. For definitions of terms and requirements for Contractor's product selection, see Section 016000 "Product Requirements."

PART 3 - EXECUTION

3.1 INSTALLATION OF UNLISTED, FIELD-FABRICATED BREECHINGS

- A. Install breechings on dual-fuel boilers, oven vents, water heaters, fireplaces, and other solid-fuel-burning appliances.
- B. Suspend breechings independent of their appliance connections.
- C. Install seismic restrains according to manufacturer's written instructions. Comply with requirements in Section 230548 "Vibration and Seismic Controls for HVAC."
- D. Align breechings at connections, with smooth internal surface and a maximum 1/8-inch misalignment tolerance.

- E. Slope breechings down in direction of appliance, with condensate drain connection at lowest point piped to nearest drain.
- F. Lap joints in direction of flow.
- G. Support breechings from building structure with bolts, concrete inserts, steel expansion anchors, welded studs, C clamps, or beam clamps.
- H. Clean breechings internally, during and after installation, to remove dust and debris. Clean external surfaces to remove welding slag and mill film. Grind welds smooth and apply touchup finish to match factory or shop finish.
- I. After completing system installation, remove burrs, dirt, and construction debris, and repair damaged finishes.
- J. Provide temporary closures at ends of breechings that are not completed or connected to equipment.

END OF SECTION 235100

SECTION 23 52 16.13 - SAMPLE SPECIFICATION FOR STAINLESS-STEEL CONDENSING
BOILERS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

ANSI Z21.13 / CSA 4.9 (Gas Fired Low Pressure Steam and Hot Water Boilers)

ASME Section IV ("H" Stamp Heating Boilers)

ASME CSD-1 (Controls and Safety Devices)

NBIC - Part 1 (Installation)

NFPA 54/ANSI Z221.3 (National Fuel Gas Code)

NFPA 70 (National Electric Code)

1.02 SUMMARY

A. This section includes gas-fired, high efficiency condensing hot water boilers with Stainless Steel heat exchangers.

B. Related Sections include, but are not limited to, the following:

Section 23 05 19 "Meters and Gages for HVAC Piping"

Section 23 05 23 "General-Duty Valves for HVAC Piping"

Section 23 05 29 "Hangers and Supports for HVAC Piping and Equipment"

Section 23 05 48 "Vibration and Seismic Controls for HVAC Piping..."

Section 23 05 53 "Identification for HVAC Piping and Equipment"

Section 23 07 19 "HVAC Piping Insulation"

Section 23 21 00 "Hydronic Piping and Pumps"

1.03 SUBMITTALS

The contractor shall submit, in a timely manner, all submittals for approval to the engineer. Under no circumstances shall the contractor install any materials until the engineer has made final approval on the submittals.

Product data and/or drawings shall be submitted to the engineer for approval and shall consist of:

General assembly drawing of the boiler including product description, model number, dimensions, clearances, weights, service sizes, etc.

Schematic flow diagram of the boiler's gas valve train(s).

Schematic wiring diagram of the boiler's control system that shows all components, interlocks, etc. and shall clearly identify factory wiring and field wiring.

Full Function Factory Fire Test must be performed and documented on the boiler's fire test label. A Factory Authorized Start-up must be completed prior to final acceptance by the engineer.

Operation and Maintenance Manuals shall be submitted prior to final acceptance by the engineer and shall contain shop drawings, product data, operating instructions, cleaning procedures, replacement parts list, maintenance and repair data, etc.

1.04 QUALITY ASSURANCE

The equipment shall, at a minimum, be in strict compliance with the requirements of this specification, shall perform as specified and shall be the manufacturer's standard commercial product unless specified otherwise.

Electrically operated components specified are to be "Listed" and/or "Labeled" as defined by NFPA 70, Article 100.

Boiler shall bear an ASME "H" stamp in accordance with ASME Section IV.

Boiler shall be CSA certified to the ANSI Z21.13 / CSA 4.9 standard for Gas Fired Low Pressure Steam and Hot Water Boilers and shall bear an authorized CSA rating label.

Boiler shall be AHRI listed and certified in accordance with the Commercial Boiler program and the BTS-2000 testing standard.

Boiler shall undergo a Full Function Factory Fire Test and bear a fire test label.

Boiler shall be registered through the National Board from the factory.

The manufacturer shall make available, upon request, all quality assurance documentation and results of Full Function Factory Fire Test based on the boiler's serial number.

1.05 COORDINATION

Equipment shall be handled, stored and installed in accordance with the manufacturer's instructions.

Factory Authorized Start-up must be completed after all appliance connections are completed, e.g. gas piping, hydronic piping, exhaust venting & electrical.

1.06 WARRANTY

The boiler manufacturer shall warrant each boiler, including boiler, trim, boiler control system, and all related components, accessories, and appurtenances against defects in workmanship and material for a period of twelve (12) months from date of startup, provided that startup is completed within six (6) months of shipment and the start-up report is furnished to the manufacturer within thirty (30) days of startup.

The boiler manufacturer shall warrant the boiler's fuel burner for a period of five (5) years from date of startup, provided that startup is completed within six (6) months of shipment and the start-up report is furnished to the manufacturer within thirty (30) days of startup.

The boiler manufacturer shall warrant the boiler's heat exchanger for a period of ten (10) years from date of startup, provided that startup is completed within six (6) months of shipment and the start-up report is furnished to the manufacturer within thirty (30) days of startup.

The boiler manufacturer shall also warrant the boiler's heat exchanger against failure due to thermal shock for a period of ten (10) years from date of startup, provided that startup is completed within six (6) months of shipment and the start-up report is furnished to the manufacturer within thirty (30) days of startup.

1.07 CERTIFICATION

Manufacturer's Certification - The boiler manufacturer shall certify the following:

The products and systems furnished are in strict compliance with the specifications.

The boiler, burner and other associated mechanical and electrical equipment have all been properly coordinated and integrated to provide a complete and operable boiler.

The boiler shall be in compliance with ANSI Z21.13 / CSA 4.9 (latest edition).

The boiler shall be CSA certified for at least 96% efficiency based on operating conditions specified for testing under ANSI Z21.13 / CSA 4.9.

The boiler shall be AHRI certified for at least 96% efficiency based on operating conditions specified for testing under BTS-2000.

The boiler shall be in compliance with ASME Section IV (latest edition).

The boiler shall be in compliance with ASME CSD-1 (latest edition).

The boiler's H-3 form shall be registered with the National Board.

Contractor's Certification - The installing contractor shall certify the following:

The products and systems installed are in strict compliance with the specifications and all applicable local and/or state codes.

The specified field tests have been satisfactorily performed by a factory authorized startup agent.

The equipment furnished contains inter-changeable parts with the specified equipment so that all major equipment parts can be obtained from the specified manufacturer.

PART 2 - PRODUCT

2.01 MANUFACTURERS

Furnish and install factory "packaged" low pressure hot water boiler(s) as manufactured by Harsco Industrial, Patterson-Kelley or as approved and accepted by the Engineer as defined in the table below:

Model Number	Fuel Type	Vent Category	Max Input High Fire (BTU/Hr)	Min Input Low Fire (BTU/Hr)	Turndown Ratio	Max Output (BTU/Hr)	AHRI Efficiency
ST-1500	NG	II or IV	1,500,000	150,000	10:1	1,455,000	97%

Each factory "packaged" boiler shall be complete with all components and accessories necessary for a complete and operable boiler as hereinafter specified. Each boiler shall be furnished factory assembled with the required wiring and piping as a self-contained unit. Each boiler shall be readily transported and ready for installation.

All "Approved Equal" or "Approved Alternate" boilers must demonstrate compliance with the requirements of this specification.

2.02 COMPONENTS

CABINET ENCLOSURE

Each boiler shall feature a fully assembled cabinet enclosure fabricated from Carbon Steel or Aluminum sheet metal (minimum 16 Gauge) with powder coat finish.

The boiler's cabinet enclosure shall not exceed 34" in width and the completed boiler shall fit through a standard 36" wide doorway.

The boiler's cabinet enclosure shall feature removable access panels / doors that can be easily opened.

The boiler's cabinet enclosure shall eliminate the use of refractory or other insulating materials by baffling the combustion air around the heat exchanger and the outer surface temperature shall not exceed 20°F above ambient temperature.

The boiler's cabinet enclosure shall prominently display all required safety, instruction, compliance and factory runout labels.

HEAT EXCHANGER

Each water-tube boiler shall contain an ASME Section IV heat exchanger with an "H" stamp designed for a maximum allowable working pressure of 160 PSIG and a maximum allowable temperature of 210°F.

The completed heat exchanger shall consist of welded 316L SS helical water tubes and provide no less than the total fireside heating surface area defined in the table below:

	ST1250	ST1500	ST1750	ST2000
Heating Surface Area	100.17 ft ²	119.8 ft ²	153.19 ft ²	153.19 ft ²

Each completed heat exchanger shall include an integral stainless steel condensate pan/collector, condensate drain, removable burner assembly, inlet temperature sensor, outlet temperature sensor, flue gas temperature sensor, heat exchanger temperature sensor, automatic air vent, thermowell for high temperature limit capillary, low water cutoff probe or flow switch, and all necessary assembly hardware.

Each stainless steel heat exchanger shall be designed to maintain water turbulence at the full published range of acceptable flow rates at various boiler conditions as described below:

The maximum allowable flow rate will generate a 20°F ΔT when the boiler is operating at full capacity.

The minimum allowable flow rate will generate a 60°F ΔT when the boiler is operating at full capacity.

The boiler's completed heat exchanger shall be capable of operating with a minimum outlet water temperature of 42°F.

Each heat exchanger must be hydrostatically tested by the manufacturer to a minimum of 1-1/2 times the maximum allowable working pressure for a minimum of 5 minutes. During this hydrostatic pressure test, the operator will inspect the pressure gauge and visually verify there are no water leaks.

MAIN GAS TRAIN

Boilers configured for single fuel operation shall be equipped with an integral main gas valve train capable of burning Natural Gas.

Each gas valve train shall include at least the following:

One (1) upstream manual shutoff valve for field-connection.

One (1) combination Air-Gas ratio control and safety shutoff valve with dual solenoids (in-series) that can be independently energized for leak testing and integrated into a single body design. The combination gas valve shall operate as a "Zero Governor" and control to a neutral gas pressure inside the gas valve.

One (1) low gas pressure switch (manual reset).

One (1) high gas pressure switch (manual reset).

Two (2) gas pressure test ports.

One (1) downstream manual shutoff valve.

Each gas train shall be completely independent and include dedicated safety devices, shutoff valves, etc. Each gas train shall be individually identified by the manufacturer with labels and dedicated paint colors (Yellow = Natural Gas).

The main gas valve train(s) shall be factory assembled, piped, and wired and allow for operation at full rated boiler capacity from 3.5 - 4.0" W.C. up to the maximum inlet gas pressure of 14.0" W.C.

If the supplied gas pressure exceeds 14" W.C., the contractor shall supply a suitable intermediate gas pressure regulator of the lock-up type to reduce the gas pressure to acceptable levels.

POWER BURNER

The boiler manufacturer shall furnish an integral power type fuel burner with each boiler. The complete power fuel burner assembly shall consist of a gas burner, combustion air blower, main gas valve train, and ignition system. The burner manufacturer shall fully coordinate the burner design with the boiler's heat exchanger and the boiler control system in order to provide the required capacities, efficiencies, and performance specified. Boilers shipped without a power burner and field-equipped with a 3rd party power burner are not acceptable.

Each burner shall be installed horizontally inside the combustion chamber with combustion gases flowing downward through the heat exchanger. The burner shall consist of a stainless steel flange and perforated stainless steel cylinder.

Each boiler shall be equipped with direct spark ignition. Main flame shall be monitored and controlled by a flame rod / ionization probe (rectification) system.

BOILER SAFETY and TRIM DEVICES

The boiler manufacturer shall furnish and test the following safety and trim devices with each boiler:

Safety relief valve shall be provided in compliance with the ASME code. Contractor is required to pipe the relief valve discharge piping to an acceptable drain.

Water pressure/temperature gauge.

Low Water / Flow cutoff.

Manual reset high limit water temperature controller.

Operating temperature control to control the sequential operation of the burner.

High and Low Gas Pressure switches.

Flame rod / ionization probe flame detection.

The boiler manufacturer shall provide a CSD-1 form identifying each safety and trim device.

The boiler shall be capable of interfacing with the following external safety devices:

Auxiliary Low Water Cutoff device.

Combustion Air Damper End Limit Switch.

Emergency Stop (E-Stop) switch.

External Safety Device w/ contact closure.

BOILER CONTROL SYSTEM

Each boiler shall be provided with all necessary controls, all necessary programming sequences, and all safety interlocks. Each boiler control system shall be properly interlocked with all safeties.

Each boiler shall be provided with a "Full Modulating" firing control system whereby the firing rate is infinitely proportional at any firing rate between low fire and high fire as determined by the pulse width modulation input control signal. Both fuel input and air input must be sequenced in unison to the appropriate firing rate without the use of mechanical linkage.

The boiler's control system shall provide the minimum capabilities:

7" color touchscreen display with one or more USB ports.

Standard on-board Ethernet port for wired internet connectivity.

Parameter uploads and downloads via external USB flash drive.

Software updates via external USB flash drive.

Capture screen shots from the control's display by saving digital image files to external USB flash drive.

Local Representative Screen can be programmed to provide contact information for the local boiler manufacturer's representative.

Programmable Relay Outputs for direct control of pumps, control valves, dampers and other auxiliary devices.

Multiple boiler "cascade" network up to 32 boilers without any external control panel. The installation of external sequencing control panels is not acceptable.

Automatic hybrid system control for multiple boiler "cascade" systems with both condensing and non-condensing boilers. This control logic prioritizes condensing boilers at low water temperatures and prioritizes non-condensing boilers at high water temperatures.

Auxiliary Boiler Relay for multiple boiler "cascade" systems which can be used to enable a 3rd party boiler platform in the event the "cascade" system is unable to satisfy the heating load.

Programmable Boiler and System pump control with modulating capabilities for multiple boiler "cascade" systems installed in a Primary-Secondary piping arrangement.

Programmable Control Valve logic with modulating capabilities for multiple boiler "cascade" systems installed in a Primary-Only piping arrangement.

Programmable synchronization of exhaust fan timing to equal the real-time burner firing rate.

5 Pre-installed PID control speeds for system optimization in addition to a user-defined PID function capability.

Integration with external Building Management Systems (BMS) via MODBUS® RTU protocol. NOTE: Optional Protocol Converter for communication via LONWORKS® and BACnet® must be available for purchase from the boiler manufacturer.

Hardwire integration with Building Management Systems (BMS) via 4-20mA analog control signal for temperature or firing rate control.

Intuitive "Setup Wizards" ask the user a series of questions and allow for step-by-step configuration of the boiler operation, control, and connectivity.

On-Screen error notifications with a comprehensive description of all alarm conditions and several troubleshooting steps.

Automatic flue gas temperature and outlet (supply) temperature compensation to prevent over-firing of the boiler equipment.

Automatic differential temperature compensation to prevent over-firing of the boiler equipment in a low flow condition.

Automatically adjust the temperature set point and shutdown the boiler based on the outdoor air temperature conditions.

Night Setback functionality via external point of closure (or BMS integration) for unique “Occupied” and “Unoccupied” temperature setpoint values. Setback feature will include the ability to schedule multiple adjustments within a 24-hour period for building optimization.

Boosted boiler operation resulting in a pre-determined, timed, increase in boiler temperature setting in an unexpected occupied mode.

Maintain single temperature set point with a minimum outlet (supply) water temperature of 42°F up to a maximum outlet (supply) water temperature of 194°F.

On-Board DHW Priority capable of seamless transition between Comfort Heat (CH) and Domestic Hot Water (DHW) operation.

On-Board CH&DHW operation for simultaneous Comfort Heat (CH) and Domestic Hot Water (DHW) operation.

Alarm Relay Output to announce alarm conditions which require manual reset on master or any member boiler from a single boiler source.

Programmable Low Fire Delay to prevent excessive short-cycling of the boiler equipment.

Local Manual Operation.

The boiler control system shall be capable of interfacing with the following external control devices:

Building Management System (MODBUS®). NOTE: Optional Protocol Converter for communication via LONWORKS® and BACnet® must be available for purchase from the boiler manufacturer.

Domestic Hot Water Break-on-Rise Aquastat (Normally Closed).

Domestic Hot Water Tank Temperature Sensor (12kΩ).

External Header Temperature Sensor (12kΩ).

Outdoor Air Temperature Sensor (12kΩ) both wired and wireless.

PART 3 - EXECUTION

3.01 INSTALLATION

Installation shall be performed by the contractor in accordance with the requirements of the applicable codes. Contractor shall review the boiler and installation for compliance with requirements and/or issues that may affect boiler performance. Installation should not proceed until unsatisfactory conditions have been corrected.

The contractor shall mount the equipment as described below:

Install boilers on cast-in-place concrete equipment base in compliance with the requirements for equipment bases and foundation specified in Section 03 30 00 "Cast-in-Place Concrete."

If required by the local code, install vibration isolation devices in compliance with Section 23 05 48 "Vibration and Seismic Controls for HVAC Piping and Equipment."

The contractor shall install gas-fired boilers in accordance with NFPA 54/ANSI Z223.1 (United States), or CAN/CSA B/149.1 (Canada).

The contractor shall install gas-fired boilers in accordance with NBIC – Part 1 (Installation), or another installation code having local jurisdiction.

The contractor shall assemble and install any external boiler safety/trim devices.

The contractor shall install any electrical devices furnished with the boiler, but not specified to be factory-mounted.

The contractor shall install control wiring to field mounted electrical devices in accordance with the requirements of NFPA 70.

The contractor shall install electrical (power) wiring to the boiler in accordance with the requirements of NFPA 70.

3.02 CONNECTIONS

GAS PIPING

Each boiler shall be provided with all necessary gas connections. Refer to the boiler's specification sheet or manual for connection sizes.

Install gas piping in accordance with NFPA 54/ANSI Z223.1 (United States), or CAN/CSA B/149.1 (Canada).

For boilers configured for Natural Gas, refer to the requirements of Section 23 11 23 "Facility Natural-Gas Piping".

HYDRONIC PIPING

Each boiler shall be provided with all necessary inlet (supply) and outlet (return) connections. Refer to the boiler's specification sheet or manual for connection sizes.

Check manufacturer's installation manual for clearance dimensions and install piping that will allow for service and ease of maintenance.

Install piping from equipment drain connection to nearest floor drain. Piping shall be at least full size of connection and adhere to proper codes for neutralization.

The hydronic piping and related components shall comply with the requirements of 23 21 00 "Hydronic Piping and Pumps".

All meters and gages in the hydronic piping shall comply with the requirements of Section 23 05 19 "Meters and Gages for HVAC Piping".

All instrumentation and controls in the hydronic piping shall comply with the requirements of Section 23 09 13 "Instrumentation and Control Devices for HVAC".

All valves in the hydronic piping shall comply with the requirements of Section 23 05 23 "General-Duty Valves for HVAC Piping".

All expansion fittings shall comply with the requirements of Section 23 05 16 "Expansion Fittings and Loops for HVAC Piping".

Any pipe hangers or supports shall comply with the requirements of Section 23 05 29 "Hangers and Supports for HVAC Piping and Equipment".

Any vibration isolation devices on the hydronic piping shall comply with the requirements of Section 23 05 48 "Vibration and Seismic Controls for HVAC Piping and Equipment."

The feedwater piping shall comply with the requirements of Section 23 53 00 "Heating Boiler Feedwater Equipment".

The hydronic piping shall be insulated in accordance with the requirements of Section 23 07 19 "HVAC Piping Insulation".

After insulation, all hydronic piping shall be identified in accordance with the requirements of Section 23 05 53 "Identification for HVAC Piping and Equipment".

Any water treatment of the hydronic system shall be in accordance with the boiler manufacturer's requirements and/or Section 23 25 13 "Water Treatment for Closed-Loop Hydronic Systems".

EXHAUST VENTING

The boilers shall be dual certified as Category II or IV appliances and are capable of operating with slightly negative to slightly positive exhaust vent pressure, and the vent gas temperature is likely to cause condensate production in the vent.

Install the exhaust/flue venting system in accordance with NFPA 54/ANSI Z223.1 (United States), or CAN/CSA B/149.1 (Canada) and per the manufacturer's recommendations in the installation manual.

All exhaust venting components shall comply with the requirements of Section 23 51 00 "Breechings, Chimneys and Stacks."

AIR INLET

The boilers shall be certified for Direct Vent / Sealed Combustion installations where the combustion air is supplied directly to the boiler through ductwork.

Install the air inlet system in accordance with NFPA 54/ANSI Z223.1 (United States), or CAN/CSA B/149.1 (Canada) and per the manufacturer's recommendations in the installation manual.

All air inlet components shall comply with the requirements of Section 23 37 00 "Air Outlets and Inlets".

ELECTRICAL

Install an external disconnect and overload protection for each boiler in accordance with the requirements of NFPA 70.

The voltage requirements for each boiler shall be configured for 208-240VAC, Single Phase (w/ Neutral), 60Hz.

The amperage requirements for each boiler is described in the table below:

	ST-1250	ST-1500	ST-1750	ST-2000
Internal Overload Protection	20 Amps	20 Amps	20 Amps	20 Amps
Recommended Circuit Capacity	20 Amps	20 Amps	20 Amps	20 Amps

END OF SECTION 235216.13

SECTION 260519

LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Copper building wire rated 600 V or less.
2. Metal-clad cable, Type MC, rated 600 V or less.
3. Connectors, splices, and terminations rated 600 V and less.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

PART 2 - PRODUCTS

2.1 COPPER BUILDING WIRE

- A. Description: Flexible, insulated and uninsulated, drawn copper current-carrying conductor with an overall insulation layer or jacket, or both, rated 600 V or less.
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Alpha Wire; brand of Belden, Inc.
 2. Belden Inc.
 3. General Cable; Prysmian Group North America.
 4. Southwire Company, LLC.
- C. Standards:
1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.
- D. Conductors: Copper, complying with ASTM B3 for bare annealed copper and with ASTM B8 for stranded conductors.
- E. Conductor Insulation:
1. Type THHN and Type THWN-2: Comply with UL 83.
 2. Type XHHW-2: Comply with UL 44.

2.2 METAL-CLAD CABLE, TYPE MC

- A. Description: A factory assembly of one or more current-carrying insulated conductors in an overall metallic sheath.
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. AFC Cable Systems; Atkore International.
 - 2. Alpha Wire; brand of Belden, Inc.
 - 3. Belden Inc.
 - 4. General Cable; Prysmian Group North America.
 - 5. Southwire Company, LLC.
- C. Standards:
 - 1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.
 - 2. Comply with UL 1569.
- D. Circuits:
 - 1. Single circuit.
 - 2. Power-Limited Fire-Alarm Circuits: Comply with UL 1424.
- E. Conductors: Copper, complying with ASTM B3 for bare annealed copper and with ASTM B8 for stranded conductors.
- F. Ground Conductor: Insulated.
- G. Conductor Insulation:
 - 1. Type TFN/THHN/THWN-2: Comply with UL 83.
 - 2. Type XHHW-2: Comply with UL 44.
- H. Armor: Aluminum, interlocked.
- I. Jacket: PVC applied over armor.

2.3 CONNECTORS AND SPLICES

- A. Description: Factory-fabricated connectors, splices, and lugs of size, ampacity rating, material, type, and class for application and service indicated; listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. 3M Electrical Products.
 - 2. ABB, Electrification Business.
 - 3. AFC Cable Systems; Atkore International.

4. Hubbell Utility Solutions; Hubbell Incorporated.
 5. Ideal Industries, Inc.
 6. NSi Industries LLC.
- C. Jacketed Cable Connectors: For steel and aluminum jacketed cables, zinc die-cast with set screws, designed to connect conductors specified in this Section.
- D. Lugs: One piece, seamless, designed to terminate conductors specified in this Section.
1. Material: Copper.
 2. Type: One hole with standard barrels.
 3. Termination: Compression.

PART 3 - EXECUTION

3.1 CONDUCTOR MATERIAL APPLICATIONS

- A. Feeders:
1. Copper; solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.
- B. Branch Circuits:
1. Copper, Solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.

3.2 CONDUCTOR INSULATION AND MULTICONDUCTOR CABLE APPLICATIONS AND WIRING METHODS

- A. Exposed Feeders: Type THHN/THWN-2, single conductors in raceway.
- B. Feeders Concealed in Ceilings, Walls, Partitions, and Crawlspace: Type THHN/THWN-2, single conductors in raceway.
- C. Exposed Branch Circuits, Including in Crawlspace: Type THHN/THWN-2, single conductors in raceway.
- D. Branch Circuits Concealed in Ceilings, Walls, and Partitions: Type THHN/THWN-2, single conductors in raceway or Metal-clad cable, Type MC.

3.3 INSTALLATION OF CONDUCTORS AND CABLES

- A. Conceal cables in finished walls, ceilings, and floors unless otherwise indicated.
- B. Complete raceway installation between conductor and cable termination points according to Section 260533 "Raceways and Boxes for Electrical Systems" prior to pulling conductors and cables.

- C. Use manufacturer-approved pulling compound or lubricant where necessary; compound used must not deteriorate conductor or insulation. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.
- D. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips, that will not damage cables or raceway.
- E. Install exposed cables parallel and perpendicular to surfaces of exposed structural members, and follow surface contours where possible.
- F. Support cables according to Section 260529 "Hangers and Supports for Electrical Systems."

3.4 CONNECTIONS

- A. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A-486B.
- B. Make splices, terminations, and taps that are compatible with conductor material and that possess equivalent or better mechanical strength and insulation ratings than unspliced conductors.
 - 1. Use oxide inhibitor in each splice, termination, and tap for aluminum conductors.
- C. Wiring at Outlets: Install conductor at each outlet, with at least 6 inch of slack.

3.5 IDENTIFICATION

- A. Identify and color-code conductors and cables according to Section 260553 "Identification for Electrical Systems."
- B. Identify each spare conductor at each end with identity number and location of other end of conductor, and identify as spare conductor.

3.6 FIRESTOPPING

- A. Apply firestopping to electrical penetrations of fire-rated floor and wall assemblies to restore original fire-resistance rating of assembly.

END OF SECTION

SECTION 260526

GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes grounding and bonding systems and equipment.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.

PART 2 - PRODUCTS

2.1 SYSTEM DESCRIPTION

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Comply with UL 467 for grounding and bonding materials and equipment.

2.2 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Burndy; Part of Hubbell Electrical Systems.
 2. Dossert; AFL Telecommunications LLC.
 3. ERICO International Corporation.
 4. Fushi Copperweld Inc.
 5. Galvan Industries Inc.; Electrical Products Division, LLC.
 6. Harger Lighting and Grounding.
 7. ILSCO.
 8. O-Z/Gedney; A Brand of the EGS Electrical Group.
 9. Robbins Lighting, Inc.
 10. Siemens Power Transmission & Distribution, Inc..

2.3 CONDUCTORS

- A. Insulated Conductors: Copper wire or cable insulated for 600 V unless otherwise required by applicable Code or authorities having jurisdiction.
- B. Bare Copper Conductors:

1. Solid Conductors: ASTM B3.
2. Stranded Conductors: ASTM B8.
3. Bonding Cable: 28 kcmil, 14 strands of No. 17 AWG conductor, 1/4 inch in diameter.
4. Bonding Conductor: No. 4 or No. 6 AWG, stranded conductor.
5. Bonding Jumper: Copper tape, braided conductors terminated with copper ferrules; 1-5/8 inches wide and 1/16 inch thick.

2.4 CONNECTORS

- A. Listed and labeled by an NRTL acceptable to authorities having jurisdiction for applications in which used and for specific types, sizes, and combinations of conductors and other items connected.
- B. Welded Connectors: Exothermic-welding kits of types recommended by kit manufacturer for materials being joined and installation conditions.
- C. Bus-Bar Connectors: Compression type, copper or copper alloy, with two wire terminals.
- D. Beam Clamps: Mechanical type, terminal, ground wire access from four directions, with dual, tin-plated or silicon bronze bolts.
- E. Cable-to-Cable Connectors: Compression type, copper or copper alloy.
- F. Cable Tray Ground Clamp: Mechanical type, zinc-plated malleable iron.
- G. Conduit Hubs: Mechanical type, terminal with threaded hub.
- H. Ground Rod Clamps: Mechanical type, copper or copper alloy, terminal with hex head bolt.
- I. Signal Reference Grid Clamp: Mechanical type, stamped-steel terminal with hex head screw.
- J. Straps: Solid copper, copper lugs. Rated for 600 A.
- K. U-Bolt Clamps: Mechanical type, copper or copper alloy, terminal listed for direct burial.
- L. Water Pipe Clamps:
 1. Mechanical type, two pieces with zinc-plated bolts.
 - a. Material: Die-cast zinc alloy.
 - b. Listed for direct burial.
 2. U-bolt type with malleable-iron clamp and copper ground connector.

PART 3 - EXECUTION

3.1 APPLICATIONS

- A. Conductors: Install solid conductor for No. 8 AWG and smaller, and stranded conductors for No. 6 AWG and larger unless otherwise indicated.

3.2 EQUIPMENT GROUNDING

- A. Install insulated equipment grounding conductors with the following items, in addition to those required by NFPA 70:
 - 1. Feeders and branch circuits.
 - 2. Lighting circuits.
 - 3. Receptacle circuits.
 - 4. Single-phase motor and appliance branch circuits.
 - 5. Three-phase motor and appliance branch circuits.
 - 6. Flexible raceway runs.
 - 7. Armored and metal-clad cable runs.

3.3 INSTALLATION

- A. Grounding Conductors: Route along shortest and straightest paths possible unless otherwise indicated or required by Code. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.
- B. Bonding Straps and Jumpers: Install in locations accessible for inspection and maintenance except where routed through short lengths of conduit.
 - 1. Bonding to Structure: Bond straps directly to basic structure, taking care not to penetrate any adjacent parts.
 - 2. Bonding to Equipment Mounted on Vibration Isolation Hangers and Supports: Install bonding so vibration is not transmitted to rigidly mounted equipment.
 - 3. Use exothermic-welded connectors for outdoor locations; if a disconnect-type connection is required, use a bolted clamp.
- C. Grounding and Bonding for Piping:
 - 1. Metal Water Service Pipe: Install insulated copper grounding conductors, in conduit, from building's main service equipment, or grounding bus, to main metal water service entrances to building. Connect grounding conductors to main metal water service pipes; use a bolted clamp connector or bolt a lug-type connector to a pipe flange by using one of the lug bolts of the flange. Where a dielectric main water fitting is installed, connect grounding conductor on street side of fitting. Bond metal grounding conductor conduit or sleeve to conductor at each end.
 - 2. Water Meter Piping: Use braided-type bonding jumpers to electrically bypass water meters. Connect to pipe with a bolted connector.

3. Bond each aboveground portion of gas piping system downstream from equipment shutoff valve.

3.4 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Tests and Inspections:

1. After installing grounding system but before permanent electrical circuits have been energized, test for compliance with requirements.
2. Inspect physical and mechanical condition. Verify tightness of accessible, bolted, electrical connections with a calibrated torque wrench according to manufacturer's written instructions.
3. Test completed grounding system at each location where a maximum ground-resistance level is specified, at service disconnect enclosure grounding terminal, and at individual ground rods. Make tests at ground rods before any conductors are connected.
 - a. Measure ground resistance no fewer than two full days after last trace of precipitation and without soil being moistened by any means other than natural drainage or seepage and without chemical treatment or other artificial means of reducing natural ground resistance.
 - b. Perform tests by fall-of-potential method according to IEEE 81.
4. Prepare dimensioned Drawings locating each test well, ground rod and ground-rod assembly, and other grounding electrodes. Identify each by letter in alphabetical order, and key to the record of tests and observations. Include the number of rods driven and their depth at each location, and include observations of weather and other phenomena that may affect test results. Describe measures taken to improve test results.

C. Grounding system will be considered defective if it does not pass tests and inspections.

D. Prepare test and inspection reports.

E. Report measured ground resistances that exceed the following values:

1. Power and Lighting Equipment or System with Capacity of 500 kVA and Less: 10 ohms.
2. Power and Lighting Equipment or System with Capacity of 500 to 1000 kVA: 5 ohms.
3. Power and Lighting Equipment or System with Capacity More Than 1000 kVA: 3 ohms.
4. Substations and Pad-Mounted Equipment: 5 ohms.

F. Excessive Ground Resistance: If resistance to ground exceeds specified values, notify Architect promptly and include recommendations to reduce ground resistance.

END OF SECTION

SECTION 260529

HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Steel slotted support systems.
2. Conduit and cable support devices.
3. Structural steel for fabricated supports and restraints.
4. Mounting, anchoring, and attachment components, including powder-actuated fasteners, mechanical expansion anchors, concrete inserts, clamps, through bolts, toggle bolts, and hanger rods.

PART 2 - PRODUCTS

2.1 SUPPORT, ANCHORAGE, AND ATTACHMENT COMPONENTS

A. Steel Slotted Support Systems: Preformed steel channels and angles with minimum 13/32-inch-diameter holes at a maximum of 8 inches o.c. in at least one surface.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. ABB, Electrification Business.
 - b. Allied Tube & Conduit; Atkore International.
 - c. Cooper B-line; brand of Eaton, Electrical Sector.
 - d. Unistrut; Atkore International.
 - e. Wesanco, Inc.
2. Standard: Comply with MFMA-4 factory-fabricated components for field assembly.
3. Material for Channel, Fittings, and Accessories: Galvanized steel.
4. Channel Width: Selected for applicable load criteria.
5. Metallic Coatings: Hot-dip galvanized after fabrication and applied according to MFMA-4.

B. Conduit and Cable Support Devices: Steel and malleable-iron hangers, clamps, and associated fittings, designed for types and sizes of raceway or cable to be supported.

C. Mounting, Anchoring, and Attachment Components: Items for fastening electrical items or their supports to building surfaces include the following:

1. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete, steel, or wood, with tension, shear, and pullout capacities appropriate for supported loads and building materials where used.
 - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1) Hilti, Inc.
 - 2) ITW Ramset/Red Head; Illinois Tool Works, Inc.
 - 3) MKT Fastening, LLC.
 - 4) Simpson Strong-Tie Co., Inc.
2. Mechanical-Expansion Anchors: Insert-wedge-type, zinc-coated steel, for use in hardened portland cement concrete, with tension, shear, and pullout capacities appropriate for supported loads and building materials where used.
 - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1) Cooper B-line; brand of Eaton, Electrical Sector.
 - 2) Empire Industries, Inc.
 - 3) Hilti, Inc.
 - 4) ITW Ramset/Red Head; Illinois Tool Works, Inc.
 - 5) MKT Fastening, LLC.
3. Concrete Inserts: Steel or malleable-iron, slotted support system units are similar to MSS Type 18 units and comply with MFMA-4 or MSS SP-58.
4. Clamps for Attachment to Steel Structural Elements: MSS SP-58 units are suitable for attached structural element.
5. Through Bolts: Structural type, hex head, and high strength. Comply with ASTM F 3125/F 3125M, Grade A325.
6. Toggle Bolts: All-steel springhead type.
7. Hanger Rods: Threaded steel.

PART 3 - EXECUTION

3.1 APPLICATION

- A. Comply with the following standards for application and installation requirements of hangers and supports, except where requirements on Drawings or in this Section are stricter:
 1. NECA 1.
 2. NECA 101
 3. NECA 102.
- B. Comply with requirements in Section 07 8413 "Penetration Firestopping" for firestopping materials and installation for penetrations through fire-rated walls, ceilings, and assemblies.

- C. Comply with requirements for raceways and boxes specified in Section 26 0533 "Raceways and Boxes for Electrical Systems."
- D. Maximum Support Spacing and Minimum Hanger Rod Size for Raceways: Space supports for EMT, IMC, and RMC as NFPA 70. Minimum rod size shall be 1/4 inch in diameter.
- E. Multiple Raceways or Cables: Install trapeze-type supports fabricated with steel slotted support system, sized so capacity can be increased by at least 25 percent in future without exceeding specified design load limits.
 - 1. Secure raceways and cables to these supports with two-bolt conduit clamps.

3.2 SUPPORT INSTALLATION

- A. Comply with NECA 1 and NECA 101 for installation requirements except as specified in this article.
- B. Strength of Support Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static loads within specified loading limits. Minimum static design load used for strength determination shall be weight of supported components plus 200 lb .
- C. Mounting and Anchorage of Surface-Mounted Equipment and Components: Anchor and fasten electrical items and their supports to building structural elements by the following methods unless otherwise indicated by code:
 - 1. To Wood: Fasten with lag screws or through bolts.
 - 2. To New Concrete: Bolt to concrete inserts.
 - 3. To Masonry: Approved toggle-type bolts on hollow masonry units and expansion anchor fasteners on solid masonry units.
 - 4. To Existing Concrete: Expansion anchor fasteners.
 - 5. Instead of expansion anchors, powder-actuated driven threaded studs provided with lock washers and nuts may be used in existing standard-weight concrete 4 inches thick or greater. Do not use for anchorage to lightweight-aggregate concrete or for slabs less than 4 inches thick.
 - 6. To Steel: Welded threaded studs complying with AWS D1.1/D1.1M, with lock washers and nuts.
 - 7. To Light Steel: Sheet metal screws.
 - 8. Items Mounted on Hollow Walls and Nonstructural Building Surfaces: Mount cabinets, panelboards, disconnect switches, control enclosures, pull and junction boxes, transformers, and other devices on slotted-channel racks attached to substrate.
- D. Drill holes for expansion anchors in concrete at locations and to depths that avoid the need for reinforcing bars.

END OF SECTION

SECTION 260533

RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS

PART 1 - GENARAL

1.1 SUMMARY

A. Section Includes:

1. Type EMT-S raceways and elbows.
2. Type ERMC-S raceways, elbows, couplings, and nipples.
3. Type FMC-S raceways.
4. Type IMC raceways.
5. Type LFMC raceways.
6. Type PVC raceways and fittings.
7. Fittings for conduit, tubing, and cable.
8. Threaded metal joint compound.
9. Solvent cements.
10. Surface metal raceways and fittings.
11. Metallic outlet boxes, device boxes, and covers.
12. Junction boxes, and pull boxes.
13. Cover plates for device boxes.
14. Hoods for outlet boxes.

1.2 ACTION SUBMITTALS

A. Product Data: For the following:

1. Wireways and auxiliary gutters.
2. Surface metal raceways.
3. Floor boxes.
4. Cabinets and cutout boxes.

PART 2 - PRODUCTS

2.1 TYPE EMT-S RACEWAYS AND ELBOWS

A. Steel Electrical Metal Tubing (EMT-S) and Elbows:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. AFC Cable Systems, Inc..
 - b. Allied Tube & Conduit.
 - c. Anamet Electrical, Inc..
 - d. Electric-Flex Company.
 - e. O-Z/Gedney.

- f. Southwire Company.
- g. Thomas & Betts Corporation.
- h. Wheatland Tube Company.

2. Applicable Standards:

- a. Regulatory Requirements: Listed and labeled in accordance with NFPA 70 and marked for intended location and use.
- b. General Characteristics:
 - 1) Reference Standards: UL 797 and UL Category Control Number FJMX.
 - 2) Material: Steel.
 - 3) Exterior Coating: Zinc.
 - 4) Interior Coating: Zinc with organic top coating.
- c. Options:
 - 1) Minimum Trade Size: 1/2 inch.
 - 2) Colors: As indicated on Drawings.

2.2 TYPE ERM-C-S RACEWAYS, ELBOWS, COUPLINGS, AND NIPPLES

A. Galvanized-Steel Electrical Rigid Metal Conduit (ERM-C-S-G), Elbows, Couplings, and Nipples:

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. AFC Cable Systems, Inc..
 - b. Allied Tube & Conduit.
 - c. Anamet Electrical, Inc..
 - d. Electric-Flex Company.
 - e. O-Z/Gedney.
 - f. Southwire Company.
 - g. Thomas & Betts Corporation.
 - h. Wheatland Tube Company.
- 2. Applicable Standards:
 - a. Regulatory Requirements: Listed and labeled in accordance with NFPA 70 and marked for intended location and use.
 - b. General Characteristics:
 - 1) Reference Standards: UL 6 and UL Category Control Number DYIX.
 - 2) Exterior Coating: Zinc.
 - 3) Interior Coating: Zinc with organic top coating.
 - c. Options:
 - 1) Minimum Trade Size: 1/2 inch.
 - 2) Colors: As indicated on Drawings.

2.3 TYPE FMC-S RACEWAYS

A. Steel Flexible Metal Conduit (FMC-S):

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. AFC Cable Systems, Inc..
 - b. Allied Tube & Conduit.
 - c. Anamet Electrical, Inc..
 - d. Electric-Flex Company.
 - e. O-Z/Gedney.
 - f. Southwire Company.
 - g. Thomas & Betts Corporation.
 - h. Wheatland Tube Company.
2. Applicable Standards:
 - a. Regulatory Requirements: Listed and labeled in accordance with NFPA 70 and marked for intended location and use.
 - b. General Characteristics:
 - 1) Reference Standard: UL 1 and UL Category Control Number DXUZ.
 - 2) Material: Steel.
 - c. Options:
 - 1) Minimum Trade Size: 1/2 inch.
 - 2) Colors: As indicated on Drawings.

2.4 TYPE IMC RACEWAYS

A. Steel Electrical Intermediate Metal Conduit (IMC):

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. AFC Cable Systems, Inc..
 - b. Allied Tube & Conduit.
 - c. Anamet Electrical, Inc..
 - d. Electric-Flex Company.
 - e. O-Z/Gedney.
 - f. Southwire Company.
 - g. Thomas & Betts Corporation.
 - h. Wheatland Tube Company.
2. Applicable Standards:
 - a. Regulatory Requirements: Listed and labeled in accordance with NFPA 70 and marked for intended location and use.
 - b. General Characteristics:

- 1) Reference Standard: UL 1242 and UL Category Control Number DYBY.
- 2) Exterior Coating: Zinc.
- 3) Interior Coating: Zinc with organic top coating.

c. Options:

- 1) Minimum Trade Size: 1/2 inch.
- 2) Colors: As indicated on Drawings.

2.5 TYPE LFMC RACEWAYS

A. Steel Liquidtight Flexible Metal Conduit (LFMC-S):

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. AFC Cable Systems, Inc..
 - b. Allied Tube & Conduit.
 - c. Anamet Electrical, Inc..
 - d. Electric-Flex Company.
 - e. O-Z/Gedney.
 - f. Southwire Company.
 - g. Thomas & Betts Corporation.
 - h. Wheatland Tube Company.
2. Applicable Standards:
 - a. Regulatory Requirements: Listed and labeled in accordance with NFPA 70 and marked for intended location and use.
 - b. General Characteristics:
 - 1) Reference Standard: UL 360 and UL Category Control Number DXHR.
 - 2) Material: Steel.
 - c. Options:
 - 1) Minimum Trade Size: 1/2 inch.
3. Colors: As indicated on Drawings.

2.6 FITTINGS FOR CONDUIT, TUBING, AND CABLE

A. Fittings for Type ERM, Type IMC, and Type PVC Raceways:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. AFC Cable Systems, Inc..
 - b. Allied Tube & Conduit.
 - c. Anamet Electrical, Inc..
 - d. Electric-Flex Company.
 - e. O-Z/Gedney.

- f. Southwire Company.
 - g. Thomas & Betts Corporation.
 - h. Wheatland Tube Company.
- 2. Applicable Standards:
 - a. Regulatory Requirements: Listed and labeled in accordance with NFPA 70 and marked for intended location and use.
 - b. General Characteristics:
 - 1) Reference Standards: UL 514B and UL Category Control Number DWTT.
 - 2) Material: Steel.
 - 3) Coupling Method: Compression coupling or Raintight compression coupling with distinctive color gland nut.
 - c. Options:
 - 1) Conduit Fittings for Hazardous (Classified) Locations: UL 1203.
 - 2) Expansion and Deflection Fittings: UL 651 with flexible external bonding jumper.

B. Fittings for Type EMT Raceways:

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. AFC Cable Systems, Inc..
 - b. Allied Tube & Conduit.
 - c. Anamet Electrical, Inc..
 - d. Electric-Flex Company.
 - e. O-Z/Gedney.
 - f. Southwire Company.
 - g. Thomas & Betts Corporation.
 - h. Wheatland Tube Company.
- 2. Applicable Standards:
 - a. Regulatory Requirements: Listed and labeled in accordance with NFPA 70 and marked for intended location and use.
 - b. General Characteristics:
 - 1) Reference Standards: UL 514B and UL Category Control Number FKAV.
 - 2) Material: Steel.
 - 3) Coupling Method: Setscrew coupling. Setscrew couplings with only single screw per conduit are unacceptable.
 - c. Options:
 - 1) Conduit Fittings for Hazardous (Classified) Locations: UL 1203.
 - 2) Expansion and Deflection Fittings: UL 651 with flexible external bonding jumper.

C. Fittings for Type FMC Raceways:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. AFC Cable Systems, Inc..
 - b. Allied Tube & Conduit.
 - c. Anamet Electrical, Inc..
 - d. Electric-Flex Company.
 - e. O-Z/Gedney.
 - f. Southwire Company.
 - g. Thomas & Betts Corporation.
 - h. Wheatland Tube Company.
2. Applicable Standards:
 - a. Regulatory Requirements: Listed and labeled in accordance with NFPA 70 and marked for intended location and use.
 - b. General Characteristics:
 - 1) Reference Standards: UL 514B and UL Category Control Number ILNR.

D. Fittings for Type LFMC Raceways:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. AFC Cable Systems, Inc..
 - b. Allied Tube & Conduit.
 - c. Anamet Electrical, Inc..
 - d. Electric-Flex Company.
 - e. O-Z/Gedney.
 - f. Southwire Company.
 - g. Thomas & Betts Corporation.
 - h. Wheatland Tube Company.
2. Applicable Standards:
 - a. Regulatory Requirements: Listed and labeled in accordance with NFPA 70 and marked for intended location and use.
 - b. General Characteristics:
 - 1) Reference Standards: UL 514B and UL Category Control Number DXAS.

2.7 METALLIC OUTLET BOXES, DEVICE BOXES, AND COVERS

A. Metallic Outlet Boxes:

1. Description: Box having pryout openings, knockouts, threaded entries, or hubs in either the sides of the back, or both, for entrance of conduit, conduit or cable fittings, or cables, with provisions for mounting outlet box cover, but without provisions for mounting wiring device directly to box.
2. Applicable Standards:
 - a. Regulatory Requirements: Listed and labeled in accordance with NFPA 70 and marked for intended location and use.

b. General Characteristics:

- 1) Reference Standards: UL 514A and UL Category Control Number QCIT.

c. Options:

- 1) Material: Sheet steel.
- 2) Sheet Metal Depth: Minimum 1.5 inch.
- 3) Luminaire Outlet Boxes and Covers: Nonadjustable, listed and labeled for attachment of luminaire weighing up to 50 lb.

B. Metallic Conduit Bodies:

1. Description: Means for providing access to interior of conduit or tubing system through one or more removable covers at junction or terminal point. In the United States, conduit bodies are listed in accordance with outlet box requirements.
2. Applicable Standards:
 - a. Regulatory Requirements: Listed and labeled in accordance with NFPA 70 and marked for intended location and use.
 - b. General Characteristics:
 - 1) Reference Standards: UL 514A and UL Category Control Number QCIT.

C. Metallic Device Boxes:

1. Description: Box with provisions for mounting wiring device directly to box.
2. Applicable Standards:
 - a. Regulatory Requirements: Listed and labeled in accordance with NFPA 70 and marked for intended location and use.
 - b. General Characteristics:
 - 1) Reference Standards: UL 514A and UL Category Control Number QCIT.
 - c. Options:
 - 1) Material: Sheet steel.
 - 2) Sheet Metal Depth: minimum 1.5 inch.
 - 3) Luminaire Outlet Boxes and Covers: Nonadjustable, listed and labeled for attachment of luminaire weighing up to 50 lb.

2.8 JUNCTION BOXES AND PULL BOXES

A. Indoor Sheet Metal Junction and Pull Boxes:

1. Description: Box with a blank cover that serves the purpose of joining different runs of raceway or cable.
2. Applicable Standards:

- a. Regulatory Requirements: Listed and labeled in accordance with NFPA 70 and marked for intended location and use.
 - b. General Characteristics:
 - 1) Reference Standards: UL Category Control Number BGUZ.
 - a) Non-Environmental Characteristics: UL 50.
 - b) Environmental Characteristics: UL 50E.
 - c. Options:
 - 1) Degree of Protection: Type 1.
- B. Indoor Cast-Metal Junction and Pull Boxes:
- 1. Description: Box with a blank cover that serves the purpose of joining different runs of raceway or cable.
 - 2. Applicable Standards:
 - a. Regulatory Requirements: Listed and labeled in accordance with NFPA 70 and marked for intended location and use.
 - b. General Characteristics:
 - 1) Reference Standards: UL Category Control Number BGUZ.
 - a) Non-Environmental Characteristics: UL 50.
 - b) Environmental Characteristics: UL 50E.
 - c. Options:
 - 1) Degree of Protection: Type 1.

PART 3 - EXECUTION

3.1 SELECTION OF RACEWAYS

- A. Unless more stringent requirements are specified in Contract Documents or manufacturers' written instructions, comply with NFPA 70 for selection of raceways. Consult Architect for resolution of conflicting requirements.
- B. Indoors:
 - 1. Exposed and Subject to Physical Damage: IMC or ERM. Raceway locations include the following:
 - a. Loading docks.
 - b. Corridors used for traffic of mechanized carts, forklifts, and pallet-handling units.
 - 2. Exposed, Not Subject to Physical Damage: EMT.
 - 3. Concealed in Ceilings and Interior Walls and Partitions: EMT.
 - 4. Damp or Wet Locations: ERM or IMC.

5. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): FMC or LFMC.
- C. Raceway Fittings: Select fittings in accordance with NEMA FB 2.10 guidelines.
 1. ERM and IMC: Provide threaded type fittings unless otherwise indicated.

3.2 SELECTION OF BOXES AND ENCLOSURES

- A. Unless more stringent requirements are specified in Contract Documents or manufacturers' written instructions, comply with NFPA 70 for selection of boxes and enclosures. Consult Architect for resolution of conflicting requirements.
- B. Degree of Protection:
 1. Indoors:
 - a. Type 1 unless otherwise indicated.
 - b. Damp or Dusty Locations: Type 12.
 - c. Surface Mounted in Kitchens and Other Locations Exposed to Oil or Coolants: Type 12.
 - d. Flush Mounted in Kitchens and Other Locations Exposed to Oil or Coolants: Type 12.
 - e. Locations Exposed to Airborne Dust, Lint, Fibers, or Flyings: Type 4.
 - f. Locations Exposed to Hosedown: Type 4.
 - g. Locations Exposed to Brief Submersion: Type 6P.
 - h. Locations Exposed to Prolonged Submersion: Type 6P.
 - i. Locations Exposed to Corrosive Agents: Type 4X.
 - j. Locations Exposed to Spraying Oil or Coolants: Type 13.

3.3 INSTALLATION OF RACEWAYS

- A. Installation Standards:
 1. Unless more stringent requirements are specified in Contract Documents or manufacturers' written instructions, comply with NFPA 70 for installation of raceways. Consult Architect for resolution of conflicting requirements.
 2. Comply with NFPA 70 limitations for types of raceways allowed in specific occupancies and number of floors.
 3. Comply with requirements in Section 26 0529 "Hangers and Supports for Electrical Systems" for hangers and supports.
 4. Comply with NECA NEIS 101 for installation of steel raceways.
 5. Comply with NECA NEIS 111 for installation of nonmetallic raceways.
 6. Install raceways square to the enclosure and terminate at enclosures without hubs with locknuts on both sides of enclosure wall. Install locknuts hand tight, plus one-quarter turn more.
 7. Terminate threaded conduits into threaded hubs or with locknuts on inside and outside of boxes or cabinets. Install bushings on conduits up to 1-1/4 inch trade size and insulated

throat metal bushings on 1-1/2 inch trade size and larger conduits terminated with locknuts.

8. Raceway Terminations at Locations Subject to Moisture or Vibration:

- a. Provide insulating bushings to protect conductors, including conductors smaller than No. 4 AWG.

B. General Requirements for Installation of Raceways:

1. Complete raceway installation before starting conductor installation.
2. Make bends in raceway using large-radius preformed ells except for parallel bends. Field bending must be in accordance with NFPA 70 minimum radii requirements. Provide only equipment specifically designed for material and size involved.
3. Conceal conduit within finished walls, ceilings, and floors unless otherwise indicated. Install conduits parallel or perpendicular to building lines.
4. Support conduit within 12 inch of enclosures to which attached.
5. Install raceway sealing fittings at accessible locations in accordance with NFPA 70 and fill them with listed sealing compound. For concealed raceways, install fitting in flush steel box with blank cover plate having finish similar to that of adjacent plates or surfaces. Install raceway sealing fittings in accordance with NFPA 70.
6. Install devices to seal raceway interiors at accessible locations. Locate seals so no fittings or boxes are between the seal and the following changes of environments. Seal interior of raceways at the following points:
 - a. Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces.
 - b. Where an underground service raceway enters a building or structure.
 - c. Conduit extending from interior to exterior of building.
 - d. Conduit extending into pressurized duct and equipment.
 - e. Conduit extending into pressurized zones that are automatically controlled to maintain different pressure set points.
 - f. Where otherwise required by NFPA 70.
7. Do not install raceways or electrical items on "explosion-relief" walls or rotating equipment.
8. Keep raceways at least 6 inch away from parallel runs of flues and steam or hot-water pipes. Install horizontal raceway runs above water and steam piping.
9. Cut conduit perpendicular to the length. For conduits 2 inch trade size and larger, use roll cutter or a guide to make cut straight and perpendicular to the length. Ream inside of conduit to remove burrs.
10. Install pull wires in empty raceways. Provide polypropylene or monofilament plastic line with not less than 200 lb tensile strength. Leave at least 12 inch of slack at both ends of pull wire. Cap underground raceways designated as spare above grade alongside raceways in use.

C. Requirements for Installation of Specific Raceway Types:

1. Types ERM and IMC:

- a. Threaded Conduit Joints, Exposed to Wet, Damp, Corrosive, or Outdoor Conditions: Apply listed compound that maintains electrical conductivity to

threads of raceway and fittings before making up joints. Follow compound manufacturer's written instructions.

2. Types FMC and LPMC:

- a. Comply with NEMA RV 3. Provide a maximum of 36 inch of flexible conduit for recessed and semirecessed luminaires, equipment subject to vibration, noise transmission, or movement; and for transformers and motors.

D. Raceway Fittings: Install fittings in accordance with NEMA FB 2.10 guidelines.

1. EMT: Provide setscrew, steel fittings. Comply with NEMA FB 2.10.
2. Flexible Conduit: Provide only fittings listed for use with flexible conduit type. Comply with NEMA FB 2.20.

E. Expansion-Joint Fittings:

1. Install in runs of aboveground ERM and EMT conduit that are located where environmental temperature change may exceed 100 deg F and that have straight-run length that exceeds 100 ft..
2. Install type and quantity of fittings that accommodate temperature change listed for the following locations:
 - a. Outdoor Locations Not Exposed to Direct Sunlight: 125 deg F temperature change.
 - b. Outdoor Locations Exposed to Direct Sunlight: 155 deg F temperature change.
 - c. Indoor Spaces Connected with Outdoors without Physical Separation: 125 deg F temperature change.
3. Install fitting(s) that provide expansion and contraction for at least 0.000078 inch per foot of length of straight run per deg F of temperature change for metal conduits.
4. Install expansion fittings at locations where conduits cross building or structure expansion joints.
5. Install expansion-joint fitting with position, mounting, and piston setting selected in accordance with manufacturer's written instructions for conditions at specific location at time of installation. Install conduit supports to allow for expansion movement.

3.4 INSTALLATION OF BOXES AND ENCLOSURES

- A. Provide boxes in wiring and raceway systems wherever required for pulling of wires, making connections, and mounting of devices or fixtures.
- B. Mount boxes at heights indicated on Drawings. If mounting heights of boxes are not individually indicated, give priority to ADA requirements.
- C. Recessed Boxes in Masonry Walls: Saw-cut opening for box in center of cell of masonry block, and install box flush with surface of wall. Prepare block surfaces to provide a flat surface for a raintight connection between box and cover plate or supported equipment and box, whether installed indoors or outdoors.

- D. Horizontally separate boxes mounted on opposite sides of walls so they are not in the same vertical channel.
- E. Locate boxes so that cover or plate will not span different building finishes.
- F. Support boxes in recessed ceilings independent of ceiling tiles and ceiling grid.
- G. Support boxes of three gangs or more from more than one side by spanning two framing members or mounting on brackets specifically designed for purpose.
- H. Fasten junction and pull boxes to, or support from, building structure. Do not support boxes by conduits.
- I. Do not install aluminum boxes, enclosures, or fittings in contact with concrete or earth.
- J. Do not rely on locknuts to penetrate nonconductive coatings on enclosures. Remove coatings in the locknut area prior to assembling conduit to enclosure to ensure a continuous ground path.
- K. Boxes and Enclosures in Areas or Walls with Acoustical Requirements:
 - 1. Seal openings and knockouts in back and sides of boxes and enclosures with acoustically rated putty.
 - 2. Provide gaskets for wallplates and covers.

3.5 FIRESTOPPING

- A. Install firestopping at penetrations of fire-rated floor and wall assemblies.

3.6 PROTECTION

- A. Protect coatings, finishes, and cabinets from damage and deterioration.
 - 1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.

3.7 CLEANING

- A. Boxes: Remove construction dust and debris from device boxes, outlet boxes, and floor-mounted enclosures before installing wallplates, covers, and hoods.

END OF SECTION

SECTION 260553

IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:

1. Color and legend requirements for raceways, conductors, and warning labels and signs.
2. Labels.
3. Bands and tubes.
4. Tapes and stencils.
5. Tags.
6. Signs.
7. Cable ties.
8. Paint for identification.
9. Fasteners for labels and signs.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Comply with ASME A13.1.
- B. Comply with NFPA 70.
- C. Comply with 29 CFR 1910.144 and 29 CFR 1910.145.
- D. Comply with ANSI Z535.4 for safety signs and labels.
- E. Adhesive-attached labeling materials, including label stocks, laminating adhesives, and inks used by label printers, shall comply with UL 969.
- F. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes.
 1. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.

2.2 COLOR AND LEGEND REQUIREMENTS

- A. Raceways and Cables Carrying Circuits at 600 V or Less:
 - 1. Black letters on an orange field.
 - 2. Legend: Indicate voltage and system or service type.
- B. Color-Coding for Phase- and Voltage-Level Identification, 600 V or Less: Use colors listed below for ungrounded service, feeder, and branch-circuit conductors.
 - 1. Color shall be factory applied.
 - 2. Colors for 208/120-V Circuits:
 - a. Phase A: Black.
 - b. Phase B: Red.
 - c. Phase C: Blue.
 - 3. Colors for 480/277-V Circuits:
 - a. Phase A: Brown.
 - b. Phase B: Orange.
 - c. Phase C: Yellow.
 - 4. Color for Neutral: White.
 - 5. Color for Equipment Grounds: Green.
 - 6. Colors for Isolated Grounds: Green two or more yellow stripes.
- C. Warning Label Colors:
 - 1. Identify system voltage with black letters on an orange background.
- D. Warning labels and signs shall include, but are not limited to, the following legends:
 - 1. Multiple Power Source Warning: "DANGER - ELECTRICAL SHOCK HAZARD - EQUIPMENT HAS MULTIPLE POWER SOURCES."
 - 2. Workspace Clearance Warning: "WARNING - OSHA REGULATION - AREA IN FRONT OF ELECTRICAL EQUIPMENT MUST BE KEPT CLEAR FOR 36 INCHES."
- E. Equipment Identification Labels:
 - 1. Black letters on a white field.
 - 2. Panelboards shall be labeled with their name, voltage, phase, main & bus ampacities, and where they are fed from panelboard or switchboard name and position.
 - 3. Transformers shall be labeled with their name, voltages, phase, kVA rating, and where they are fed from panelboard or switchboard name and position, what panelboard or switchboard they feed.

2.3 LABELS

- A. Vinyl Wraparound Labels: Preprinted, flexible labels laminated with a clear, weather- and chemical-resistant coating and matching wraparound clear adhesive tape for securing label ends.
- B. Snap-around Labels: Slit, pretensioned, flexible, preprinted, color-coded acrylic sleeves, with diameters sized to suit diameter and that stay in place by gripping action.
- C. Self-Adhesive Wraparound Labels: Preprinted, 3-mil-thick, polyester flexible label with acrylic pressure-sensitive adhesive.
 - 1. Self-Lamination: Clear; UV-, weather- and chemical-resistant; self-laminating, protective shield over the legend. Labels sized such that the clear shield overlaps the entire printed legend.
 - 2. Marker for Labels: Machine-printed, permanent, waterproof, black ink recommended by printer manufacturer.
- D. Self-Adhesive Labels: Polyester, thermal, transfer-printed, 3-mil-thick, multicolor, weather- and UV-resistant, pressure-sensitive adhesive labels, configured for intended use and location.
 - 1. Minimum Nominal Size:
 - a. 1-1/2 by 6 inches for raceway and conductors.
 - b. 3-1/2 by 5 inches for equipment.
 - c. As required by authorities having jurisdiction.

2.4 BANDS AND TUBES

- A. Snap-around, Color-Coding Bands: Slit, pretensioned, flexible, solid-colored acrylic sleeves, 2 inches long, with diameters sized to suit diameter and that stay in place by gripping action.
- B. Heat-Shrink Preprinted Tubes: Flame-retardant polyolefin tubes with machine-printed identification labels, sized to suit diameters of and shrunk to fit firmly around item being identified. Full shrink recovery occurs at a maximum of 200 deg F. Comply with UL 224.

2.5 TAPES AND STENCILS

- A. Marker Tapes: Vinyl or vinyl-cloth, self-adhesive wraparound type, with circuit identification legend machine printed by thermal transfer or equivalent process.
- B. Self-Adhesive Vinyl Tape: Colored, heavy duty, waterproof, fade resistant; not less than 3 mils thick by 1 to 2 inches wide; compounded for outdoor use.
- C. Tape and Stencil: 4-inch-wide black stripes on 10-inch centers placed diagonally over orange background and is 12 inches wide. Stop stripes at legends.
- D. Floor Marking Tape: 2-inch-wide, 5-mil pressure-sensitive vinyl tape, with yellow and black stripes and clear vinyl overlay.

- E. Stenciled Legend: In nonfading, waterproof, black ink or paint. Minimum letter height shall be 1 inch.

2.6 TAGS

A. Write-on Tags:

1. Polyester Tags: 0.010 inch thick, with corrosion-resistant grommet and cable tie for attachment.
2. Marker for Tags: Permanent, waterproof, black ink marker recommended by tag manufacturer.
3. Marker for Tags: Machine-printed, permanent, waterproof, black ink marker recommended by printer manufacturer.

2.7 SIGNS

A. Baked-Enamel Signs:

1. Preprinted aluminum signs, punched or drilled for fasteners, with colors, legend, and size required for application.
2. 1/4-inch grommets in corners for mounting.
3. Nominal Size: 7 by 10 inches.

B. Metal-Backed Butyrate Signs:

1. Weather-resistant, nonfading, preprinted, cellulose-acetate butyrate signs, with 0.0396-inch galvanized-steel backing, punched and drilled for fasteners, and with colors, legend, and size required for application.
2. 1/4-inch grommets in corners for mounting.
3. Nominal Size: 10 by 14 inches.

C. Laminated Acrylic or Melamine Plastic Signs:

1. Engraved legend.
2. Thickness:
 - a. For signs up to 20 sq. in., minimum 1/16 inch thick.
 - b. For signs larger than 20 sq. in., 1/8 inch thick.
 - c. Engraved legend with white letters on a dark gray background.
 - d. Punched or drilled for mechanical fasteners with 1/4-inch grommets in corners for mounting.
 - e. Framed with mitered acrylic molding and arranged for attachment at applicable equipment.

2.8 CABLE TIES

- A. General-Purpose Cable Ties: Fungus inert, self-extinguishing, one piece, self-locking, and Type 6/6 nylon.

1. Minimum Width: 3/16 inch.
2. Tensile Strength at 73 Deg F according to ASTM D638: 12,000 psi.
3. Temperature Range: Minus 40 to plus 185 deg F.
4. Color: Black, except where used for color-coding.

2.9 MISCELLANEOUS IDENTIFICATION PRODUCTS

- A. Paint: Comply with requirements in painting Sections for paint materials and application requirements. Retain paint system applicable for surface material and location (exterior or interior).
- B. Fasteners for Labels and Signs: Self-tapping, stainless-steel screws or stainless-steel machine screws with nuts and flat and lock washers.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Verify and coordinate identification names, abbreviations, colors, and other features with requirements in other Sections requiring identification applications, Drawings, Shop Drawings, manufacturer's wiring diagrams, and operation and maintenance manual. Use consistent designations throughout Project.
- B. Verify identity of each item before installing identification products.
- C. Coordinate identification with Project Drawings, manufacturer's wiring diagrams, and operation and maintenance manual.
- D. Apply identification devices to surfaces that require finish after completing finish work.
- E. Install signs with approved legend to facilitate proper identification, operation, and maintenance of electrical systems and connected items.
- F. Self-Adhesive Identification Products: Before applying electrical identification products, clean substrates of substances that could impair bond, using materials and methods recommended by manufacturer of identification product.
- G. System Identification for Raceways and Cables under 600 V: Identification shall completely encircle cable or conduit. Place identification of two-color markings in contact, side by side.
 1. Secure tight to surface of conductor, cable, or raceway.
- H. Auxiliary Electrical Systems Conductor Identification: Identify field-installed alarm, control, and signal connections.
- I. Elevated Components: Increase sizes of labels, signs, and letters to those appropriate for viewing from the floor.
- J. Vinyl Wraparound Labels:

1. Secure tight to surface at a location with high visibility and accessibility.
 2. Attach labels that are not self-adhesive type with clear vinyl tape, with adhesive appropriate to the location and substrate.
- K. Snap-around Labels: Secure tight to surface at a location with high visibility and accessibility.
- L. Self-Adhesive Wraparound Labels: Secure tight to surface of raceway or cable at a location with high visibility and accessibility.
- M. Self-Adhesive Labels:
1. On each unit of equipment, install unique designation label that is consistent with wiring diagrams, schedules, and operation and maintenance manual.
 2. Unless otherwise indicated, provide a single line of text with 1/2-inch-high letters on 1-1/2-inch-high label; where two lines of text are required, use labels 2 inches high.
- N. Snap-around Color-Coding Bands: Secure tight to surface at a location with high visibility and accessibility.
- O. Heat-Shrink, Preprinted Tubes: Secure tight to surface at a location with high visibility and accessibility.
- P. Marker Tapes: Secure tight to surface at a location with high visibility and accessibility.
- Q. Self-Adhesive Vinyl Tape: Secure tight to surface at a location with high visibility and accessibility.
1. Field-Applied, Color-Coding Conductor Tape: Apply in half-lapped turns for a minimum distance of 6 inches where splices or taps are made. Apply last two turns of tape with no tension to prevent possible unwinding.
- R. Tape and Stencil: Comply with requirements in painting Sections for surface preparation and paint application.
- S. Floor Marking Tape: Apply stripes to finished surfaces following manufacturer's written instructions.
- T. Write-on Tags:
1. Place in a location with high visibility and accessibility.
 2. Secure using UV-stabilized cable ties.
- U. Baked-Enamel Signs:
1. Attach signs that are not self-adhesive type with mechanical fasteners appropriate to the location and substrate.
 2. Unless otherwise indicated, provide a single line of text with 1/2-inch-high letters on minimum 1-1/2-inch-high sign; where two lines of text are required, use signs minimum 2 inches high.
- V. Metal-Backed Butyrate Signs:

1. Attach signs that are not self-adhesive type with mechanical fasteners appropriate to the location and substrate.
2. Unless otherwise indicated, provide a single line of text with 1/2-inch-high letters on minimum 1-1/2-inch-high sign; where two lines of text are required, use signs minimum 2 inches high.

W. Laminated Acrylic or Melamine Plastic Signs:

1. Attach signs and plastic labels that are not self-adhesive type with mechanical fasteners appropriate to the location and substrate.
2. Unless otherwise indicated, provide a single line of text with 1/2-inch-high letters on minimum 1-1/2-inch-high sign; where two lines of text are required, use signs minimum 2 inches high.

X. Cable Ties: General purpose, for attaching tags, except as listed below:

1. Outdoors: UV-stabilized nylon.
2. In Spaces Handling Environmental Air: Plenum rated.

3.2 IDENTIFICATION SCHEDULE

- A. Install identification materials and devices at locations for most convenient viewing without interference with operation and maintenance of equipment. Install access doors or panels to provide view of identifying devices.
- B. Identify conductors, cables, and terminals in enclosures and at junctions, terminals, pull points, and locations of high visibility. Identify by system and circuit designation.
- C. Accessible Raceways and Metal-Clad Cables, 600 V or Less, for Service, Feeder, and Branch Circuits, More Than 30 A and 120 V to Ground: Identify with self-adhesive raceway labels.
 1. Locate identification at changes in direction, at penetrations of walls and floors, at 50-foot maximum intervals in straight runs, and at 25-foot maximum intervals in congested areas.
- D. Power-Circuit Conductor Identification, 600 V or Less: For conductors in vaults, pull and junction boxes, manholes, and handholes, use self-adhesive wraparound labels to identify the phase.
 1. Locate identification at changes in direction, at penetrations of walls and floors, at 50-foot maximum intervals in straight runs, and at 25-foot maximum intervals in congested areas.
- E. Control-Circuit Conductor Identification: For conductors and cables in pull and junction boxes, manholes, and handholes, use self-adhesive wraparound labels with the conductor or cable designation, origin, and destination.
- F. Control-Circuit Conductor Termination Identification: For identification at terminations, provide heat-shrink preprinted tubes with the conductor designation.

- G. Conductors to Be Extended in the Future: Attach write-on tags to conductors and list source.
- H. Workspace Indication: Apply floor marking tape to finished surfaces. Show working clearances in the direction of access to live parts. Workspace shall comply with NFPA 70 and 29 CFR 1926.403 unless otherwise indicated. Do not install at flush-mounted panelboards and similar equipment in finished spaces.
- I. Instructional Signs: Self-adhesive labels, including the color code for grounded and ungrounded conductors.
- J. Operating Instruction Signs: Self-adhesive labels.
- K. Equipment Identification Labels:
 - 1. Indoor Equipment: Laminated acrylic or melamine plastic sign.
 - 2. Outdoor Equipment: Laminated acrylic or melamine sign.

END OF SECTION 260553

SECTION 262816

ENCLOSED SWITCHES AND CIRCUIT BREAKERS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Fusible switches.
2. Nonfusible switches.
3. Molded-case circuit breakers (MCCBs).
4. Molded-case switches.
5. Enclosures.

1.2 ACTION SUBMITTALS

- ###### A. Product Data:
- For each type of enclosed switch, circuit breaker, accessory, and component indicated. Include nameplate ratings, dimensioned elevations, sections, weights, and manufacturers' technical data on features, performance, electrical characteristics, ratings, accessories, and finishes.

1.3 CLOSEOUT SUBMITTALS

- ###### A. Operation and maintenance data.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS

- ###### A. Source Limitations:
- Obtain enclosed switches and circuit breakers, overcurrent protective devices, components, and accessories, within same product category, from single manufacturer.
- ###### B. Product Selection for Restricted Space:
- Drawings indicate maximum dimensions for enclosed switches and circuit breakers, including clearances between enclosures, and adjacent surfaces and other items. Comply with indicated maximum dimensions.
- ###### C. Electrical Components, Devices, and Accessories:
- Listed and labeled as defined in NFPA 70, by an NRTL, and marked for intended location and application.
- ###### D. Comply with NFPA 70.

2.2 FUSIBLE SWITCHES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. ABB, Electrification Business.
 2. Eaton.
 3. Siemens Industry, Inc., Energy Management Division.
 4. Square D; Schneider Electric USA.
- B. Type HD, Heavy Duty:
1. Single throw.
 2. Three pole.
 3. 600-V ac.
 4. 1200 A and smaller.
 5. UL 98 and NEMA KS 1, horsepower rated, with clips or bolt pads to accommodate specified fuses.
 6. Lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.
- C. Accessories:
1. Equipment Ground Kit: Internally mounted and labeled for copper and aluminum ground conductors.
 2. Neutral Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.

2.3 NONFUSIBLE SWITCHES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. ABB, Electrification Business.
 2. Eaton.
 3. Siemens Industry, Inc., Energy Management Division.
 4. Square D; Schneider Electric USA.
- B. Type HD, Heavy Duty, Three Pole, Single Throw, 600-V ac, 1200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.
- C. Accessories:
1. Equipment Ground Kit: Internally mounted and labeled for copper and aluminum ground conductors.
 2. Neutral Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.

2.4 MOLDED-CASE CIRCUIT BREAKERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. ABB, Electrification Business.
 2. Eaton.
 3. Siemens Industry, Inc., Energy Management Division.
 4. Square D; Schneider Electric USA.
- B. Circuit breakers shall be constructed using glass-reinforced insulating material. Current carrying components shall be completely isolated from the handle and the accessory mounting area.
- C. Circuit breakers shall have a toggle operating mechanism with common tripping of all poles, which provides quick-make, quick-break contact action. The circuit-breaker handle shall be over center, be trip free, and reside in a tripped position between on and off to provide local trip indication. Circuit-breaker escutcheon shall be clearly marked on and off in addition to providing international I/O markings. Equip circuit breaker with a push-to-trip button, located on the face of the circuit breaker to mechanically operate the circuit-breaker tripping mechanism for maintenance and testing purposes.
- D. The maximum ampere rating and UL, IEC, or other certification standards with applicable voltage systems and corresponding interrupting ratings shall be clearly marked on face of circuit breaker. Circuit breakers shall be 100 percent rated.
- E. MCCBs shall be equipped with a device for locking in the isolated position.
- F. Lugs shall be suitable for 167 deg F (75 deg C) rated wire.
- G. Standards: Comply with UL 489 with interrupting capacity to comply with available fault currents.
- H. Thermal-Magnetic Circuit Breakers: Inverse time-current thermal element for low-level overloads and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.
- I. Current-Limiting Circuit Breakers: Frame sizes 400 A and smaller, and let-through ratings less than NEMA FU 1, RK-5.
- J. Features and Accessories:
1. Standard frame sizes, trip ratings, and number of poles.
 2. Shunt Trip: Trip coil energized from separate circuit, with coil-clearing contact.

2.5 ENCLOSURES

- A. Enclosed Switches and Circuit Breakers: UL 489, NEMA KS 1, NEMA 250, and UL 50, to comply with environmental conditions at installed location.
- B. Enclosure Finish: The enclosure shall be finished with gray baked enamel paint, electrodeposited on cleaned, phosphatized steel (NEMA 250 Type 1).

- C. Operating Mechanism: The circuit-breaker operating handle shall be externally operable with the operating mechanism being an integral part of the box, not the cover. The cover interlock mechanism shall have an externally operated override. The override shall not permanently disable the interlock mechanism, which shall return to the locked position once the override is released. The tool used to override the cover interlock mechanism shall not be required to enter the enclosure in order to override the interlock.

PART 3 - EXECUTION

3.1 ENCLOSURE ENVIRONMENTAL RATING APPLICATIONS

- A. Enclosed Switches and Circuit Breakers: Provide enclosures at installed locations with the following environmental ratings.
 - 1. Indoor, Dry and Clean Locations: NEMA 250, Type 1.
 - 2. Outdoor Locations: NEMA 250, Type 3R.
 - 3. Wash-Down Areas: NEMA 250, Type 4X, stainless steel.
 - 4. Other Wet or Damp, Indoor Locations: NEMA 250, Type 4.
 - 5. Indoor Locations Subject to Dust, Falling Dirt, and Dripping Noncorrosive Liquids: NEMA 250, Type 12.

3.2 INSTALLATION

- A. Interruption of Existing Electric Service: Do not interrupt electric service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electric service according to requirements indicated:
 - 1. Notify Owner no fewer than seven days in advance of proposed interruption of electric service.
 - 2. Indicate method of providing temporary electric service.
 - 3. Do not proceed with interruption of electric service without Owner's written permission.
 - 4. Comply with NFPA 70E.
- B. Coordinate layout and installation of switches, circuit breakers, and components with equipment served and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.
- C. Install individual wall-mounted switches and circuit breakers with tops at uniform height unless otherwise indicated.
- D. Temporary Lifting Provisions: Remove temporary lifting of eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.
- E. Install fuses in fusible devices.
- F. Comply with NFPA 70 and NECA 1.

3.3 IDENTIFICATION

A. Comply with requirements in Section 260553 "Identification for Electrical Systems."

1. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs.
2. Label each enclosure with engraved metal or laminated-plastic nameplate.

3.4 FIELD QUALITY CONTROL

A. Tests and Inspections for Switches:

1. Visual and Mechanical Inspection:

- a. Inspect physical and mechanical condition.
- b. Inspect anchorage, alignment, grounding, and clearances.
- c. Verify that the unit is clean.
- d. Verify blade alignment, blade penetration, travel stops, and mechanical operation.
- e. Verify that fuse sizes and types match the Specifications and Drawings.
- f. Verify that each fuse has adequate mechanical support and contact integrity.
- g. Inspect bolted electrical connections for high resistance using one of the two following methods:
 - 1) Use a low-resistance ohmmeter.
 - a) Compare bolted connection resistance values to values of similar connections. Investigate values that deviate from those of similar bolted connections by more than 50 percent of the lowest value.
 - 2) Verify tightness of accessible bolted electrical connections by calibrated torque-wrench method in accordance with manufacturer's published data or NETA ATS Table 100.12.
 - a) Bolt-torque levels shall be in accordance with manufacturer's published data. In the absence of manufacturer's published data, use NETA ATS Table 100.12.
- h. Verify that operation and sequencing of interlocking systems is as described in the Specifications and shown on the Drawings.
- i. Verify correct phase barrier installation.
- j. Verify lubrication of moving current-carrying parts and moving and sliding surfaces.

2. Electrical Tests:

- a. Perform resistance measurements through bolted connections with a low-resistance ohmmeter. Compare bolted connection resistance values to values of similar connections. Investigate values that deviate from adjacent poles or similar switches by more than 50 percent of the lowest value.

- b. Measure contact resistance across each switchblade fuseholder. Drop values shall not exceed the high level of the manufacturer's published data. If manufacturer's published data are not available, investigate values that deviate from adjacent poles or similar switches by more than 50 percent of the lowest value.
- c. Perform insulation-resistance tests for one minute on each pole, phase-to-phase and phase-to-ground with switch closed, and across each open pole. Apply voltage in accordance with manufacturer's published data. In the absence of manufacturer's published data, use Table 100.1 from the NETA ATS. Investigate values of insulation resistance less than those published in Table 100.1 or as recommended in manufacturer's published data.
- d. Measure fuse resistance. Investigate fuse-resistance values that deviate from each other by more than 15 percent.
- e. Perform ground fault test according to NETA ATS 7.14 "Ground Fault Protection Systems, Low-Voltage."

B. Tests and Inspections for Molded Case Circuit Breakers:

1. Visual and Mechanical Inspection:

- a. Verify that equipment nameplate data are as described in the Specifications and shown on the Drawings.
- b. Inspect physical and mechanical condition.
- c. Inspect anchorage, alignment, grounding, and clearances.
- d. Verify that the unit is clean.
- e. Operate the circuit breaker to ensure smooth operation.
- f. Inspect bolted electrical connections for high resistance using one of the two following methods:
 - 1) Use a low-resistance ohmmeter.
 - a) Compare bolted connection resistance values to values of similar connections. Investigate values that deviate from those of similar bolted connections by more than 50 percent of the lowest value.
 - 2) Verify tightness of accessible bolted electrical connections by calibrated torque-wrench method in accordance with manufacturer's published data or NETA ATS Table 100.12.
 - a) Bolt-torque levels shall be in accordance with manufacturer's published data. In the absence of manufacturer's published data, use NETA ATS Table 100.12.
- g. Inspect operating mechanism, contacts, and chutes in unsealed units.
- h. Perform adjustments for final protective device settings in accordance with the coordination study.

2. Electrical Tests:

- a. Perform resistance measurements through bolted connections with a low-resistance ohmmeter. Compare bolted connection resistance values to values of similar

- connections. Investigate values that deviate from adjacent poles or similar switches by more than 50 percent of the lowest value.
- b. Perform insulation-resistance tests for one minute on each pole, phase-to-phase and phase-to-ground with circuit breaker closed, and across each open pole. Apply voltage in accordance with manufacturer's published data. In the absence of manufacturer's published data, use Table 100.1 from the NETA ATS. Investigate values of insulation resistance less than those published in Table 100.1 or as recommended in manufacturer's published data.
 - c. Perform a contact/pole resistance test. Drop values shall not exceed the high level of the manufacturer's published data. If manufacturer's published data are not available, investigate values that deviate from adjacent poles or similar switches by more than 50 percent of the lowest value.
 - d. Perform insulation resistance tests on all control wiring with respect to ground. Applied potential shall be 500-V dc for 300-V rated cable and 1000-V dc for 600-V rated cable. Test duration shall be one minute. For units with solid state components, follow manufacturer's recommendation. Insulation resistance values shall be no less than two megohms.
 - e. Determine the following by primary current injection:
 - 1) Long-time pickup and delay. Pickup values shall be as specified. Trip characteristics shall not exceed manufacturer's published time-current characteristic tolerance band, including adjustment factors.
 - 2) Short-time pickup and delay. Short-time pickup values shall be as specified. Trip characteristics shall not exceed manufacturer's published time-current characteristic tolerance band, including adjustment factors.
 - 3) Ground-fault pickup and time delay. Ground-fault pickup values shall be as specified. Trip characteristics shall not exceed manufacturer's published time-current characteristic tolerance band, including adjustment factors.
 - 4) Instantaneous pickup. Instantaneous pickup values shall be as specified and within manufacturer's published tolerances.
 - f. Test functionality of the trip unit by means of primary current injection. Pickup values and trip characteristics shall be as specified and within manufacturer's published tolerances.
 - g. Perform minimum pickup voltage tests on shunt trip and close coils in accordance with manufacturer's published data. Minimum pickup voltage of the shunt trip and close coils shall be as indicated by manufacturer.
 - h. Verify correct operation of auxiliary features such as trip and pickup indicators; zone interlocking; electrical close and trip operation; trip-free, anti-pump function; and trip unit battery condition. Reset all trip logs and indicators. Investigate units that do not function as designed.
 - i. Verify operation of charging mechanism. Investigate units that do not function as designed.
3. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
 4. Test and adjust controls, remote monitoring, and safeties. Replace damaged and malfunctioning controls and equipment.
- C. Enclosed switches and circuit breakers will be considered defective if they do not pass tests and inspections.

- D. Prepare test and inspection reports.
 - 1. Test procedures used.
 - 2. Include identification of each enclosed switch and circuit breaker tested and describe test results.
 - 3. List deficiencies detected, remedial action taken, and observations after remedial action.

END OF SECTION



BID NUMBER: 2502-23	LFG JOB NUMBER: 2024.LFG.134	DRAWING NUMBER: T-001
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MECHANICAL SYMBOLS			
	RECTANGULAR, FLAT OVAL OR ROUND AIR DUCT (PLAN VIEW)		BALANCING VALVE WITH 100% SHUTOFF
	HOT WATER SUPPLY PIPING		CHECK VALVE
	HOT WATER RETURN PIPING		OS & Y VALVE
	CONDENSATE DRAIN PIPING		TWO-WAY CONTROL VALVE
	PIPE ELBOW (UP & DN)		THREE-WAY CONTROL VALVE
	TAKEOFF FROM TOP OF MAIN PIPE		PRESSURE REDUCING VALVE
	TAKEOFF FROM BOTTOM OF MAIN PIPE		PRESSURE RELIEF VALVE
	CONDENSER WATER SUPPLY PIPING		PUMP (SCHEMATIC)
	CONDENSER WATER RETURN PIPING		AIR VENT (MANUAL OR AUTOMATIC)
	CAPPED END OF PIPE		FLEXIBLE CONNECTOR
	DIRECTION OF FLUID FLOW		THERMOMETER
	BREAK FLANGES		PRESSURE GAUGE WTH SHUT-OFF COCK
	UNION		STRAINER WITH BLOW-DOWN VALVE
	BALL VALVE		ROOM THERMOSTAT OR TEMPERATURE SENSOR
	BUTTERFLY VALVE		ROOM HUMIDITY SENSOR OR HUMIDISTAT
	GATE VALVE		FLOW SWITCH
	GLOBE VALVE		DUCT SMOKE DETECTOR (SD)
	NEW DUCTWORK (BOLD LINE)		POINT OF CONNECTION
	EXISTING DUCTWORK (FINE LINE)		
(E)	EXISTING		
AS	AIR SEPARATOR	HWS	HOT WATER SUPPLY
B	BOILER	HWR	HOT WATER RETURN
BP	BOILER PUMP	TSTAT	THERMOSTAT
CW	COLD WATER (DOMESTIC)		
ET	EXPANSION TANK		
(E)	EXISTING		
	HAND-OFF-AUTO STARTER		VARIABLE FREQUENCY DRIVE
	DIFF. PRESSURE SWITCH		DIFF. PRESSURE TRANSMITTER

PROJECT DESCRIPTION

THE PRIMARY INTENT OF THIS PROJECT IS TO REPLACE STEAM BOILERS, WITH CAT. IV CONDENSING HOT WATER BOILERS, REMOVE CONDENSATE TANK, HEAT EXCHANGER AND INSTALL NEW BOILER PUMPS, PIPING AND CONTROLS. THE CONTRACTOR SHALL BE RESPONSIBLE FOR A COMPLETE INSTALLATION INCLUDING (BUT NOT LIMITED TO) THE FOLLOWING:

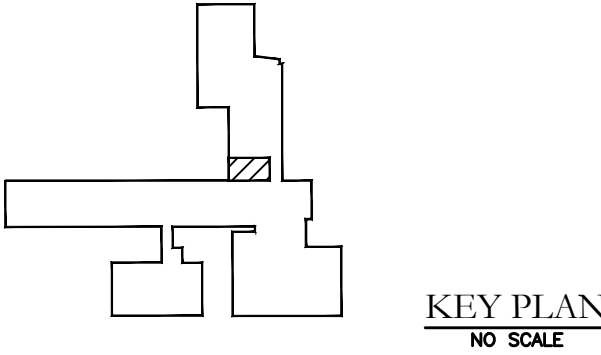
- DEMO OF ALL EXISTING STEAM SUPPLY, CONDENSATE RETURN EQUIPMENT AND PIPING.
- DISCONNECTION, REMOVAL AND SAFE DISPOSAL OF EXISTING BOILERS.
- RIGGING AND INSTALLATION OF NEW CONDENSING GAS BOILERS.
- INSTALLATION OF NEW HOT WATER PIPING AS INDICATED.
- INSTALLATION OF NEW BOILER PUMPS, EXPANSION TANK, AIR SEPARATOR AND ALL ASSOCIATED VALVES AND TRIM.
- INSTALLATION OF NEW HOT WATER COIL AND PIPING IN AT EXITING AUDITORIUM AIRHANDLER.
- PLUMBING WORK INCLUDING MODIFICATION OF NATURAL GAS PIPING TO ACCOMMODATE NEW BOILERS.
- COMBUSTION AIR PIPING AND VENT FOR NEW CONDENSING GAS BOILERS.
- HOT WATER PIPING INSULATION
- LABELING OF NEW & EXIST'G PIPING IN BOILER ROOM
- ALL ASSOCIATED ELECTRICAL WORK TO SUPPORT NEW MECHANICAL EQUIPMENT AS DEPICTED ON PLANS.
- INTEGRATION OF NEW NEW MECHANICAL EQUIPMENT INTO BUILDING AUTOMATION SYSTEM (BAS) AND NEW COMMUNICATION WIRING FOR REMOTE MONITORING OF NEW BOILERS BY BOILER VENDOR.
- STARTUP OF BOILERS AND PUMPS WITH SUPPORT FROM MANUFACTURER REPRESENTATIVES
- LIBRARY CEILING REMOVAL, REINSTALLATION AND RESTORATION
- CORE DRILLS REQUIRED FOR NEW HOT WATER PIPING TO 2ND FLR.
- HYDROSTATIC TESTING OF NEW PIPING PRIOR TO SYSTEM FILL
- WATER TESTING AND BALANCING.
- PIPING SHOP DRAWINGS.
- PIPING AS-BUILT DRAWINGS.
- PROJECT O&M MANUALS AT PROJECT CLOSEOUT
- 4HRS OF OWNER TRAINING ON NEW MECHANICAL EQUIPMENT AND CONTROLS.

PROJECT NOTES:

- REFER TO WRITTEN (BOOK) SPECIFICATIONS FOR ADDITIONAL INFORMATION.
- BIDDERS SHALL NOTE THAT (3) CONDENSING GAS BOILERS AND (3) INLINE BOILER PUMPS HAVE BEEN PRE-PURCHASED BY THE OWNER; THE COST TO FURNISH THIS EQUIPMENT SHALL BE EXCLUDED FROM THE BID.
- ALL COSTS FOR TRANSPORTATION, HANDLING, STORAGE AND RIGGING OF BOILERS SHALL BE CARRIED IN CONTRACTOR'S BASE BID.
- ALL BIDDERS SHALL VISIT PROJECT SITE TO THOROUGHLY FAMILIARIZE THEMSELVES WITH EXISTING CONDITIONS. CLAIMS FOR EXTRA PAYMENTS FOR WORK, WHICH COULD HAVE BEEN IDENTIFIED VIA CAREFUL SITE INSPECTION, WILL NOT BE ACKNOWLEDGED.
- CONTRACTOR SHALL WORK ONLY AT TIMES AND IN AREAS DESIGNATED BY THE OWNER. MAJOR CONSTRUCTION IS EXPECTED TO COMMENCE ON JUNE 28, 2025 AND END NO LATER THAN AUGUST 17, 2025. MINOR CONSTRUCTION MAY BE PERMITTED PRIOR TO 6-26-25. CONTRACTOR SHALL NOTE THAT SUMMER SCHOOL ACTIVITIES WILL TAKE PLACE BETWEEN 7/7 AND 8/15; WORK IS PERMITTED DURING THIS PERIOD BY EFFORTS SHALL BE MADE TO CONTAIN NOISE TO AVOID DISRUPTION OF EDUCATIONAL ACTIVITIES.
- BOILERS SHALL BE STARTED AND OPERATIONAL BY AUGUST 20, 2025. IF OVERTIME LABOR IS REQUIRED IN ORDER TO MEET THIS DEADLINE, CONTRACTOR SHALL INCLUDE THESE COSTS IN BASE BID.
- ALL DDC CONTROLS WORK SHALL BE PERFORMED BY BUILDING ATC CONTRACTOR:
- CONNECTICUT TEMPERATURE CONTROLS, LLC.
ATTN: MIKE SULLO
(800) 890-2022

LEGEND	
	FAN OR PUMP
	FAN OR PUMP
	TEMPERATURE TRANSMITTER
	HUMIDITY TRANSMITTER
	FLOW SWITCH
	HAND OFF AUTO
	MOTORIZED OPERATOR
	SMOKE DETECTOR
	VARIABLE FREQUENCY DRIVE
	DIFFERENTIAL PRESSURE SWITCH
	LOW LIMIT SWITCH (FREEZESTAT)
	CARBON DIOXIDE LEVEL SENSOR
	CONTROL VALVE (MODULATING)
	RUN INDICATOR
	START/STOP
	HOT WATER SUPPLY
	HOT WATER RETURN
	PRESSURE TRANSDUCER
	ZONE DAMPER
	AIR HANDLING UNIT
	FAN COIL UNIT
	RETURN AIR
	SUPPLY AIR
	OUTSIDE AIR
	EXISTING
	NEW
	ZONE DESIGNATION
	NORMALLY CLOSED
	NORMALLY OPEN
	VOLUME DAMPER
	EXHAUST FAN
	ISOLATION VALVE
	FIRE DAMPER
	THERMOSTAT
	FACTORY CONTROL PANEL
	SPEED CONTROL
	SMOKE DETECTOR (DUCT MOUNTED)
	SPEED REFERENCE
	DRIVE FAULT
	AIR OR WATER FLOW METER
	BAS INTERFACE POINT (NEW UNLESS OTHERWISE NOTED)
	POINT OF CONNECTION, NEW WORK TO EXISTING

DRAWING INDEX	
T-001	PROJECT COVER SHEET
M-001	MECHANICAL DESCRIPTION, SYMBOLS, LEGEND & NOTES
MD-100	MECHANICAL DEMO PLAN
M-100	MECHANICAL PLANS
M-200	MECHANICAL PIPING & CONTROLS DIAGRAM
M-300	MECHANICAL SCHEDULES
M-400	MECHANICAL DETAILS
P-001	PLUMBING DESCRIPTION, SYMBOLS, LEGEND AND NOTES
PD-100	PLUMBING DEMO PLAN
P-100	PLUMBING PLANS
E-001	ELECTRICAL LEGEND, NOTES, & ABBREVIATIONS
ER-100	ELECTRICAL BOILER ROOM REMOVALS PLAN
E-100	ELECTRICAL BOILER ROOM POWER PLAN
E-110	ELECTRICAL BOILER ROOM LIGHTING PLAN (ALT #E1)
E-200	ELECTRICAL PANEL SCHEDULES
E-201	ELECTRICAL DIAGRAMS, SCHEDULES, & MATRIX OF OPERATIONS



BOILER REPLACEMENT
AT EASTERN MIDDLE
SCHOOL

EASTERN MIDDLE SCHOOL
51 HENDRIE AVENUE
RIVERSIDE, CT 06878

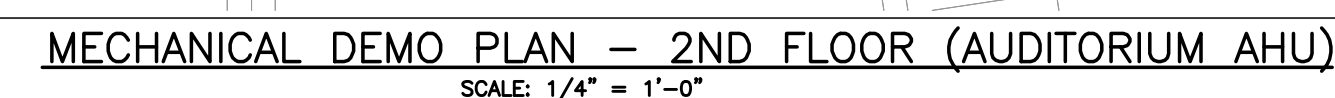
SCALE:	AS NOTED	APPROVED BY:	RS	DRAWN BY:	
DATE:	February 4, 2025	CHECKED BY:	RS		

MECHANICAL DESCRIPTION, SYMBOLS,
LEGEND AND NOTES

BID NUMBER:	LFG JOB NUMBER:	DRAWING NUMBER:
2302-25	2024.LFG.134	M-001



LANDMARK
FACILITIES
GROUP, INC.



 EQUIPMENT / MATERIAL TO BE REMOVED

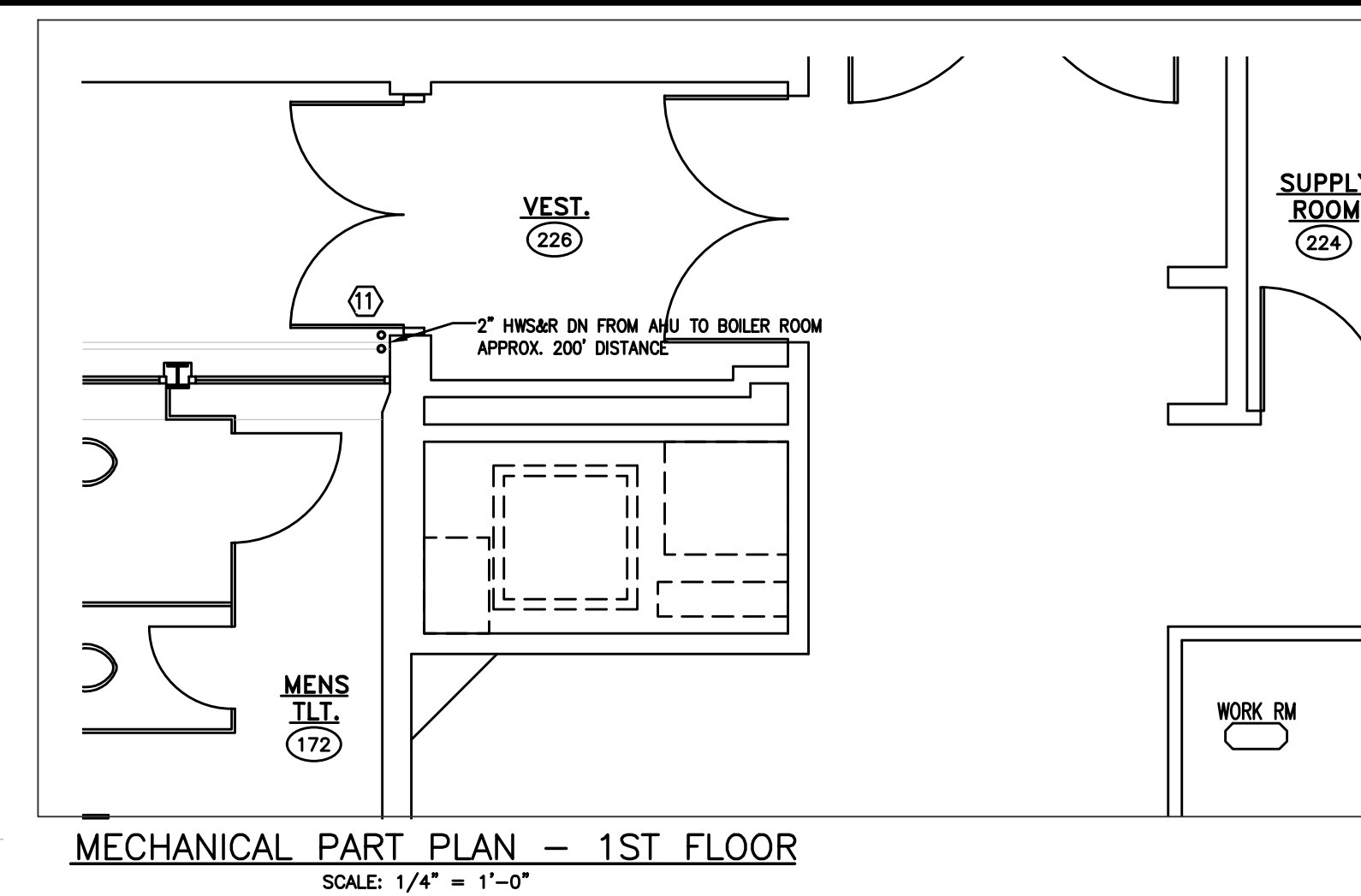
1. DEMO EXISTING HOUSEKEEPING PADS
2. DEMO EXISTING EQUIPMENT AND ALL ASSOCIATED HANGERS AND SUPPORTS.
3. CONTRACTOR SHALL BE RESPONSIBLE FOR DISCONNECTION, REMOVAL, AND SAFE DISPOSAL OF ALL EQUIPMENT, PIPING AND MATERIAL SHOWN. ALL STEAM SUPPLY AND CONDENSATE RETURN PIPING SHALL BE REMOVED IN ITS ENTIRETY.
4. COORDINATE WITH ELECTRICAL AND CONTROLS CONTRACTORS TO DISCONNECT & REMOVE ALL LINE AND LOW VOLTAGE WIRING FROM EQUIPMENT TO BE REMOVED.
5. CONTRACTOR SHALL BE RESPONSIBLE FOR REMOVAL OF LIBRARY PIPING REQUIRED TO DISCONNECT AND REMOVE EXISTING STEAM PIPING AND HANGERS.

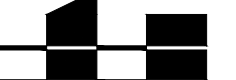
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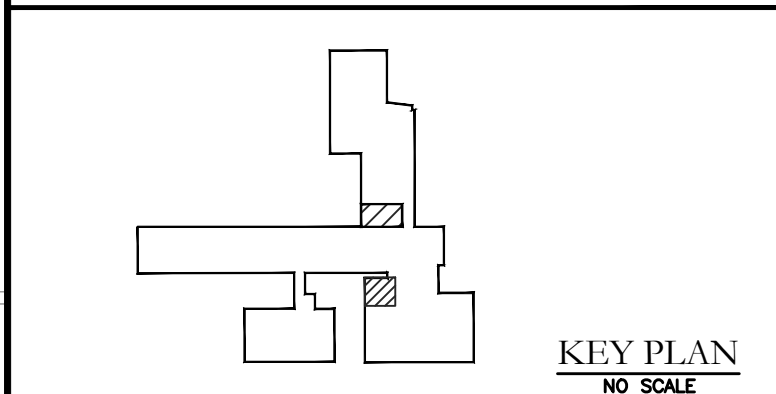
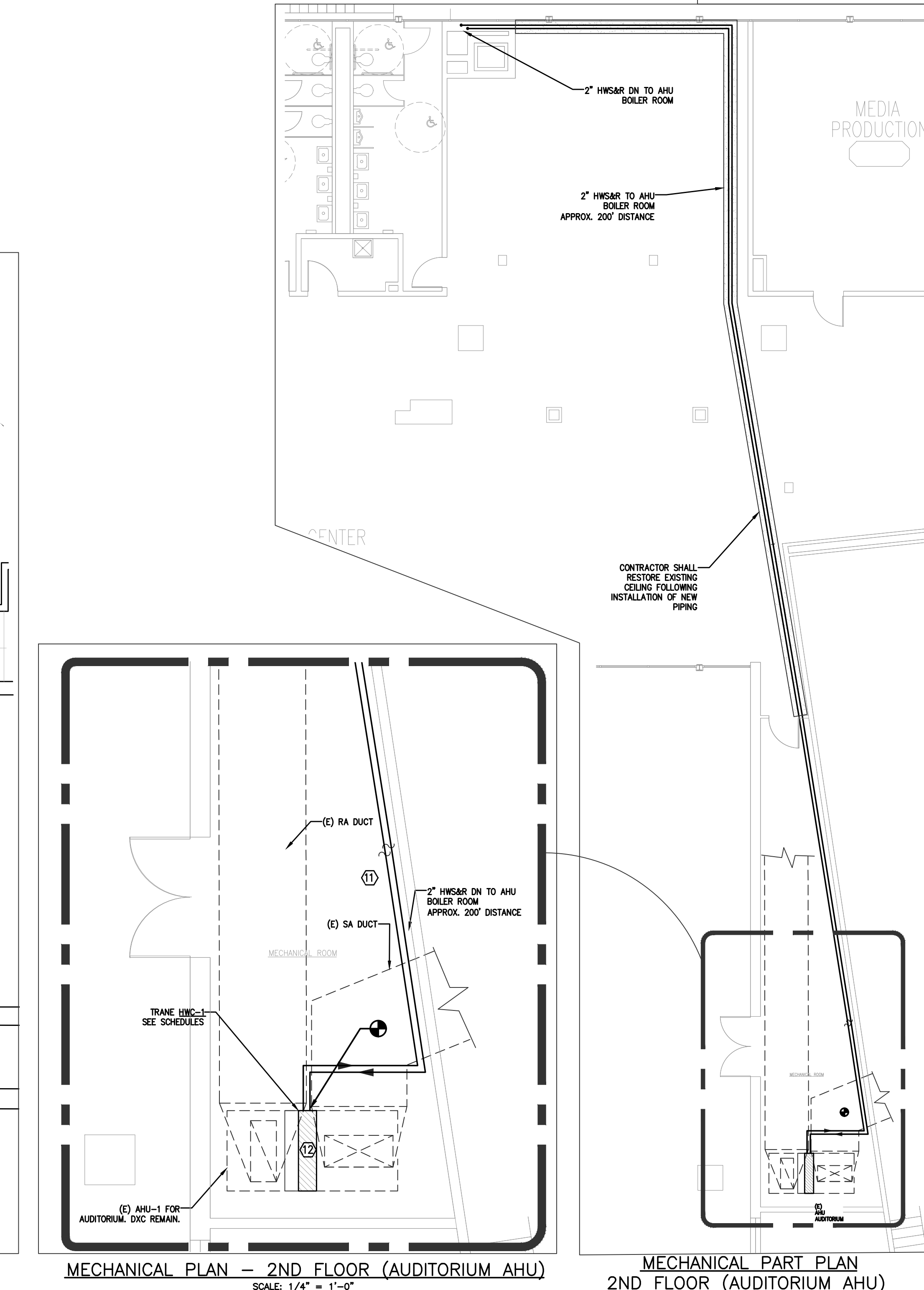
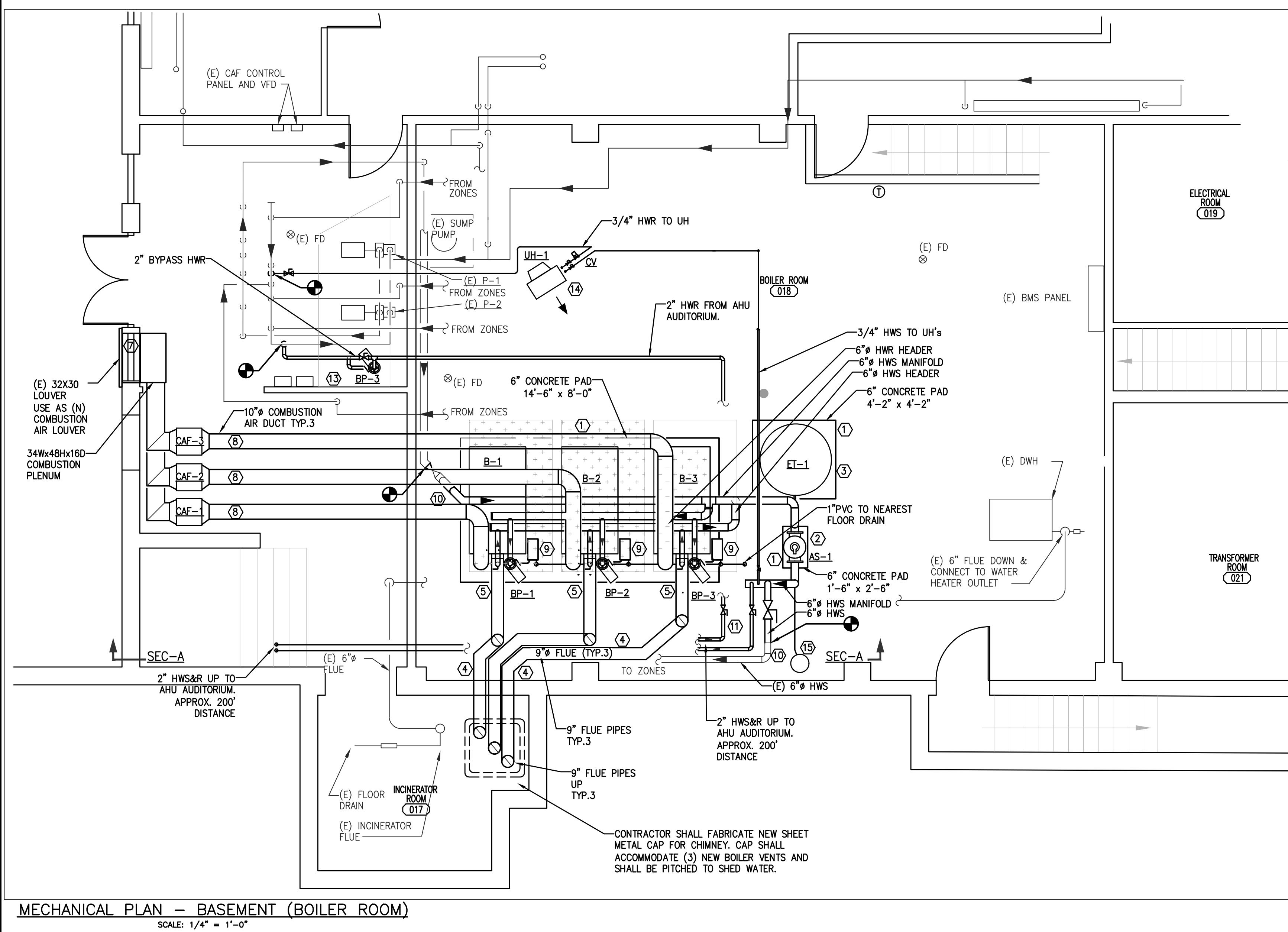
EASTERN MIDDLE SCHOOL
51 HENDRIE AVENUE
RIVERSIDE, CT 06878

MECHANICAL DEMO PLAN

BID NUMBER: 2502-25	LFG JOB NUMBER: 2024.LFG.134	DRAWING NUMBER: MD-100
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- 
- 252 East Avenue
Norwalk, CT 06855
(203) 866-4626 Tel
(203) 866-8019 Fax

[illegible]

BOILER REPLACEMENT AT EASTERN MIDDLE SCHOOL

EASTERN MIDDLE SCHOOL
51 HENDRIE AVENUE
RIVERSIDE, CT 06878

SCALE:	AS NOTED	APPROVED BY: RS	DRAWN BY:
DATE:	February 4, 2025		CHECKED BY: RS

MECHANICAL PLANS

BID NUMBER:	LFG JOB NUMBER:	DRAWING NUMBER:
		35400

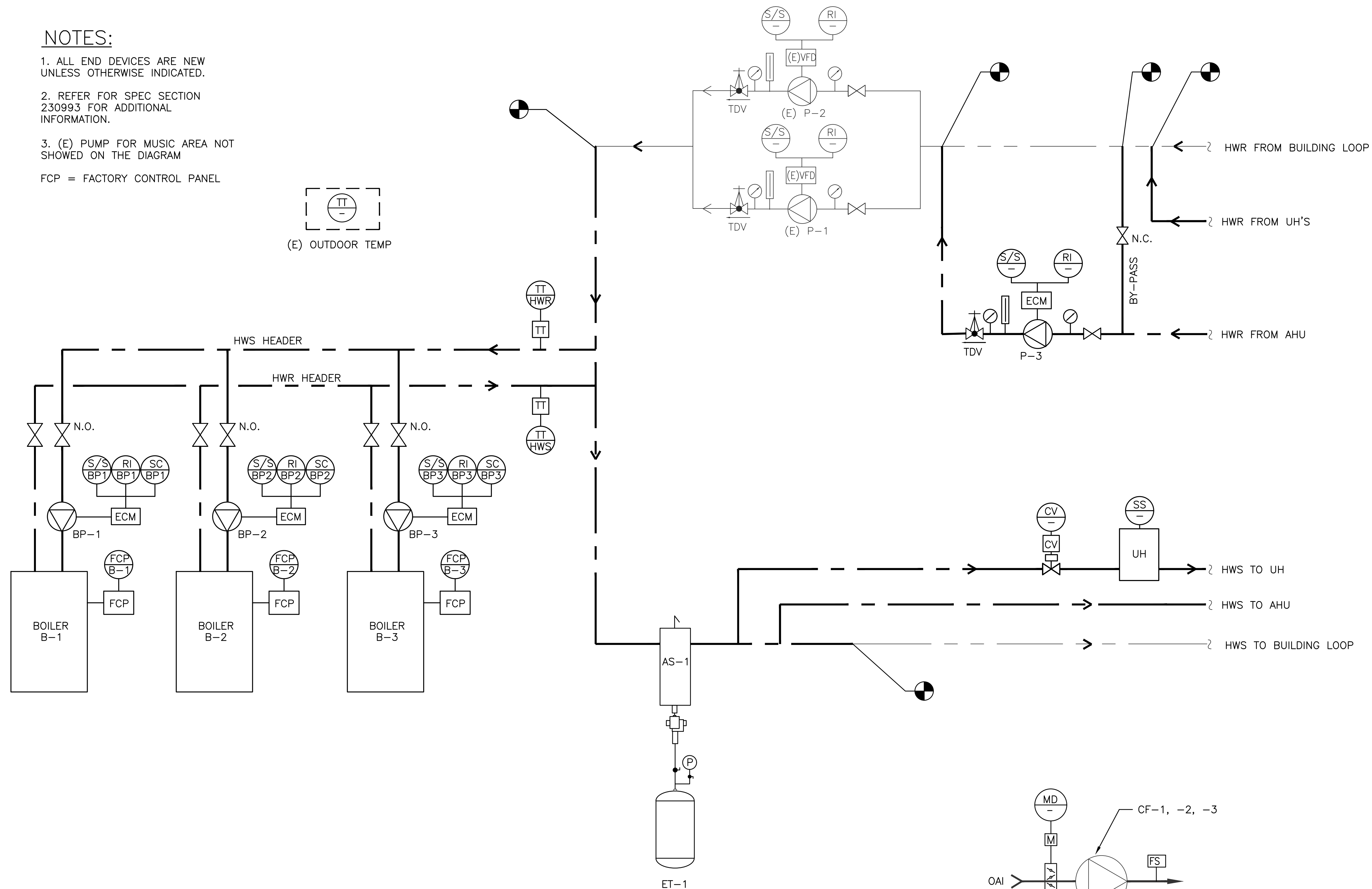
1. ALL END DEVICES ARE NEW
UNLESS OTHERWISE INDICATED.

2. REFER FOR SPEC SECTION 230993 FOR ADDITIONAL INFORMATION.

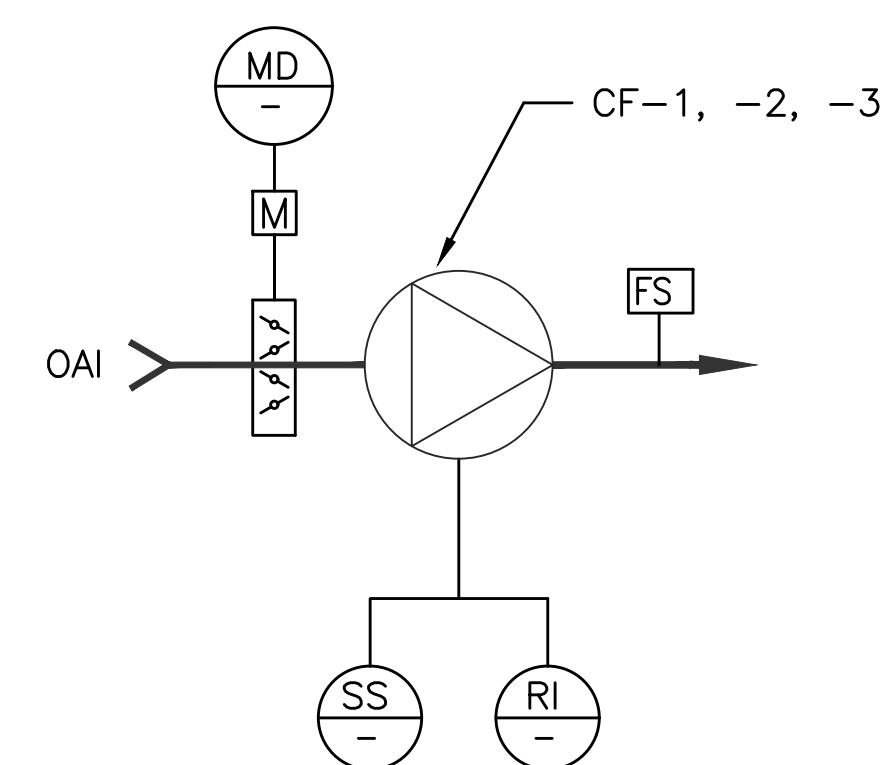
3. (E) PUMP FOR MUSIC AREA NOT SHOWN ON THE DIAGRAM

FCP = FACTORY CONTROL PANEL

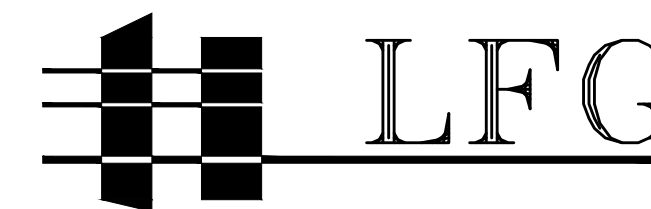
FCP = FACTORY CONTROL PANEL



HOT WATER PIPING & CONTROLS SCHEMATIC DIAGRAM

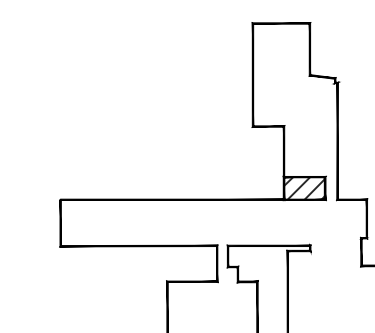


CAF-1,-2,-3
CONTROLS SCHEMATIC



252 East Avenue
Norwalk, CT 06851
(203) 866-4626 Tel
(203) 866-8019 Fax

LANDMARK
FACILITIES
GROUP, INC.

[illegible]

BOILER REPLACEMENT AT EASTERN MIDDLE SCHOOL

EASTERN MIDDLE SCHOOL
51 HENDRIE AVENUE
RIVERSIDE, CT 06878

SCALE: AS NOTED	APPROVED BY: RS	DRAWN BY:
DATE: February 4, 2025		CHECKED BY: RS

MECHANICAL PIPING
& CONTROLS DIAGRAM

BID NUMBER: 2502-25	LFG JOB NUMBER: 2024.LFG.134	DRAWING NUMBER: M-200
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HOT WATER BOILER SCHEDULE											
Unit Number		HW Boiler	B-1	B-2	B-3						
Service Area			EMS	EMS	EMS						
Manufacturer			Patterson-Kelley	Patterson-Kelley	Patterson-Kelley						
Model			Storm: ST-1500	Storm: ST-1500	Storm: ST-1500						
Type			Condensing HW Boiler	Condensing HW Boiler	Condensing HW Boiler						
Fuel			Nat. Gas	Nat. Gas	Nat. Gas						
Min. / Max. Gas Pressure	In W.C.		3.5 / 14.0	3.5 / 14.0	3.5 / 14.0						
Input Min. / Max.	MBH		150 / 1,500	150 / 1,500	150 / 1,500						
Gross Output	MBH		1,455	1,455	1,455						
NET IBR	MBH		1,237	1,237	1,237						
Flow	GPM		146	146	146						
Thermal Efficiency	%		97.0%	97.0%	97.0%						
Gas Connection	In		1.5	1.5	1.5						
Water Connection Sup / Ret	In		2.5" / 2.5" Grooved	2.5" / 2.5" Grooved	2.5" / 2.5" Grooved						
Air Inlet / Vent Size Connection	In		8" / 8"	8" / 8"	8" / 8"						
Cond Drain Connection	In		3/4"	3/4"	3/4"						
Electrical	V/ph/Hz		208/3/60	208/3/60	208/3/60						
MCA	A		15	15	15						
MOP	A	15	15	15							
Dimmensions											
Weight	lbs	1150	1150	1150							
W x Lx H	In	34" x 58" x 55"	34" x 58" x 55"	34" x 58" x 55"							
NOTES:		1-4	1-4	1-4							
Notes: 1. Furnish Boiler Nuro Control with BAC NET Converter and Outside / Room Temperature Sensor. 2. Provide dedicated electrical outlet. 3. Provide Factory Condensate Neutralizer kit NB5LP. 4. Boiler Pressure relief valve: 60 PSI.											

FAN SCHEDULE											
MARK	SERVICE - DESTINATION	MFR	MODEL	CFM	RPM	S.P. (IN W.G.)	Motor Watts	VOLT/PH/HZ	OPER WT (LBS)	Sones	REMARKS
CAF-1	COMBUSTION AIR FAN - for B-1	Tjernlund	EC500ID	375	-	0.750	93	115/1/60	13.6	-	1,2,3
CAF-2	COMBUSTION AIR FAN - for B-2	Tjernlund	EC500ID	375	-	0.750	93	115/1/60	13.6	-	1,2,3
CAF-3	COMBUSTION AIR FAN - for B-3	Tjernlund	EC500ID	375	-	0.750	93	115/1/60	13.6	-	1,2,3
REMARKS: 1 Provide with factory mounted Disconnect Switch. 2 Provide Speed Controller. 3 Interlock Fan with Burner with flow switch. ECM motor control by 0-10V signal from Burner.											

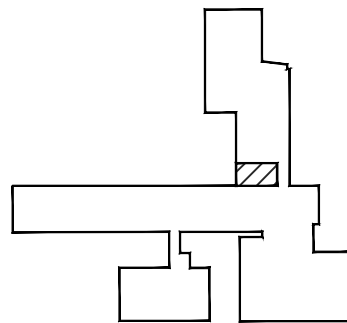
UNIT HEATER SCHEDULE												
MARK	SERVICE - DESTINATION	MFR	MODEL	CFM	EWT	GPM	WPD	MBH	ELECTRICAL		OPER WT (LBS)	REMARKS
									BHP	VOLT/PH/HZ		
UH-1	BOILER ROOM	Modine	HHD-45	710	180	3	4.7	34.7	0.40	115/1/60	70	1,2,3
REMARKS: 1 Provide with factory mounted Disconnect Switch. 2 Provide Remote wall Thermostat. 3 Provide ceiling hanging bracket.												

HOT WATER COIL SCHEDULE												
			(E) Trane AHU	HWC-1								
				Trane								
				DSWB4206								
				Copper - 1 Row								
				HEATING COIL								
HEATING	Type				Hot Water Coil							
	Unit function											
	Heating type											
	Gross Total Heating Capacity			MBH	417.5							
	Heating Entering DB			F	45							
	Heating Leaving Unit DB				80							
	Airflow			CFM	11000							
	Air Pressure Drop			in WC	0.1							
	Entering Water Temperature			F	180							
	Leaving Water Temperature			F	159							
Flow		GPM		39.70								
Water Pressure Drop		ft		3.7								
Dimension: W x H x D		in		64" x 42" x 4"								
Notes			1									

PUMP SCHEDULE																
MARK	TYPE	DESIGNATION	MFR	MODEL	PUMP									HOT WATER		REMARKS
					RPM	CASING	IMPELLER DIA	FLANGE INCH	WEIGHT LBS	MOTOR HP	NPSH FT	EFF %	VOLT/PH/HZ	GPM	HEAD (FT.H2O)	
BP-1	IN-LINE	HW - PRIMARY B-1	TACO	VR-30M-1	3400	CAST IRON	-	-	66	2.0	-	63.0	208/1/60	146	25	1, 2, 3
BP-2	IN-LINE	HW - PRIMARY B-2	TACO	VR-30M-1	3400	CAST IRON	-	-	66	2.0	-	63.0	208/1/60	146	25	1, 2, 3
BP-3	IN-LINE	HW - PRIMARY B-3	TACO	VR-30M-1	3400	CAST IRON	-	-	66	2.0	-	63.0	208/1/60	146	25	1, 2, 3
P-3	IN-LINE	HW - AHU Auditorium	TACO	VR30H-1	4000	CAST IRON	-	3	72	2.1	-	33.0	208/1/60	40	50	1, 2
REMARKS: 1. PROVIDE STRAINER, CHECK VALVE & ISOLATION VALVES. REFER TO PUMP DETAIL FOR ADD'L INFO																

EXPANSION TANK SCHEDULE											
MARK	TYPE	DESIGNATION	MFR	MODEL	TANK						REMARKS
					VOLUME GAL.	MAX. ACCEPT. VAL. GAL	DIA INCH	HEIGHT INCH	CONN. SIZE INCH	WEIGHT LBS	
ET-1	DIAPHRAGM	HW SYSTEM	Taco	CA2000-125	528.0	330	48.0	94.4	1.5	1650	1-2
REMARKS: 1. PROVIDE 4" HIGH CONCRETE PAD AS SHOWN ON PLAN. 2. REFER TO PIPING DETAIL FOR ADDITIONAL INFORMATION.											

AIR SEPARATOR SCHEDULE										
MARK	TYPE	DESIGNATION	MFR	MODEL	UNIT					REMARKS
					FLOW RATE GPM	DIA INCH	HEIGHT INCH	PIPE SIZE INCH	WEIGHT LBS	
AS-1	Air Separator	HW SYSTEM	TACO	4905AD-125	306.0	14.0	34.0	5	230	1, 2
REMARKS: 1. PROVIDE 4" HIGH CONCRETE PAD AS SHOWN ON PLAN. 2. REFER TO PIPING DETAIL FOR ADDITIONAL INFORMATION.										



KEY PLAN
NO SCALE

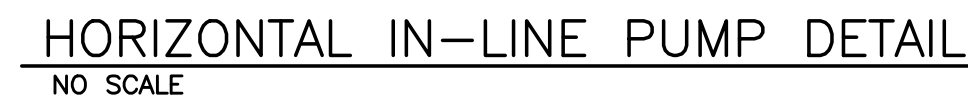
BOILER REPLACEMENT
AT EASTERN MIDDLE
SCHOOL

EASTERN MIDDLE SCHOOL
51 HENDRIE AVENUE
RIVERSIDE, CT 06878

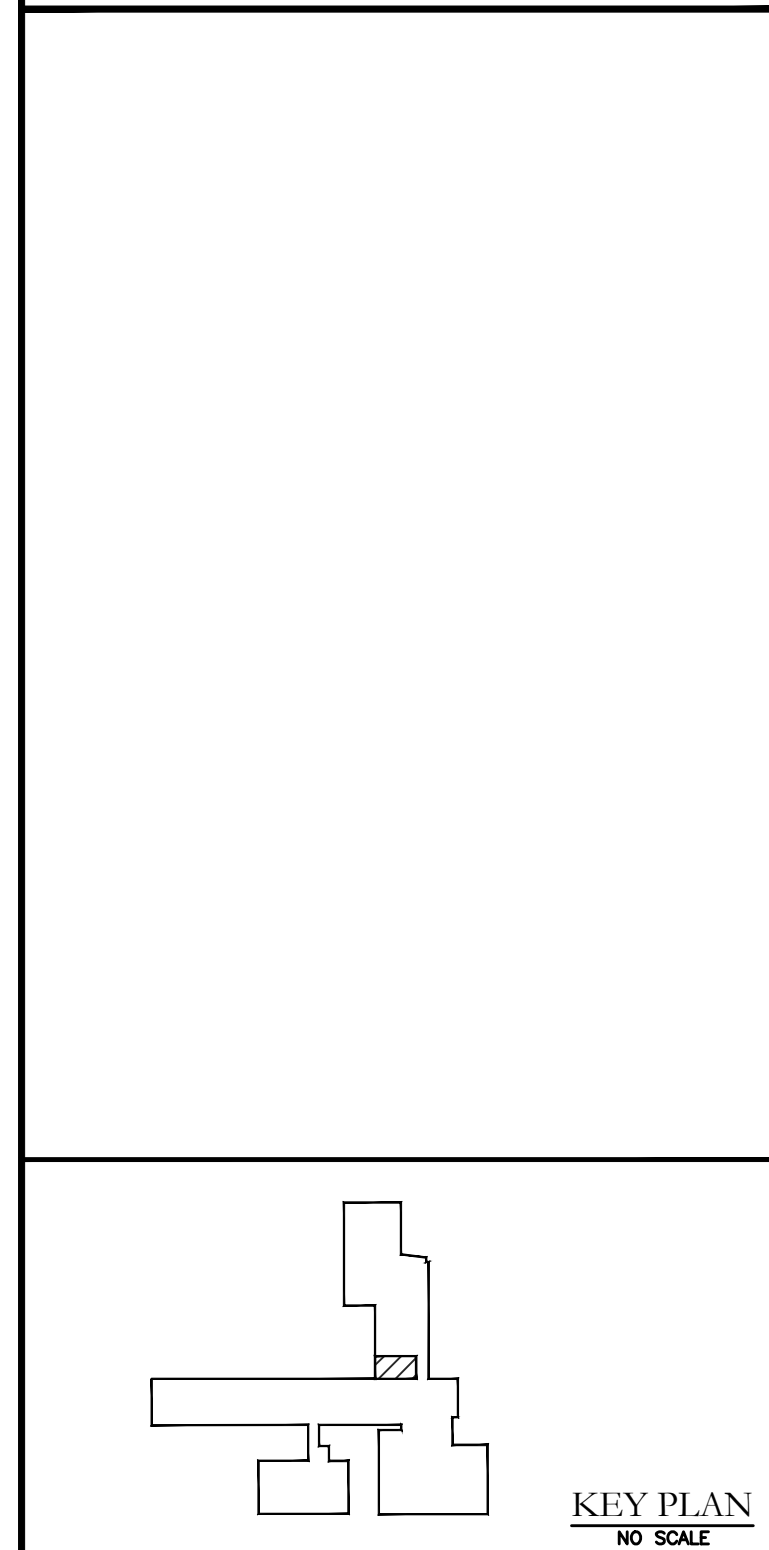
SCALE: AS NOTED	APPROVED BY: RS	DRAWN BY:
DATE: February 4, 2025	CHECKED BY: RS	

MECHANICAL SCHEDULES

BID NUMBER: 2502-25	LFG JOB NUMBER: 2024LFG.134	DRAWING NUMBER: M-300
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CLEVIS HANGER

[illegible]

BID NUMBER: 2502-25	LFG JOB NUMBER: 2024.LFG.134	DRAWING NUMBER: M-400
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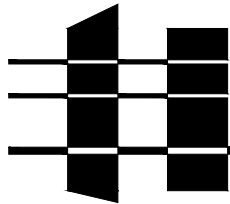
PLUMBING EQUIPMENT SCHEDULE	
GPR-1	GAS PRESSURE REGULATOR: PIETRO FIORENTINI MODEL #31154, 2PSI INLET PRESSURE, OUTLET SPRING COLOR: BLACK, OUTLET OPERATING PRESSURE – 8”W.C., 500 TO 1 TURNDOWN RATIO, CSA APPROVED EXTERNAL VENT LIMITER, POSITIVE 100% BUBBLE TIGHT LOCK UP INLET AND OUTLET TEST PORTS.
GPR-2	GAS PRESSURE REGULATOR: PIETRO FIORENTINI MODEL #31154, 2PSI INLET PRESSURE, OUTLET SPRING COLOR: BLACK, OUTLET OPERATING PRESSURE – 8”W.C., 500 TO 1 TURNDOWN RATIO, CSA APPROVED EXTERNAL VENT LIMITER, POSITIVE 100% BUBBLE TIGHT LOCK UP INLET AND OUTLET TEST PORTS.
GPR-3	GAS PRESSURE REGULATOR: PIETRO FIORENTINI MODEL #31154, 2PSI INLET PRESSURE, OUTLET SPRING COLOR: BLACK, OUTLET OPERATING PRESSURE – 8”W.C., 500 TO 1 TURNDOWN RATIO, CSA APPROVED EXTERNAL VENT LIMITER, POSITIVE 100% BUBBLE TIGHT LOCK UP INLET AND OUTLET TEST PORTS.
RPZ-1	REDUCED PRESSURE PRINCIPLE BACKFLOW PREVENTER ASSEMBLY: AMES MODEL #LF4000B, 1–1/2”, LEAD FREE, CAST SILICON COPPER ALLOY CONSTRUCTION. INSTALL PER LOCAL CODE AND MANUFACTURERS RECOMMENDATIONS.

PROJECT NOTES:

1. CONTRACTORS SHALL VISIT PROJECT SITE TO THOROUGHLY FAMILIARIZE THEMSELVES WITH EXISTING CONDITIONS. CLAIMS FOR EXTRA PAYMENTS FOR WORK, WHICH COULD HAVE BEEN IDENTIFIED VIA CAREFUL SITE INSPECTION, WILL NOT BE ACKNOWLEDGED.
2. PRIOR TO COMMENCEMENT OF WORK, CONTRACTOR SHALL PREPARE EQUIPMENT SUBMITTALS & SHOP DRAWINGS PER SPECIFICATION AND SUBMIT TO DESIGN ENGINEER FOR REVIEW/APPROVAL.
3. UPON COMPLETION OF WORK, CONTRACTOR SHALL SUBMIT AS–BUILT DRAWINGS TO THE ENGINEER FOR APPROVAL.
4. PROVIDE NO LESS THAN (2) HARD COPIES OF OPERATION AND MAINTENANCE MANUALS AT PROJECT CLOSEOUT. MANUALS SHALL INCLUDE ALL EQUIPMENT CUT SHEETS, OPERATING INSTRUCTIONS AND WARRANTY INFORMATION. SUBMIT FOR ENGINEER REVIEW PRIOR TO SUBMISSION TO OWNER.
6. THE CONTRACTOR SHALL INSTALL AND TEST THE LP GAS SYSTEM, PER NFPA 54, NFPA 58 AND SPECIFICATIONS ONCE SYSTEM IS INSTALLED, AND BEFORE SUBSTANTIAL COMPLETION.
11. GAS REGULATORS SHALL BE INSTALLED PER MANUFACTURER’S SPECIFICATION AND VENT PIPING TERMINATIONS SHALL OCCUR ABOVE FLOOD WATER PLANE IF APPLICABLE FOR GAS REGULATOR VENTED APPLICATIONS.

PLUMBING SYMBOL LIST	
NOTE: NOT ALL SYMBOLS ARE USED	
SYMBOL	DESCRIPTION
— — — — —	EXISTING PIPING TO REMAIN
	EXISTING PIPING TO BE REMOVED
— — — — —	SANITARY PIPE ABOVE FLOOR/SLAB (S)
— — — — —	SANITARY PIPE BELOW FLOOR/SLAB (S)
— — — — —	FATS, OILS, GREASE SANITARY PIPE ABOVE FLOOR/SLAB (S)
— — — — —	FATS, OILS, GREASE SANITARY PIPE BELOW FLOOR/SLAB (S)
— — — — —	STORM WATER PIPE ABOVE FLOOR/SLAB (ST)
— — — — —	STORM WATER PIPE BELOW FLOOR/SLAB (ST)
— — — — —	STORM WATER OVERFLOW PIPE ABOVE FLOOR/SLAB (OF)
— — — — —	STORM WATER OVERFLOW PIPE BELOW FLOOR/SLAB (OF)
— — — — —	VENT PIPE (V)
— — — — —	EXISTING COLD WATER PIPING
— — — — —	EXISTING HOT WATER PIPING
— — — — —	EXISTING HOT WATER RETURN PIPING
— — — — —	COLD WATER PIPING (CW)
— — — — —	HOT WATER PIPING (HW)
— — — — —	HOT WATER RETURN PIPING (HWR)
	HEAT TRACE (HT)
— — — — —	COLD WATER PIPING UNDER GROUND(CW)
	UNDER GROUND DOMESTIC WATER PRE–INSULATED PEX PIPING
— — — — —	GAS PIPING
— — — — —	INDIRECT WASTE PIPING
— — — — —	TRAP PRIMER PIPING
— — — — —	DIRECTION OF FLOW
— — — — —	PIPE RISE OR UP THRU SLAB
— — — — —	PIPE DROP OR DOWN THRU SLAB
— — — — —	BOTTOM OF PIPE TAKE–OFF CONNECTION
— — — — —	TOP OF PIPE TAKE–OFF CONNECTION
— — — — —	P–TRAP
— — — — —	CAP PIPE OUTLET
— — — — —	CLEANOUT (CO)
— — — — —	UNION
— — — — —	VALVE IN RISE / VERTICAL
— — — — —	FLOOR DRAIN
— — — — —	BALL VALVE
— — — — —	COLD WATER SUPPLY SHUT OFF VALVE
— — — — —	GAS SHUT OFF VALVE
— — — — —	CHECK VALVE
— — — — —	MIXING VALVE
— — — — —	GAS REGULATOR
— — — — —	UTILITY COMPANY METER
— — — — —	POINT OF NEW CONNECTION

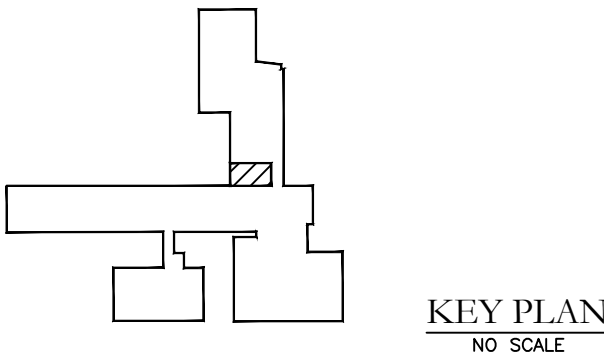
PLUMBING ABBREVIATION LIST	
SYMBOL	DESCRIPTION
AFF	ABOVE FINISHED FLOOR
ADA	HANDICAPPED ACCESSIBLE
CO	CLEANOUT
CV	CHECK VALVE
CW	COLD WATER
CLG	CEILING
CONN	CONNECT
CONT	CONTINUATION
DN	DOWN (PENETRATES FLOOR SLAB)
DR	DRAIN
DPCO	DECK PLATE CLEANOUT
DWG	DRAWING
EX	EXISTING
EL	ELEVATION
EW2	ELECTRIC WATER COOLER – HANDICAPPED ACCESSIBLE
F1 or F2	FLOOR DRAIN
FL	FLOOR
F.O.G.	FATS, OILS, GREASE SANITARY
HWR	HOT WATER RECIRCULATION
IW	INDIRECT WASTE
L1 or L2	LAVATORY
LV	LAVATORIES
MIN	MINIMUM
MTD	MOUNTED
NTS	NOT TO SCALE
OF	STORM WATER OVERFLOW
OFD	STORM WATER OVERFLOW DRAIN
S	SANITARY
ST	STORM WATER
SK	SINK
RD	ROOF DRAIN
TYP	TYPICAL
UP	UP (PENETRATES FLOOR SLAB)
U1 or U2	URINAL
V or VNT	VENT
VTR	VENT THROUGH ROOF
VIF	VERIFY IN FIELD
W	WASTE
W1, W2, or W3	WATER CLOSET
WCO	WALL CLEANOUT
WH	WATER HEATER



LFG

252 East Avenue
Norwalk, CT 06855
(203) 866-4626 Tel
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LANDMARK
FACILITIES
GROUP, INC.



BOILER REPLACEMENT
AT EASTERN MIDDLE
SCHOOL

EASTERN MIDDLE SCHOOL
51 HENDRIE AVENUE
RIVERSIDE, CT 06878

SCALE: AS NOTED
DATE: February 4, 2025

APPROVED BY: RS

DRAWN BY:
CHECKED BY: RS

PLUMBING DESCRIPTION, SYMBOLS,
LEGEND AND NOTES

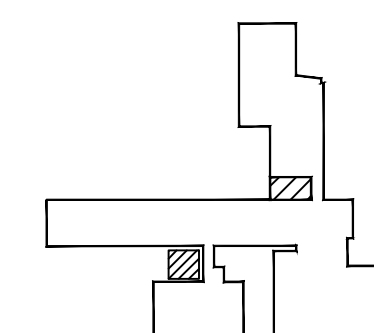
BID NUMBER:
2502-25

LFG JOB NUMBER:
2024LFG.134

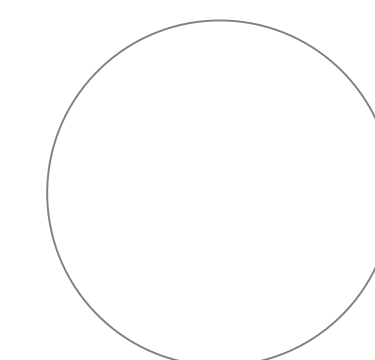
DRAWING NUMBER:
P-001



LANDMARK
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KEY PLAN
NO SCALE

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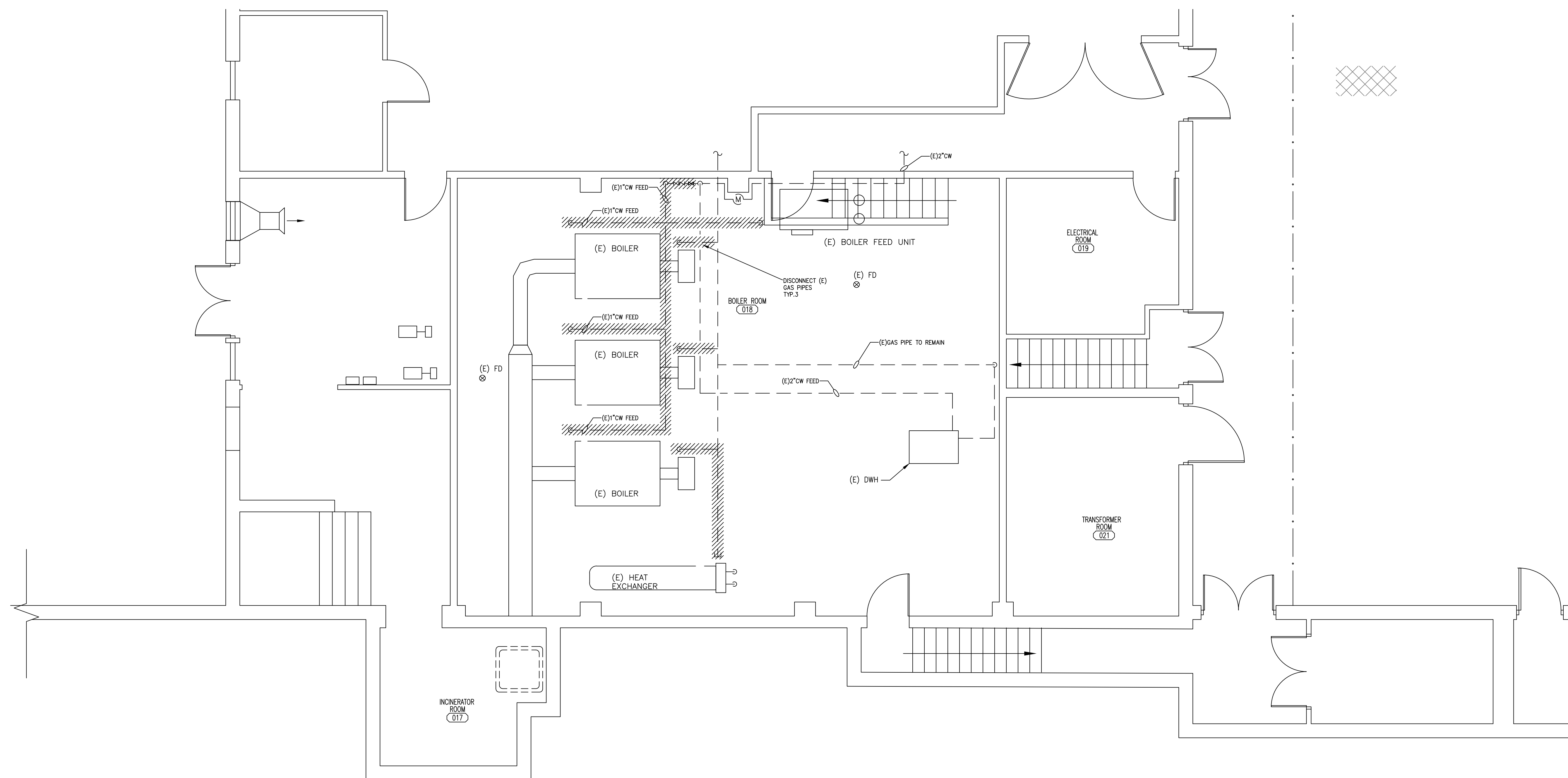
BOILER REPLACEMENT AT EASTERN MIDDLE SCHOOL

EASTERN MIDDLE SCHOOL
51 HENDRIE AVENUE
RIVERSIDE, CT 06878

SCALE:	AS NOTED	APPROVED BY: RS	DRAWN BY:
DATE:	February 4, 2025		CHECKED BY:
			RS

PLUMBING DEMO PLAN

BID NUMBER: 2502-25	LFG JOB NUMBER: 2024.LFG.134	DRAWING NUMBER: PD-100
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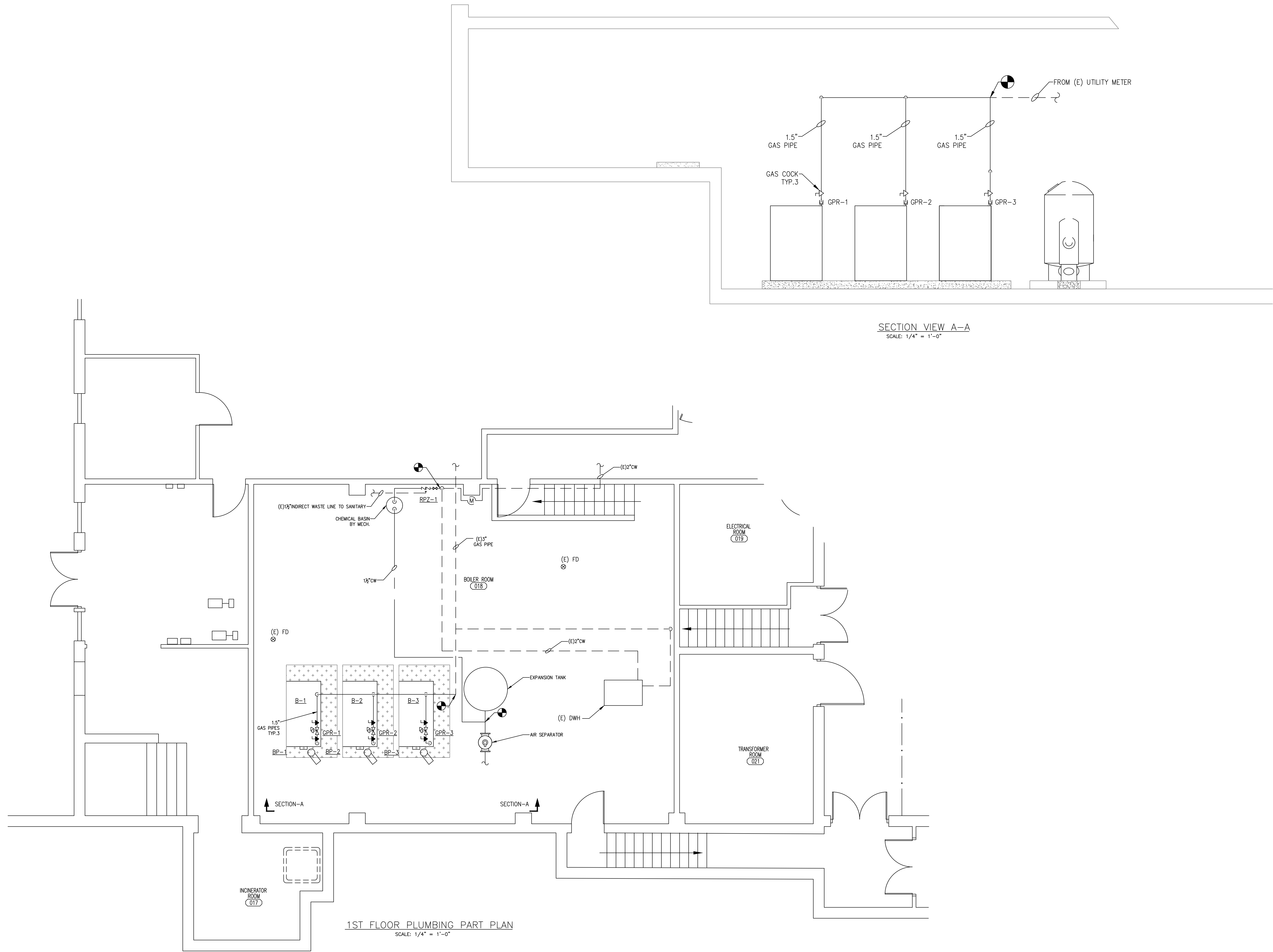
1ST FLOOR PLUMBING DEMOLITION PART PLAN
SCALE: 1/4" = 1'-0"

[illegible]

EASTERN MIDDLE SCHOOL
51 HENDRIE AVENUE
RIVERSIDE, CT 06878

PLUMBING PLANS

BID NUMBER: 2502-25	LFG JOB NUMBER: 2024.LFG.134	DRAWING NUMBER: P-100
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ELECTRICAL LEGEND

-  DUPLEX RECEPTACLE
-  DOUBLE-DUPLEX RECEPTACLE
-  DEDICATED RECEPTACLE
-  HOMERUN (WITH PANEL AND CIRCUIT DESIGNATION)
-  JUNCTION BOX
-  LOCKABLE DISCONNECT SWITCH WITH RATINGS
-  SWITCH
-  SWITCH, 3-WAY
-  SWITCH, 4-WAY
-  BOILER EMERGENCY STOP SWITCH
-  PANEL
-  RECESSED PANEL
-  CONDUIT UP
-  CONDUIT DOWN

FIRE ALARM LEGEND

-  SMOKE DETECTOR
-  ELEVATOR SMOKE DETECTOR
-  DUCT SMOKE DETECTOR [S=SUPPLY SIDE, R= RETURN SIDE]
-  HEAT DETECTOR
-  DUAL ACTION PULL STATION
-  CARBON MONOXIDE DETECTOR WITH SOUNDER (SYSTEM SENSOR CO1224TR)
-  FLOW SWITCH
-  TAMPER SWITCH
-  STROBE, MOUNTED AT 80" AFF U.O.N.
-  STROBE, CEILING MOUNTED
-  SPEAKER STROBE, MOUNTED AT 80" AFF U.O.N.
-  SPEAKER STROBE, CEILING MOUNTED
-  SPEAKER, CEILING MOUNTED
-  REMOTE TEST SWITCH
-  MONITORING MODULE
-  MAGNETIC DOOR HOLDER
-  CONTROL RELAY
-  NAC POWER SUPPLY
-  SLC FAULT ISOLATION MODULE
-  SYSTEM RECORDS DOCUMENTS BOX WITH INTEGRAL USB STORAGE
-  FIRE ALARM CONTROL PANEL
-  DUAL PATH CELLULAR/IP COMMUNICATOR
-  REMOTE ANNUNCIATOR
-  PULL STATION VANDAL RESISTANT COVER
-  EOL DEVICE
-  BOILER

GENERAL NOTES:

1. ALL WORK SHOWN IS NEW UNLESS INDICATED AS EXISTING.

CODE NOTES:

CONTRACTOR SHALL PERFORM ALL WORK IN STRICT COMPLIANCE TO ALL APPLICABLE CODES AS ADOPTED BY THE AUTHORITY HAVING JURISDICTION. INCLUDING BUT NOT LIMITED TO:

- 2022 CONNECTICUT STATE BUILDING CODE, WHICH ADOPTS THE FOLLOWING MODEL CODES WITH ADDITIONS, AMENDMENTS, AND DELETIONS MADE BY THE STATE OF CONNECTICUT:
- 2021 INTERNATIONAL BUILDING CODE
- 2021 INTERNATIONAL EXISTING BUILDING CODE
- 2021 INTERNATIONAL PLUMBING CODE
- 2021 INTERNATIONAL MECHANICAL CODE
- 2021 INTERNATIONAL RESIDENTIAL CODE
- 2021 INTERNATIONAL ENERGY CONSERVATION CODE
- 2020 NATIONAL ELECTRICAL CODE (NFPA 70)
- 2009 ICC A117.1 ACCESSIBLE AND USABLE BUILDINGS & FACILITIES

REMOVAL NOTES:

1. CONTRACTOR SHALL REMOVE POWER FEEDS FOR ALL EQUIPMENT DEMOLISHED BY MECHANICAL CONTRACTOR UNLESS NOTED FOR REUSE.
2. CONSULT WITH ENGINEER & OWNER PRIOR TO DEMOLITION IF ANYTHING NOTED FOR REMOVAL WOULD DE-ENERGIZE EQUIPMENT IN USE, CAUSE DAMAGE TO FACILITY, OR CREATE AN UNSAFE CONDITION.
3. CONTRACTOR SHALL SWITCH CIRCUIT BREAKERS LEFT FROM DEMOLISHED EQUIPMENT IN PANELS INTO THE OFF POSITION. CONTRACTOR SHALL REMOVE LABELS FOR DEMOLISHED EQUIPMENT FROM PANELS AND LABEL ANY REMAINING CIRCUIT BREAKERS AS SPARE.

ABBREVIATIONS:

- RMC RIGID METAL CONDUIT
- GRC GALVANIZED RIGID STEEL CONDUIT (NEC RMC)
- RGS SEE GRC
- IMC INTERMEDIATE METAL CONDUIT (STEEL U.N.O.)
- EMT ELECTRICAL METAL TUBING (STEEL U.N.O.)
- PVC RIGID POLYVINYL CHLORIDE CONDUIT (SCHEDULE 40 U.N.O.)
- FMC FLEXIBLE METAL CONDUIT
- LFMC LIQUID TIGHT FLEXIBLE METAL CONDUIT
- U.N.O. UNLESS NOTED OTHERWISE
- TYP. TYPICAL
- MIN. MINIMUM
- MAX. MAXIMUM
- gfi GROUND FAULT CIRCUIT INTERRUPTER TYPE
- afi ARC FAULT CIRCUIT INTERRUPTER TYPE
- WP WEATHER-PROOF WHILE IN USE TYPE
- UP CONDUIT UP
- DN CONDUIT DN
- Y YES
- N NO
- N/A NOT APPLICABLE
- C CONDUIT
- GND GROUND
- D.S./DS DISCONNECT SWITCH
- F.D.S./FDS FUSED DISCONNECT SWITCH
- VFD VARIABLE FREQUENCY DRIVE
- M.S./MS MOTOR STARTER
- V VOLTS
- A AMPS
- AS AMPS SWITCHED
- AF AMPS FUSED
- AT AMPS TRIP
- HP HORSE POWER
- W WATTS
- VA VOLT-AMPS
- kW KILOWATTS
- Ø PHASE
- LF LINEAR FEET
- ARCH. ARCHITECT
- GC GENERAL CONTRACTOR
- EC ELECTRICAL CONTRACTOR
- MC MECHANICAL CONTRACTOR
- PC PLUMBING CONTRACTOR
- COORD. COORDINATE
- SCC PROSPECTIVE SHORT CIRCUIT CURRENT
- MCA MINIMUM CIRCUIT AMPACITY
- FLA FULL LOAD AMPERES
- RLA RATED LOAD AMPERES
- LRA LOCKED ROTOR AMPERES
- MOCP MAXIMUM OVER CURRENT PROTECTION
- RFS RECOMMENDED FUSE SIZE
- (N) NEW
- (E) EXISTING TO REMAIN
- (RL) RELOCATE EXISTING
- (RP) REPLACE EXISTING IN LOCATION
- (R) REMOVE/DEMOLISH EXISTING

BOILER EMERGENCY STOP NOTES:

CONTRACTOR SHALL PROVIDE NEW BOILER EMERGENCY STOP BUTTONS. BASIS OF DESIGN: STI STOPPER STATIONS SS22292A-EN

ANY EMERGENCY STOP BUTTON WHEN PRESSED SHALL SHUT DOWN ALL BOILERS AND CLOSE THE FUEL SUPPLY VALVE. THE BOILER SHUTDOWN SHALL BE RESET BY AN ACTION AT THE PRESSED BUTTON. COORDINATE WITH CONTROLS VENDOR.

REQUIRED IDENTIFICATION:

1. ALL ELECTRICAL EQUIPMENT SHALL BE MARKED WITH THEIR TAG.
2. ALL PANELS SHALL BE MARKED WITH THEIR TAG, VOLTAGE, PHASE, BUS RATING, MAIN RATING, AND WHERE THEY ARE FED FROM (PHYSICAL LOCATION, PANEL TAG AND CIRCUIT NUMBER IF APPLICABLE).
3. ALL DISCONNECTS SHALL BE MARKED WITH THE EQUIPMENT THAT THEY SERVE.
4. ALL SERVICE EQUIPMENT SHALL BE MARKED WITH THE AVAILABLE FAULT CURRENT.
5. EACH UTILITY METER AND SERVICE DISCONNECT SHALL BE MARKED WITH THE AREA IT SERVES.
6. RECEPTACLES AND EQUIPMENT DISCONNECTS SHALL BE MARKED WITH A SELF-ADHESIVE TYPED LABEL INDICATING THE PANEL AND CIRCUIT THEY ARE FED FROM. FOR INTERIOR AREAS THE LABEL SHALL BE ON THE FACE OF THE COVER PLATE OR DISCONNECT. FOR EXTERIOR RECEPTACLES THE LABEL SHALL BE INSIDE THE WEATHER PROOF ENCLOSURE AND FOR EXTERIOR DISCONNECTS ON THE INTERIOR OF THE DISCONNECT DOOR.

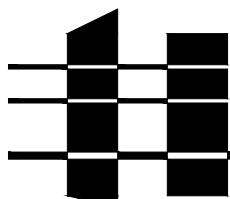
CONNECTIONS TO VIBRATING EQUIPMENT:

1. ALL CONNECTIONS TO VIBRATING EQUIPMENT SHALL BE MADE WITH FLEXIBLE CONDUIT, FMC IF INTERIOR AND LFMC IF EXTERIOR.

FIRE ALARM NOTES:

CONTRACTOR SHALL SUB-CONTRACT TO DISTRICT FIRE ALARM VENDOR FOR ALL PANEL PROGRAMMING AND TESTING.

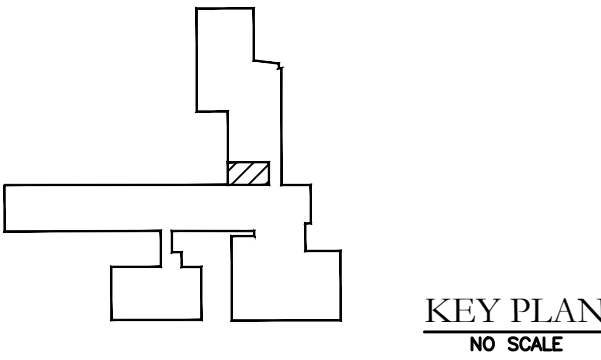
EXISTING FIRE ALARM SYSTEM IS EDWARDS EST. ALL DEVICES SHALL BE COMPATIBLE WITH THE EXISTING FIRE ALARM SYSTEM. CONTRACTOR SHALL UPGRADE ALL NECESSARY POWER SUPPLIES, BATTERIES, SLC & NAC CARDS, AMPLIFIERS, CENTRAL PROCESSORS TO PROVIDE A FULL, COMPLETE AND CODE COMPLIANT SYSTEM AFTER ALL MODIFICATIONS HAVE BEEN MADE.



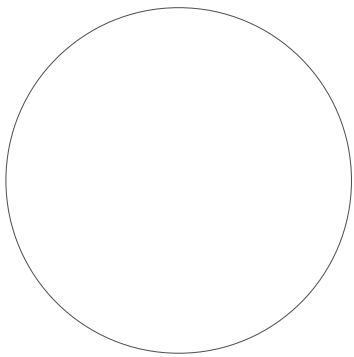
LFG

LANDMARK
FACILITIES
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252 East Avenue
Norwalk, CT 06855
(203) 866-4626 Tel
(203) 866-8019 Fax



	02-04-2025	ISSUE FOR BID
REV	DATE	DESCRIPTION



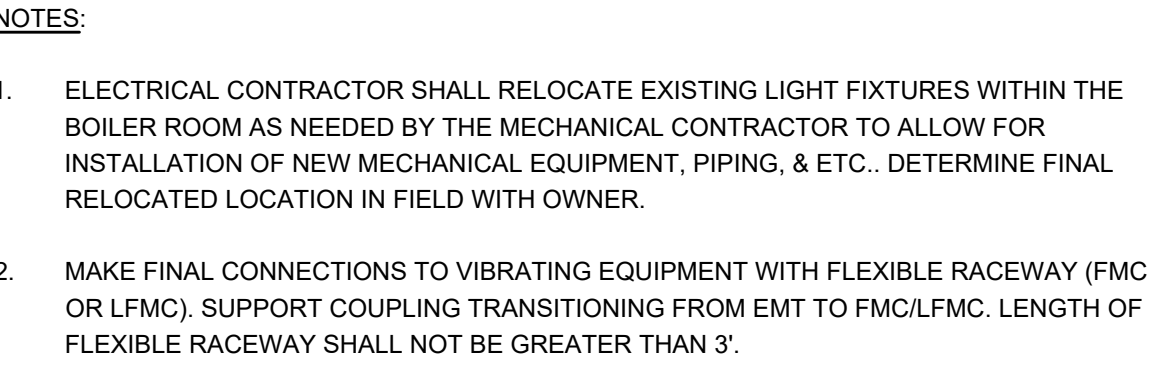
BOILER REPLACEMENT
AT EASTERN MIDDLE
SCHOOL

EASTERN MIDDLE SCHOOL
51 HENDRIE AVENUE
RIVERSIDE, CT 06878

SCALE: AS NOTED	APPROVED BY: RS	DRAWN BY: L.C.
DATE: February 4, 2025	CHECKED BY: RS	

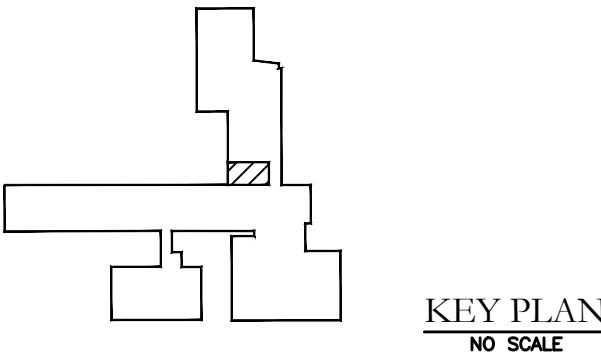
ELECTRICAL LEGEND, NOTES, &
ABBREVIATIONS

BID NUMBER: 2502-25	LFG JOB NUMBER: 2024LFG-134	DRAWING NUMBER: E-001
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FIRE ALARM CODED NOTES:

- | | |
|----------|--|
| A | FIRE ALARM CONTROL RELAY PROGRAMMED TO SHUTDOWN BOILERS UPON CARBON MONOXIDE DETECTION WITHIN BOILER ROOM. |
| B | FIRE ALARM SYSTEM HEAT DETECTOR. |
| C | FIRE ALARM SYSTEM CARBON MONOXIDE DETECTOR WITH SOUNDER BASE FOR BOILER SHUTDOWN. |

[illegible]

BOILER REPLACEMENT AT EASTERN MIDDLE SCHOOL

EASTERN MIDDLE SCHOOL
51 HENDRIE AVENUE
RIVERSIDE, CT 06878

SCALE: AS NOTED	APPROVED BY: RS	DRAWN BY: LC
DATE: February 4, 2025		CHECKED BY: RS

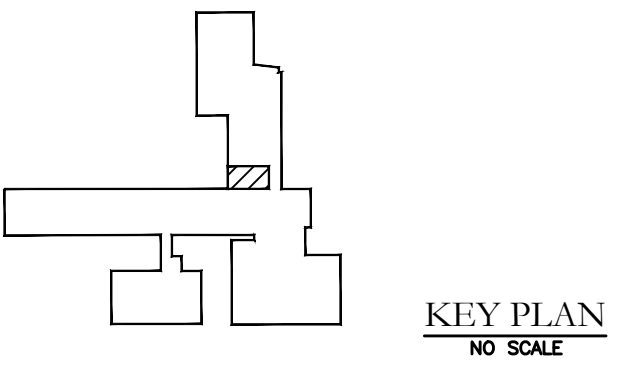
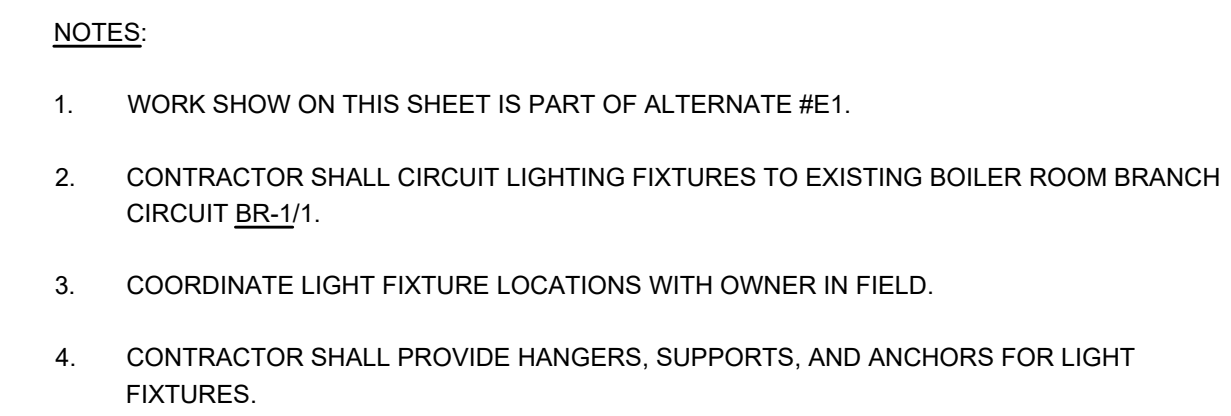
ELECTRICAL BOILER ROOM
POWER PLAN

BID NUMBER: 2502-25	LFG JOB NUMBER: 2024.LFG.134	DRAWING NUMBER: E-100
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1

Electrical Boiler Room Plan – Power

SCALE: $1/4'' = 1'-0''$



EASTERN MIDDLE SCHOOL
51 HENDRIE AVENUE
RIVERSIDE, CT 06878

SCALE: AS NOTED	APPROVED BY: RS	DRAWN BY: LC
DATE: February 4, 2025		CHECKED BY: RS
ELECTRICAL BOILER ROOM LIGHTING PLAN (ALT #E1)		
BID NUMBER: 2502-25	LFG JOB NUMBER: 2024LFG-134	DRAWING NUMBER: E-110

1 Electrical Boiler Room Plan - Lighting
SCALE: 1/4" = 1'-0"

REMOVALS SCOPE:

EXISTING PANEL SCHEDULE <u>BR-1</u>															
208Y/120V, 3 PHASE, 4 WIRE PANELBOARD BRANCH POLES: 30 POLE MOUNTING: SURFACE (E)GE A-Series II Panelboard										3 PHASE LINE BUS: 125A NEUTRAL BUS: 125A MAIN LUGS: 125A SCCR: 10kA					
Description	Notes	Wire	Ground	Conduit	BRKR	Pole	PH-A	PH-B	PH-C	Pole	BRKR	Conduit	Ground	Wire	Description
Boiler Room Lights		12	12	1/2"	20A	1				2	20A	1/2"	12	12	Boiler Room 2nd Floor Light
Outlets		12	12	1/2"	20A	3				4	20A	1/2"	12	12	Fuel Change Over
Boiler Control Box		12	12	1/2"	20A	5				6	20A				Spare
Temp Control		12	12	1/2"	20A	7				8					
Boiler Condensate Pump		12	12	1/2"	20A	9				10	15A				Spare
Spare					20A	11				12					
Boiler #1		12	12	1/2"	15A	13				14					
					15A	15				16	15A	1/2"	12	12	Fuel Oil Pumps
					15A	17				18					
Boiler #2		12	12	1/2"	15A	19				20					
					15A	21				22	15A	1/2"	12	12	Boiler Feed Pumps
					15A	23				24					
					15A	25				26					
Boiler #3		12	12	1/2"	15A	27				28	20A	1/2"	12	12	Fan VFD
					15A	29				30					
TOTAL CONNECTED LOAD:							total-A	total-B	total-C						
TOTAL DESIGN LOAD:							0	0	0						
							0	VA	=	0	AMPS				
							0	VA	=	0	AMPS				

EXISTING PANEL SCHEDULE <u>BR-2</u>															
208Y/120V, 3 PHASE, 4 WIRE PANELBOARD BRANCH POLES: 42 POLE MOUNTING: SURFACE (E)Eaton PRL1a										3 PHASE LINE BUS: 225A NEUTRAL BUS: 225A MAIN CIRCUIT BREAKER: 200A SCCR: 10kA					
Description	Notes	Wire	Ground	Conduit	BRKR	Pole	PH-A	PH-B	PH-C	Pole	BRKR	Conduit	Ground	Wire	Description
Hot Water Pump #2 (P-2)		8	10	3/4"	40A	1				2					Hot Water Pump #1 (P-1)
						3				4	40A	3/4"	10	8	
Existing Branch Circuit		12	12	1/2"	20A	7				8	20A	1/2"	12	12	Existing Branch Circuit
Existing Branch Circuit		12	12	1/2"	20A	9				10	20A	1/2"	12	12	Existing Branch Circuit
Existing Branch Circuit		12	12	1/2"	20A	11				12	20A	1/2"	12	12	Existing Branch Circuit
Existing Branch Circuit		12	12	1/2"	20A	13				14	20A	1/2"	12	12	Existing Branch Circuit
Existing Branch Circuit		12	12	1/2"	20A	15				16	20A	1/2"	12	12	Existing Branch Circuit
Existing Branch Circuit		12	12	1/2"	20A	17				18	20A	1/2"	12	12	Existing Branch Circuit
Existing Branch Circuit		12	12	1/2"	20A	19				20	20A	1/2"	12	12	Existing Branch Circuit
Existing Branch Circuit		12	12	1/2"	20A	21				22	20A	1/2"	12	12	Existing Branch Circuit
Space						23				24					Space
Space						25				26					Space
Space						27				28					Space
Space						29				30					Space
Space						31				32					Space
Space						33				34					Space
Space						35				36					Space
Space						37				38					Space
Space						39				40					Space
Space						41				42					Space
TOTAL CONNECTED LOAD:							total-A	total-B	total-C						
TOTAL DESIGN LOAD:							0	0	0						
							0	VA	=	0	AMPS				
							0	VA	=	0	AMPS				

NEW WORK SCOPE:

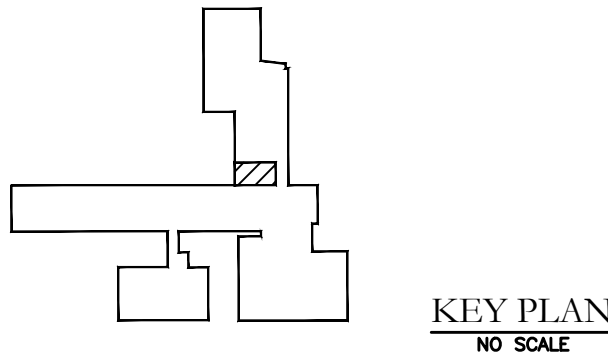
EXISTING PANEL SCHEDULE <u>BR-1</u>															
208Y/120V, 3 PHASE, 4 WIRE PANELBOARD BRANCH POLES: 30 POLE MOUNTING: SURFACE (E)GE A-Series II Panelboard										3 PHASE LINE BUS: 125A NEUTRAL BUS: 125A MAIN LUGS: 125A SCCR: 10kA					
Description	Notes	Wire	Ground	Conduit	BRKR	Pole	PH-A	PH-B	PH-C	Pole	BRKR	Conduit	Ground	Wire	Description
Boiler Room Lights		12	12	1/2"	20A	1				2	20A	1/2"	12	12	Boiler Room 2nd Floor Light
Outlets		12	12	1/2"	20A	3				4	20A				Spare
Boiler Control Box		12	12	1/2"	20A	5				6	20A				
Temp Control		12	12	1/2"	20A	7				8	15A	1/2"	12	12	1
Spare					20A	9				10	15A	1/2"	12	12	1
Spare					20A	11				12	15A				Spare
Boiler #1 (B-1)	1	12	12	1/2"	20A	13	1664	690		14					
					20A	15				16	15A	1/2"	12	12	1
Boiler #2 (B-2)	1	12	12	1/2"	20A	17				18					
					20A	19	1664	690		20	15A	1/2"	12	12	1
Boiler #3 (B-3)	1	12	12	1/2"	20A	21				22					
					20A	23				24	15A	1/2"	12	12	1
					20A	25				26					
Spare					15A	27				28	20A				Spare
					15A	29				30					
TOTAL CONNECTED LOAD:							total-A	total-B	total-C						
TOTAL DESIGN LOAD:							4987	5884	4708						
							15579	VA	=	43	AMPS				
							19474	VA	=	54	AMPS				

NOTES (Typ. All Panel Schedules):
1 - PROVIDE HACR TYPE CIRCUIT BREAKER
2 - PROVIDE LOCKING CLIPS
3 - PROVIDE MEANS OF LOCKING CIRCUIT BREAKER IN OFF POSITION
4 - VERIFY POWER REQUIREMENTS FOR ACTUAL EQUIPMENT BEFORE INSTALLATION
5 - PROVIDE GFCI CIRCUIT BREAKER
6 - PROVIDE AFCI CIRCUIT BREAKER
7 - PROVIDE DUAL FUNCTION CIRCUIT BREAKER
8 - CIRCUIT CONTROLLED VIA TIMECLOCK

LEGEND (Typ. All Panel Schedules):

	New
	Existing to Remain
	Remove Existing

EXISTING PANEL SCHEDULE <u>BR-2</u>															
208Y/120V, 3 PHASE, 4 WIRE PANELBOARD BRANCH POLES: 42 POLE MOUNTING: SURFACE (E)Eaton PRL1a										3 PHASE LINE BUS: 225A NEUTRAL BUS: 225A MAIN CIRCUIT BREAKER: 200A SCCR: 10kA					
Description	Notes	Wire	Ground	Conduit	BRKR	Pole	PH-A	PH-B	PH-C	Pole	BRKR	Conduit	Ground	Wire	Description
Hot Water Pump #2 (P-2)	1	8	10	3/4"	40A	1	2328	2328		2					Hot Water Pump #1 (P-1)
						3				4	40A	3/4"	10	8	
Existing Branch Circuit		12	12	1/2"	20A	7				8	20A	1/2"	12	12	Existing Branch Circuit
Existing Branch Circuit		12	12	1/2"	20A	9				10	20A	1/2"	12	12	Existing Branch Circuit
Existing Branch Circuit		12	12	1/2"	20A	11				12	20A	1/2"	12	12	Existing Branch Circuit
Existing Branch Circuit		12	12	1/2"	20A	13				14	20A	1/2"	12	12	Existing Branch Circuit
Existing Branch Circuit		12	12	1/2"	20A	15				16	20A	1/2"	12	12	Existing Branch Circuit
Existing Branch Circuit		12	12	1/2"	20A	17				18	20A	1/2"	12	12	Existing Branch Circuit
Existing Branch Circuit		12	12	1/2"	20A	19				20	20A	1/2"	12	12	Existing Branch Circuit
Existing Branch Circuit		12	12	1/2"	20A	21				22	20A	1/2"	12	12	Existing Branch Circuit
Hot Water Pump #3 (P-3)	1	12	12	1/2"	15A	23				24					Space
Space						25				26					Space
Space						27				28					Space
Space						29				30					Space
Space						31				32					Space
Space						33				34					Space
Space						35				36					Space
Space						37				38					Space
Space						39				40					Space
Space						41				42					Space
TOTAL CONNECTED LOAD:							total-A	total-B	total-C						
TOTAL DESIGN LOAD:							4656	4656	4656						
							13968	VA	=	39	AMPS				
							17460	VA	=	48	AMPS				



REV	DATE	DESCRIPTION
	02-04-2025	ISSUE FOR BID

BOILER REPLACEMENT
AT EASTERN MIDDLE
SCHOOL

EASTERN MIDDLE SCHOOL
51 HENDRIE AVENUE
RIVERSIDE, CT 06878

SCALE: AS NOTED	APPROVED BY: RS	DRAWN BY: L.C.
DATE: February 4, 2025	CHECKED BY: RS	

ELECTRICAL PANEL SCHEDULES

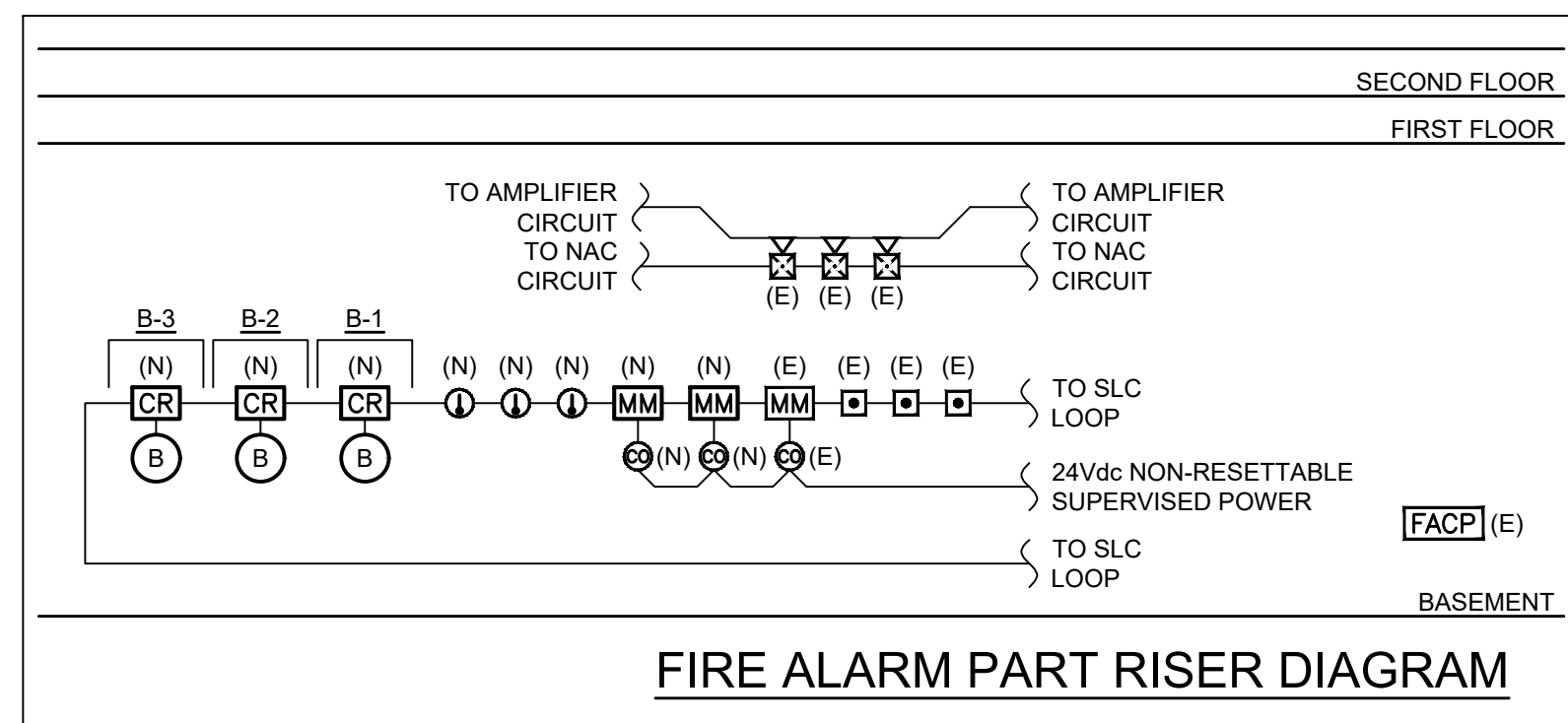
BID NUMBER: 2502-25	LFG JOB NUMBER: 2024-LFG-134	DRAWING NUMBER: E-200
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TAG	DESCRIPTION	HP KW AMPS	VOLTS	Ø	OVER- CURRENT PROTECT.	WIRE & CONDUIT	PANEL/CIRCUIT(S)	DISCONNECTING MEANS	LOCATION	NOTES
<u>B-1</u>	BOILER	20A	208	1	20A-2P	2-#12, 1-#12 N, & 1-#12G IN 1/2" C	BR1/13,15	30A/2P D.S. (DS1)	BOILER ROOM	-
<u>B-2</u>	BOILER	20A	208	1	20A-2P	2-#12, 1-#12 N, & 1-#12G IN 1/2" C	BR1/17,19	30A/2P D.S. (DS1)	BOILER ROOM	-
<u>B-3</u>	BOILER	20A	208	1	20A-2P	2-#12, 1-#12 N, & 1-#12G IN 1/2" C	BR1/21,23	30A/2P D.S. (DS1)	BOILER ROOM	-
<u>BP-1</u>	BOILER PUMP	1.9hp 6A 1380W	208	1	15A-2P	2-#12 & 1-#12G IN 1/2" C	BR1/14,16	30A/2P D.S. (DS2)	BOILER ROOM	1
<u>BP-2</u>	BOILER PUMP	1.9hp 6A 1380W	208	1	15A-2P	2-#12 & 1-#12G IN 1/2" C	BR1/18,20	30A/2P D.S. (DS2)	BOILER ROOM	1
<u>BP-3</u>	BOILER PUMP	1.9hp 6A 1380W	208	1	15A-2P	2-#12 & 1-#12G IN 1/2" C	BR1/22,24	30A/2P D.S. (DS2)	BOILER ROOM	1
<u>P-3</u>	HOT WATER ZONE PUMP	2.1hp 6.6A 1550W	208	1	15A-2P	2-#12 & 1-#12G IN 1/2" C	BR2/23,25	30A/2P D.S. (DS2)	BOILER ROOM	1
<u>CAF-1</u>	BOILER COMBUSTION AIR FAN	93W	120	1	15A-1P	2-#12 & 1-#12G IN 1/2" C	BR1/8	FACTORY FURNISHED DISCONNECT	BOILER ROOM	2
<u>CAF-2</u>	BOILER COMBUSTION AIR FAN	93W	120	1	15A-1P	2-#12 & 1-#12G IN 1/2" C	BR1/8	FACTORY FURNISHED DISCONNECT	BOILER ROOM	2
<u>CAF-3</u>	BOILER COMBUSTION AIR FAN	93W	120	1	15A-1P	2-#12 & 1-#12G IN 1/2" C	BR1/8	FACTORY FURNISHED DISCONNECT	BOILER ROOM	2
<u>UH-1</u>	BOILER ROOM HOT WATER UNIT HEATER	0.4hp 9.8A	120	1	15A-1P	2-#12 & 1-#12G IN 1/2" C	BR1/10	FACTORY FURNISHED DISCONNECT	BOILER ROOM	2

DISCONNECT SWITCH SCHEDULE

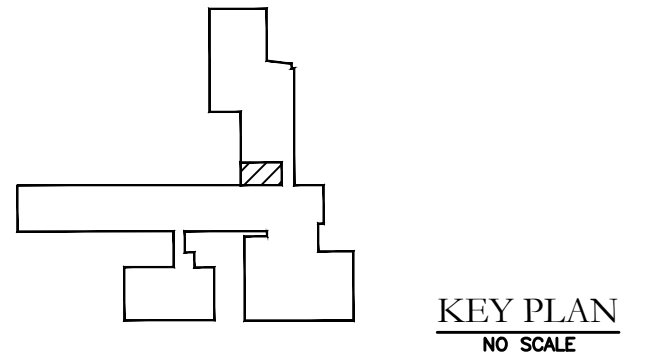
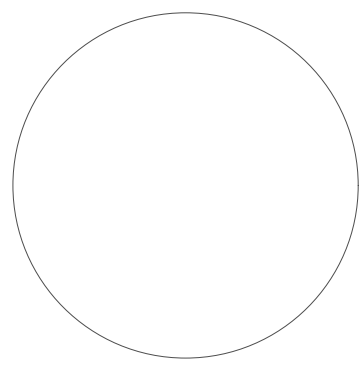
TAG	AMPS	VOLTS	POLES	NEUTRAL	MIN. HP RATING	EQUIPMENT GROUND (Y/N)	SERVICE ENTRANCE LISTED (Y/N)	DUTY	WIRE & CONDUIT	FUSED (Y/N)	FUSES	OPTIONS/ACCESSORIES
<u>DS1</u>	30A	208	2	INSULATED	-	Y	N	HEAVY	IN: 2-#12, 1-#12 N, & 1-#12G IN 1/2" C OUT: 2-#12, 1-#12 N, & 1-#12G IN 1/2" C	N	N/A	-
<u>DS2</u>	30A	208	2	NONE	3	Y	N	HEAVY	IN: 2-#12 & 1-#12G IN 1/2" C OUT: 2-#12 & 1-#12G IN 1/2" C	N	N/A	-

TAG	DESCRIPTION	EQUIVALENT MANUFACTURERS AND CATALOG NUMBER	WATTAGE OR LAMPS	QUANTITY	REMARKS
A	SURFACE MOUNT 4' LED STRIP SEALED GASKETED ENCLOSURE WITH IMPACT RESISTANT DIFFUSER PENDANT MOUNTED	LITHONIA LIGHTING FEM LED FEM-L48-6000LM-LPAFL-MD-MVOLT-GZ10-40K -80CRI-DPMB	37.8W LED 4000K 120V	14	ADD ALT #E1
A-E	SURFACE MOUNT 4' LED STRIP SEALED GASKETED ENCLOSURE WITH IMPACT RESISTANT DIFFUSER PENDANT MOUNTED WITH INTEGRAL EMERGENCY DRIVER	LITHONIA LIGHTING FEM LED FEM-L48-6000LM-LPAFL-MD-MVOLT-GZ10-40K -80CRI-DPMB-E10WMCP	37.8W LED 4000K 120V	7	ADD ALT #E1



SYSTEM INPUTS		A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	
1	MANUAL FIRE ALARM BOXES	X	X					X	X		X							X									1	
2	AREA SMOKE DETECTORS	X	X					X	X	X								X					X	X	X	X	X	2
3	DESIGNATED LEVEL ELEVATOR LOBBY SMOKE DETECTORS	X	X					X	X	X								X	X							X	X	3
4	ALTERNATE LEVEL ELEVATOR LOBBY SMOKE DETECTORS	X	X					X	X	X								X		X			X	X	X	X	X	4
5	ELEVATOR HOISTWAY & MACHINE ROOM SMOKE DETECTORS	X	X					X	X	X								X	X			X	X	X	X	X	X	5
6	IN-DUCT SMOKE DETECTORS	X	X					X	X	X								X					X	X	X	X	X	6
7	HEAT DETECTORS	X	X					X	X	X								X	X				X	X	X	X	X	7
8	ELEVATOR HOISTWAY HEAT DETECTOR	X	X					X	X	X								X	X		X		X	X	X	X	X	8
9	WATERFLOW	X	X					X	X	X		X						X	X				X	X	X	X	X	9
10	KITCHEN (ANSUL) SYSTEM	X	X					X	X	X								X					X	X	X	X	X	10
11	CARBON MONOXIDE DETECTORS AT SOURCE			X	X			X						X		X	X											11
12	CARBON MONOXIDE DETECTORS REMOTE FROM SOURCE			X	X			X						X		X												12
13	SPRINKLER CONTROL VALVE (TAMPER SWITCH)			X	X			X				X						X										13
14	FIRE ALARM AC FAILURE					X	X	X									X											14
15	FIRE ALARM SYSTEM LOW BATTERY					X	X	X									X											15
16	OPEN CIRCUIT					X	X	X									X											16
17	GROUND FAULT					X	X	X									X											17
18	NOTIFICATION APPLIANCE CIRCUIT SHORT					X	X	X									X											18
		A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	

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(203) 866-8019 Fax

[illegible]

EASTERN MIDDLE SCHOOL
51 HENDRIE AVENUE
RIVERSIDE, CT 06878

ELECTRICAL DIAGRAMS, SCHEDULES, & MATRIX OF OPERATIONS

BID NUMBER: 2502-25	LFG JOB NUMBER: 2024.LFG.134	DRAWING NUMBER: E-201
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