PROJECT MANUAL and SPECIFICATIONS
for the
John G. Prendergast School Boilers Replacement
59 Finney Street Ansonia, CT
Bid REF # 1617-06

City of Ansonia Public Schools

42 Grove Street Ansonia, CT

DeCarlo & Doll Project No. 51916

BID DATE: May 1, 2020

John G. Prendergast School Boilers Replacement

BID DOCUMENTS & SPECIFICATIONS

TABLE OF CONTENTS

DIVISION 26 – ELECTRICAL

INVITATION TO PROPOSERS:

FOR THE

BOILER REPLACEMENT
John G. Prendergast School

FOR

ANSONIA PUBLIC SCHOOLS
ANSONIA, CT

Sealed proposals are invited by Ansonia Board of Education until 1:00 p.m. on Friday, May 1, 2020 at the Robert A. Zuraw Administrative Offices 42 Grove Street Ansonia, CT for the above-named project.

Proposals received after the above time will not be accepted. Proposals will be opened publicly and read aloud beginning at 1:05 p.m. All interested parties are invited to attend.

A pre-proposal conference will be held at John G. Prendergast School at 59 Finney Street Ansonia, CT at 11:00 AM, on Wednesday, April 15, 2020. This conference will afford Contractors an opportunity to visit the project site to fully acquaint themselves with the existing conditions and limitations of the proposed work.

Copies of the Contract Documents are available at no cost at www.ansonia.org or www.cityofansonia.com. In order to receive addendum and other information regarding this Bid, if any, interested firms should reply to bevans@ansonia.org with the firm name and contact person.

A proposal bond for five percent (5%) of the base bid cost is required and must accompany each proposal. Bids must be held firm for ninety (90) days beyond the bid opening date.

The successful proposer must file a Certificate of Insurance with the City within ten (10) days of notice of bid award.

No proposal shall be withdrawn for a period of forty-five (45) days subsequent to the opening of bids or until the next work day immediately following said period, without the consent of the Owner.

The City of Ansonia and the Ansonia Board of Education reserves the right to accept or reject any or all proposals, to reduce the scope of the project to reflect available funding, and to waive any informalities in the bidding, if such actions are in the best interest of the City and or Board.

Prospective proposers may contact: Robert W. Grzywacz, via email at grzywaczr@luchs.com or telephone (203) 379-0467 x206 for additional information regarding the Project.

We do business in accordance with all applicable federal laws and regulations.

DATED: April 2, 2020

ANSONIA BOARD OF EDUCATION
42 GROVE STREET

ANSONIA, CT 06401
(203) 736-5095
Bid REF #1617-06

COVER SHEET

The City of Ansonia, acting by its Board of Education (the "Owner") will accept bids for the following contract:

NAME OF CONTRACT:
JOHN G. PRENDERGAST SCHOOL BOILER REPLACEMENT PROJECT

Bids will be received until: Date: May 1, 2020 Time: 1:00 PM

Submit Bids to:	Robert Evans, Facilities Director Ansonia Board of Education 42 Grove Street Ansonia, CT 06401
Type of bid:	Sealed
Bid Security:	5% Required
Site Visit:	Mandatory
Anticipated Date of Award:	10 to 14 days after bid opening and/or final funding approval.
Installation/Delivery/ and completion date is a consideration in awarding this bid:	Yes

Instructions: There will be a mandatory site visit on Wednesday April 15, 2020 at the John G. Prendergast School, 59 Finney St, Ansonia, CT. 06401 at 11:00 a.m.

We will meet at the Main Entrance.

In accordance with the CDC Guidelines, the following procedures have been Implement in response to the Covid-9 pandemic.

- The initial meeting will be held outside, at the main entrance.
- Attendees are asked to observe social distancing practices, including 6'

separation from other attendees

- The meeting and boiler room tour will be limited to a maximum of 5 people, including myself and the owners representative. The meeting will be repeated as often as necessary, in groups of 5, until all attendees have participated. We ask firms to minimize the number of attendees as much as possible.

- Upon arrival, attendees are asked to register (business cards please) for the meeting while remaining in their cars. Attendees will be grouped on a first come first serve basis. Please do not attend if you don't feel well and/or have a temperature.

- It is suggested that you submit any questions, via email, prior to the meeting.

- A Report of Meeting will be posted, that includes all questions raised during each of the individual meetings.

We thank you for your interest in this project and your anticipated cooperation during this difficult time.

If you should have any questions please forward them to:

Robert W. Grzywacz
DeCarlo and Doll
89 Colony Street, Meriden, CT
203 379-0467 x 206

All bidders must carefully familiarize themselves with the following Bid Specifications, as they apply, and any other document(s) related to the work/contract.

Bidders choosing to submit a bid must fill out the attached Bid Response Form.

REFERENCES

1. Company: _____

   Contact Person: _____

   Address: _____

   _____

   _____

   Phone (contact person): _____

2. Company: _____

   Contact Person: _____

   Address: _____

   _____

   _____

   Phone (contact person): _____

3. Company: _____

   Contact Person: _____

   Address: _____

   _____

   _____

   Phone (contact person): _____

CITY OF ANSONIA, CONNECTICUT
REQUEST FOR BIDS
Bid REF #1617 -06

BID DUE May 1, 2020 at 1:00PM

PROPOSAL

Proposal of _____ (hereinafter called "Proposer, Bidder"); organized and existing under the laws of the State of Connecticut, doing business in Ansonia, Connecticut (hereinafter called the City).

In compliance with the Advertisement for Proposals, Proposer hereby proposes for the INSTALLATION OF NEW BOILERS, in the City of Ansonia, Connecticut together with all related incidental and appurtenant work as described in the drawings outlined and/or shown on the exhibits. The work is to be done in strict accordance with the Specifications, within the time set forth therein, and at the prices stated on the Proposal Schedule.

By submission of this Proposal, the Proposer certifies, that this Proposal has been arrived at independently, without consultation, communication, or agreement as to any matter relating to this Proposal with any other Proposer or with any competitor.

Proposer hereby agrees to commence work under this contract on or before a date to be specified in the "Notice to Proceed", and to fully complete the Project within 75 SEVENTY FIVE (75) consecutive calendar days thereafter. System Start Up is to be completed by September 1, 2020.

Proposer further agrees that he will provide and sustain the required Bonds and Insurance Policies as required.

Proposer understands that the Town reserves the right to reject any or all proposals and to waive any informality in the bidding.

Proposer agrees that this proposal shall be good and may not be withdrawn for a period of NINETY (90) calendar days after the scheduled closing time for receiving proposals.

Upon receipt of written notice of the acceptance of this proposal, proposer shall execute the formal contract attached within five (5) days and deliver a Surety Bond or Bonds as required in the General Conditions. The Bid Security attached in the sum of_____Dollars ($_____) is to become the property of the Town in the event the contract and bond are not executed within the time above set forth, as liquidated damages for the delay and additional expense to the Town caused thereby.

_____	_____
Company Name	By (Signature)
_____	_____
Address	Print Name
_____	_____
	Title
_____	_____
Date	Telephone/Fax

CITY OF ANSONIA, CONNECTICUT
REQUEST FOR BIDS
Bid REF #1617-06

BID DUE: May 1 2020 at 1:00PM

PROPOSAL (Continued)

The undersigned hereby declares that in regard to all conditions affecting the work to be done and the labor and materials required, this proposal is based on his investigations and findings, and the City of Ansonia Public Schools and their officers, agents and employees shall not in any manner be held responsible for the accuracy of, or be bound by any estimates, borings, water or underground conditions relative to the proposed work, indicated in this or in the other contract documents; that no warranty or representation has been made by the City of Ansonia Public Schools or their officers, agents and employees as to subsurface soil or rock conditions, ground water, or other underground and similar conditions; nor has any representation or warranty been so made that the estimated quantities to be used for comparison of proposals will even approximate the actual quantities or materials and work which the Contractor may be required to furnish or perform.

1. OFFER

Pursuant to and in compliance with the Invitation to Bid relating thereto, the Undersigned has thoroughly reviewed all drawings, requirements, scope of work, standards, and general instructions of Bid REF #1617-06 together with any addenda issued and received prior to closing time for receipt of Bids and agrees to provide all materials, all labor and all else whatsoever necessary to erect and properly finish all work in accordance with said documents for the above mentioned projects to the satisfaction of the City of Ansonia Public Schools for the stipulated sum of:

Base Bid (in words) $_____
Base Bid (in figures) $_____

OTHER COSTS (BIDDER TO IDENTIFY) $_____
OTHER COSTS (in figures) $_____

BID TOTAL SUM (in words): $_____

BID TOTAL SUM (in figures): $_____

Enclosed herewith is the Bid Guaranty (10% of Base Bid minimum), in the form of: ( ) Bid Bond ( ) Certified Check

ANSONIA BOARD OF EDUCATION

BID SPECIFICATIONS
FOR
BOILER REPLACEMENT
(*Boilers #1 & #2)*
John G. Prendergast School
59 Finney Street
Ansonia, CT 06401

SCOPE OF WORK:

The Project Scope of Work consists the replacement of two boilers and associated work as described in the drawings, specifications, Addenda and these Bid Instructions.

Additional details, if any, will be identified in the Agreement between the City of Ansonia and the Winning Bidder / Contractor.

1. INSTRUCTIONS to BIDDERS

These bid specifications accompany all contracts for supplies, services and construction for the Board of Education of the City of Ansonia. (The City and its Board of Education are collectively referred to herein as the Owner.) Certain of these specifications will apply only to certain types of contracts, as will be apparent from the content.

The Owner has provided information about the contract on the Cover Sheet. These Bid Specifications may also be accompanied by other contract documents depending on the type of contract. Bidders should review those carefully and include with their bid any additional sheets that are to be filled out, including alternates and unit prices.

The Owner is exempt from the payment of Federal Excise Taxes and Connecticut Sales and Use Tax. These taxes must not be included in bid prices nor added to any items specified.

II. BIDDING PROCEDURE

Bids will be accepted until the date and time indicated on the Cover Sheet.

Bids shall be in sealed envelopes with the bidder's name in the upper left corner and the name of bid and the time and date of bid opening in the center of the envelope. Two original executed copies of all the bid papers must be included in the envelope. All the documentation must be readable and legible.

Bids may not be sent by fax or any other electronic means.

Any bid may be withdrawn prior to the scheduled bid opening as indicated on the specification cover sheet, or prior to an authorized postponement date thereof.

Any bid received after the date and time specified on the specification Cover Sheet for receipt of the bid or an authorized extension thereof, will not be considered.

No bidder may withdraw its bid for a period of 90 days following the actual time of bid opening.

There will be a mandatory site visit as indicated on the Cover Sheet on Wednesday, April 15, 2020 that will be on site at the John G. Prendergast Elementary School - 59 Finney Street, Ansonia, CT. 06401 at 11:00 AM. ALL contractors and perspective bidders will meet at the Main Entrance to sign in.

Any questions by bidders must be submitted in writing, not orally. If appropriate the Owner will respond by Addenda.

III. REVIEW AND AWARD OF BID

The Owner reserves the right to reject any and all bids.
The Owner reserves the right to negotiate with any bidder prior to award.
The Owner reserves the right to waive any informality in bids.
The Owner may reject any bid deemed non-responsive or conditional.

The Owner may make such investigations, as it deems necessary to determine the ability, qualifications and experience of the bidder to perform the work. The bidder shall furnish to the Owner all such information and data for this purpose as the Owner may request. Any information requested of the bidder by the Owner that is not provided to the satisfaction of the Owner will result in the bidder and bid being disqualified from consideration.

If no responsive bids are received, the Owner reserves the right to negotiate with all responsible bidders/vendors for the award of the contract.

IV. CONTRACT GENERAL CONDITIONS

Insurance

Prior to the start of work the bidder shall submit to the Owner certificates of insurance in the amounts indicated by the Insurance Requirements Chart attached hereto. The certificates shall indicate that both the Town of Ansonia and the Ansonia Board of Education are additional insured under the applicable policies.

Subcontracting

Unless specifically indicated in the contract documents, no part of the contract may be subcontracted or sub-let without written permission of the Owner.

Cancellation

The contractor should be advised that should budgetary constraints dictate part and/or all the items listed in this bid might be rejected. The decision shall be considered final and not subject to recourse by the bidder.

Regulations Governing Product Design, Safety and Composition

All products must conform to strict OSHA, Fire, Electrical, Building Codes or any other applicable codes or standards as required by local ordinance, state and federal laws. Ingredients contained in products shall conform to Federal and State of Connecticut Regulations governing safety of products for use in our schools.

Products containing asbestos material will not be allowed in the completion of any contract awarded by the Ansonia Public Schools.

Certifications of compliance to these standards may be required to be submitted by the bidder awarded the contract.

MSDS identification sheets where required must be mailed to the Owner at its Business Office.

Regulations Governing Installation Codes and Standards

All installation work shall conform to the applicable codes and standards of the agencies listed below. When a conflict between standards arises the more stringent standard is to be followed:

1. NEC - National Electric Code
2. Local Electrical Codes and Ordinances
3. NFPA - National Fire Protection Association
4. NEMA - National Electrical Manufacturers Association
5. EIA/TIA - Electronic Industries Association / Telecommunications Industries Association
6. ANSI - American National Standards Institute, X3T9.5FDDI Standard
7. IEEE - Institute of Electrical and Electronic Engineers
8. FCC - Federal Communications Commission
9. UL- Underwriters Laboratories
10. OSHA - Occupational Health and Safety Administration

Changes, Deviation From the Specification

Any deviation from the contract requirements or specifications must be completely detailed in writing by the contractor and approved in writing by the Owner prior to the performance of said work. Any change in the work or contract requirements likewise must be detailed in writing by the contractor and approved in writing' by the Owner prior to the performance of said work.

Environmental Certifications

If the contract entails any exposure to a regulated material including but not limited to asbestos or lead, the bidder certifies that it and each of Its subcontractors and their workers will be certified and trained under all OSHA and other relevant regulations for such work.

Funding Requirements

Some or the entire contract may be funded by state, federal or other grant programs. The bidder is advised that such funding" programs may include contractual provisions binding on contractors and which may, for example, require audits or certifications under oath that the contractor has not been debarred, suspended or excluded from any publicly funded project or programs.

Time of Performance:

Delays

Bidders are advised to examine the contract documents regarding the time of performance.
If this is a construction project the contract documents may indicate an estimated start date and time of completion, and may include liquidated damages for late completion.

If this is a services contract the contract documents may indicate the period of services sought, and may include provisions for renewal.

If this is a contract for the sale of goods, the bid may include the bidder's proposal for how soon products may be delivered and for how long the bid price will remain available.

The commencement or performance of this contract may be delayed due to events that are not the contractor's responsibility. In such event the contractor shall be entitled to an extension of time but no monetary compensation. Such an extension shall be at the sole discretion of the Owner, in conjunction with the Contractor and the Director of Facilities.

Nondiscrimination and Affirmative Action

The bidder is required to comply with all provisions of the Civil Rights Act of 1964, State of Connecticut Executive Order #3, the Equal Employment Opportunity Act of 1972, Executive Orders 11246,11375, 11478, and if applicable, the Connecticut Fair Employment Practice Law and any/all other applicable nondiscrimination and affirmative action provisions as presently stated, or as amended.

Pursuant to Conn. Gen. Stat. Sect. 4a-60, the contractor agrees and warrants that in the performance of the contract, the contractor will not discriminate or permit discrimination against any person or group of persons on the grounds of race, color, religious creed, age, marital status, national origin, ancestry, sex, mental retardation or physical disability, including but not limited to, blindness, unless it Is shown by the contractor that such disability prevents performance of the work involved, in any manner prohibited by the laws of the United States or the State of Connecticut.

The contractor further agrees to take affirmative action to insure that applicants with Job related qualifications are employed and that employees are treated when employed without regard to their race, color, religious creed, age, marital status, national origin, ancestry, sex, mental retardation, or physical disability, including, but not limited blindness, unless it is shown by such contractor that such disability prevents performance of the work involved; (2) the contractor agrees, in all solicitations or advertisements for employees placed by or on behalf of the contractor, to state that It is an Affirmative action-equal opportunity employer in accordance with regulations adopted by the Connecticut Commission on Human Rights and Opportunities; (3) the contractor agrees to provide each labor union or representative of workers with which such contractor has a collective bargaining agreement or other contract or understanding and each vendor with which such contractor has a contract or understanding, a notice to be provided by the commission advising the labor union or workers' representative of the contractor's commitments under this section, and to post copies of the notice in conspicuous places available to employees and applicants for employment; (4) the contractor agrees to comply with each provision of section 4a-60 and section 46a-68e and 6a-68f and with each regulation or relevant order issued by said commission pursuant to sections 46a-56, 46a-68e, and 46a-68f; (5) the contractor agrees to provide the Commission on Human Rights and Opportunities with such information requested by the commission, and permit access to pertinent books, records and accounts concerning the employment practices and procedures of the contractor as related to the provisions of this section and section 46a-56.

If this is a construction contract, the contractor agrees and warrants that he will make good faith efforts to employ minority business enterprises as subcontractors and suppliers of materials. This contract may be

governed by the State of Connecticut Department of Education procedures regarding affirmative action. ·A copy of the state's Affirmative Action Packet is a part of these specifications. The contractor is required to determine from the packet what affirmative action reports and other compliance will be required, and submit that information to the Owner at the time that the contract is awarded.

Indemnification

To the greatest extent permitted by law, the bidder agrees to defend, indemnify and save harmless the City of Ansonia, the Ansonia Board of Education, their agents and employees from sod against all claims, demands, damages, workers compensation payments, or other loss or expense, Including costs and attorney's fees, arising out of or resulting from the performance of this contract, including any bodily injury, including death at any time resulting therefore, sustained by any person or persons (including employees of the contractor or any subcontractor) or on account of damage to the property of any person, including the loss caused in any degree by the negligence of the City of Ansonia, the Ansonia Board of Education, their agents and employees or otherwise.

The existence of insurance shall in no way limit the scope of this Indemnification.

The Contractor shall carry liability insurance covering the operation of trucks and automobiles and shall take out and maintain public liability and property damage liability insurance in not less than the following amounts:

BODILY INSURANCE

Each Person	**Each Occurrence**
$1,000,000	**$1,000,000**

PROPERTY DAMAGE

Each Accident	**Each Occurrence**
$1,000,000	**$1,000,000**

Evidence of the above insurance in the form of certificates shall be issued to the Owner prior to starting work. Certificates of insurance shall state that the Owner will be notified, in writing, ten (10) days prior to cancellation of any insurance coverage. Certificates shall be filed with the Owner and shall name Ansonia Public Schools as an additional insured.

Upon job completion, the Contractor and a designated representative by the Owner will make a final inspection. No payment will be authorized for work done until such inspection has been made, and all work is found to have been performed in accordance with the specifications and to the satisfaction of the owner.

Any and all legal expenses incurred by Ansonia Public Schools for the contractor’s failure to comply with these specifications will be borne by the Contractor.

The Contractor is to maintain for the duration of the contract and for the protection of all employees engaged there under workers compensation as required by the labor laws of the state, and all municipal and federal liability. Evidence of Workers Compensation insurance is to be provided prior to starting work.

All bids must be made on this form. To be responsive this bid must be properly executed, accompanied by the appropriate bid security, and accompanied by any additional bid sheets required by the contract documents and/or Bid Specifications.

The undersigned acknowledges that it has carefully examined all of the contract documents bound in with this bid, including any addenda, has participated in any site visit and is familiar with any factors which may affect this contract, and offers to perform, in strict conformity with each and every provision of the contract at the prices set forth in this bid and within the period of time specified for completion in the contract documents. **This offer shall be irrevocable for a period of 60 working days from the date on which the Contractor notified the Owner, in writing, that it wished to terminate the contract. If the Contractor does not provide appropriate cancellation notification and vacates the contract prior to the expiration of the contract, the Contractor will be liable for any and all costs to the Owner for completion of the contract through the contract's expiration date.**

By submission of this bid, the undersigned and each person signed on behalf of the undersigned certifies, under penalty of perjury, that: (a) The prices in this bid have been arrived at independently, without collusion, consultation, communication, or agreement, for the purpose of restricting competition, as to any matter relating to such prices with any other bidder or with any competitor; (b) unless otherwise required by law, the prices which have been quoted in this bid have not been knowingly disclosed by the undersigned and will not knowingly be disclosed by the undersigned prior to opening, directly or indirectly, to any other bidder or to any competitor (c) no attempt has been or will be made by the undersigned to induce any other person, partnership or corporation to submit or not to submit a bid for the purpose of restricting competition.

SECTION 003126 – EXISTING HAZARDOUS MATERIALS INFORMATION

PART 1 - GENERAL

1.1 SUMMARY

A. This Document with its referenced attachments is part of the Procurement and Contracting Requirements for Project. They provide Owner's information for Bidders' convenience and are intended to supplement rather than serve in lieu of Bidders' own investigations. They are made available for Bidders' convenience and information, but are not a warranty of existing conditions. This Document and its attachments are not part of the Contract Documents.

B. This Section includes the following:

1. *Prendergast School Boiler Room - Boiler Asbestos testing report 12-11-18*, by Mystic Air Consultants, Inc.

1.2 PROJECT CONDITIONS

A. Existing Conditions: Data and information furnished or referenced in this Section is for the Contractors' information. The Owner, Architect, or Owner's Representative shall not be responsible for any interpretation of, or conclusion drawn from the data or information, by the Contractor.

B. An Underground Storage Tank and its contents to remain are noted in the Drawings.

C. Should any hazardous materials be revealed during construction, abatement will be undertaken by negotiated Change Order or a separate contract.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 003126

Mystic Air Quality Consultants, Inc.
1204 North Road (Rt. 117) Groton, Connecticut 06340

December 11, 2018

Ansonia Public Schools
42 Grove Street
Ansonia, Connecticut 06401
Attn: Mr. Robert Evans
Director of Buildings and Grounds

Re: Limited and Directed Interior and Exterior Boiler Asbestos Bulk Inspection

Site Address: Prendergast School
59 Finney Street, Ansonia, CT

Location: Boiler Room – HB Smith 11516 and 11517

Date of Inspection: November 29, 2018

Encl: (1) Bulk Asbestos Sample Analysis Summary

Dear Mr. Evans:

As requested, Mystic Air Quality Consultants, Inc. on November 29, 2018, conducted a limited and directed boiler inspection for interior and exterior suspect materials at the school referenced above. A State of Connecticut licensed asbestos inspector conducted the survey. The purpose of the survey was to sample all suspect building materials of both boilers prior to their planned replacement.

The inspection involved sampling of all interior and exterior boiler materials. **Enclosure (1)** contains the bulk asbestos sample analysis summary for the boilers. The samples were analyzed for asbestos by Polarized Light Microscopy. An accredited American Industrial Hygiene Association (AIHA) laboratory performed the analysis.

None of the suspect interior and exterior boiler materials contained any quantities of asbestos. This includes both HB Smith boilers (CT11516, CT11517).

Communications (24 hours):
Office: (860) 449-8903 FAX: (860) 449-8860 Toll Free: 1 (800) 247-7746
website: www.mysticair.com e-mail:maqc2@aol.com

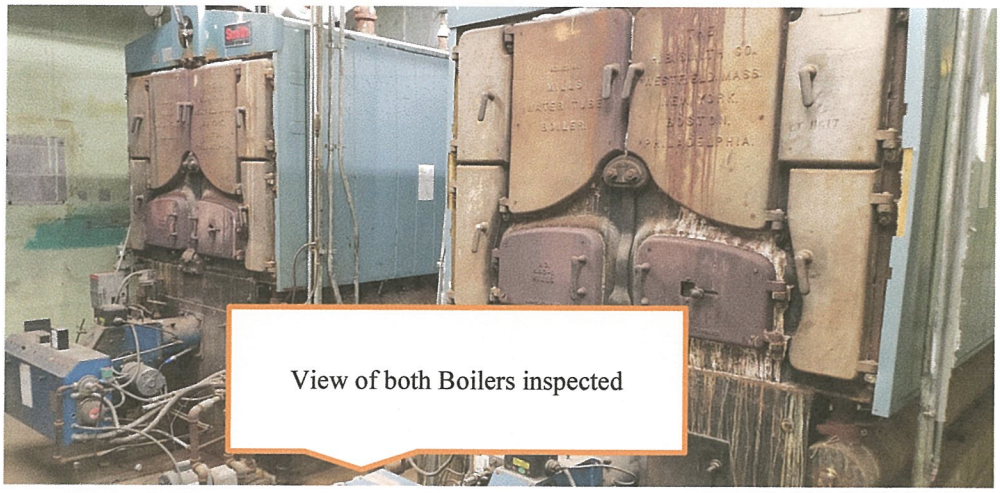
Non-Asbestos Materials Listing

Type of Material	Location of Material
Packing Material – Lower Assembly	HB CT11516
Packing Material – Behind Fiberglass Exterior	HB CT11516
Roping – Between Ribs	HB CT11516
Packing Material – Top of Header	HB CT11516
Packing Material – Lower Assembly	HB CT11517
Roping – Between Ribs	HB CT11517
Debris – Inside Boilers	HB CT11517
Fire Brick	HB CT11517
Packing Material – Behind Fiberglass Exterior	HB CT11517
Packing Material – Top of Header	HB CT11517

Site Pictures

Site Pictures (continued)

Boiler Exhaust (rear)
Fiberglass insulation



View of both Boilers inspected

Microscope Limitation Factors

Your results are stated by itemizing the contents of the material in terms of percentage of overall sample. Any material containing more than 1% asbestos is considered an asbestos-containing material by the EPA, OSHA, and the State of Connecticut.

Certain non-friable materials, especially resilient floor coverings and vinyl floor tiles, and their associated mastics when tested by Polarized Light Microscope, often times are found to have less than 1% asbestos because the asbestos fibers are milled to a size smaller that the detection limits of that scope. Samples are recommended to be tested by Transmission Electron Microscopy to assure more accurate results.

The same would be the case with most plasters or wallboards tested and analyzed.

Laboratory Policy

All sample results are strictly confidential and, unless subpoenaed by a court, will not be released to anyone other than the sample submitter without the permission of the client. Mystic Air Quality Consultants, Inc. reserves the right to refuse samples which are not collected on the appropriate sample medium, and cannot be responsible for loss of samples. Mystic Air Quality Consultants, Inc. will employ qualified personnel to analyze submitted samples, and, where possible, will use established state-of-the-art analysis techniques. Mystic Air Quality Consultants, Inc. makes no other warranties expressed or implied.

Limitations of the survey

This survey and report only deal with the boilers located in the boiler room of the school. Additionally, there may be other non-accessible materials above ceilings, behind walls, and below floors that become evident during renovation activity. Should the requisite EPA/OSHA competent person working for the contractor discover such materials they will need to be tested for asbestos content so determinations of their abatement and disposal (if required) can then be made.

Please do not hesitate to contact us with any questions or comments relating to the sample results. We thank you for selecting Mystic Air Quality to perform your bulk sampling collection and analysis.

Sincerely,

David Wiseman, MS, CIAQP, CIAQC, CIEC
Compliance and Inspection Service

Enclosure (1)

Environmental Hazards Services, L.L.C.
7469 Whitepine Rd
Richmond, VA 23237
Telephone: 800.347.4010

Asbestos Bulk Analysis Report

Report Number: 18-11-03932

Client: Mystic Air Quality Consultants
1204 North Road Rt.117
Groton, CT 06340

Received Date: 11/30/2018
Analyzed Date: 12/02/2018
Reported Date: 12/04/2018

Project/Test Address: Prendergast; 59 Finney St.; Ansonia, CT

Client Number:
07-2564

Fax Number:
860-449-8860

Laboratory Results

Lab Sample Number	Client Sample Number	Layer Type	Lab Gross Description	Asbestos	Other Materials
18-11-03932-001	1		Tan Powder; Fibrous; Inhomogeneous	NAD	10% Cellulose 20% Fibrous Glass 70% Non-Fibrous
18-11-03932-002	2		Tan Powder; Fibrous; Inhomogeneous	NAD	10% Cellulose 20% Fibrous Glass 70% Non-Fibrous
18-11-03932-003	3		Tan Powder; Fibrous; Inhomogeneous	NAD	10% Cellulose 20% Fibrous Glass 70% Non-Fibrous
18-11-03932-004	4		Tan Powder; Fibrous; Inhomogeneous	NAD	10% Cellulose 20% Fibrous Glass 70% Non-Fibrous
18-11-03932-005	5		Tan Powder; Fibrous; Inhomogeneous	NAD	10% Cellulose 20% Fibrous Glass 70% Non-Fibrous

Environmental Hazards Services, L.L.C

Client Number: 07-2564 **Report Number:** 18-11-03932

Project/Test Address: Prendergast; 59 Finney St.; Ansonia, CT

Lab Sample Number	Client Sample Number	Layer Type	Lab Gross Description	Asbestos	Other Materials
18-11-03932-006	6		Tan Powder; Fibrous; Inhomogeneous	NAD	10% Cellulose 20% Fibrous Glass 70% Non-Fibrous
18-11-03932-007	7		Off-White Fibrous; Tan Granular; Inhomogeneous	NAD	1% Cellulose 90% Fibrous Glass 9% Non-Fibrous
18-11-03932-008	8		Off-White Fibrous; Tan Granular; Inhomogeneous	NAD	1% Cellulose 90% Fibrous Glass 9% Non-Fibrous
18-11-03932-009	9		Off-White Fibrous; Homogeneous	NAD	1% Cellulose 97% Fibrous Glass 2% Non-Fibrous
18-11-03932-010	10		Gray Powder; Fibrous; Inhomogeneous	NAD	10% Cellulose 22% Fibrous Glass 68% Non-Fibrous
18-11-03932-011	11		Gray Powder; Fibrous; Inhomogeneous	NAD	10% Cellulose 22% Fibrous Glass 68% Non-Fibrous
18-11-03932-012	12		Gray Powder; Fibrous; Inhomogeneous	NAD	10% Cellulose 22% Fibrous Glass 68% Non-Fibrous

Environmental Hazards Services, L.L.C

Client Number: 07-2564 **Report Number:** 18-11-03932

Project/Test Address: Prendergast; 59 Finney St.; Ansonia, CT

Lab Sample Number	Client Sample Number	Layer Type	Lab Gross Description	Asbestos	Other Materials
18-11-03932-013	13		Tan Powder; Fibrous; Inhomogeneous	NAD	10% Cellulose 20% Fibrous Glass 70% Non-Fibrous
18-11-03932-014	14		Tan Powder; Fibrous; Inhomogeneous	NAD	10% Cellulose 20% Fibrous Glass 70% Non-Fibrous
18-11-03932-015	15		Tan Powder; Fibrous; Inhomogeneous	NAD	10% Cellulose 20% Fibrous Glass 70% Non-Fibrous
18-11-03932-016	16		Off-White Fibrous; Tan Granular; Inhomogeneous	NAD	1% Cellulose 85% Fibrous Glass 14% Non-Fibrous
18-11-03932-017	17		Off-White Fibrous; Tan Granular; Inhomogeneous	NAD	1% Cellulose 85% Fibrous Glass 14% Non-Fibrous
18-11-03932-018	18		Off-White Fibrous; Tan Granular; Inhomogeneous	NAD	1% Cellulose 85% Fibrous Glass 14% Non-Fibrous
18-11-03932-019	19		Brown Granular; Homogeneous	NAD	100% Non-Fibrous
18-11-03932-020	20		Brown Granular; Homogeneous	NAD	100% Non-Fibrous

Environmental Hazards Services, L.L.C

Client Number: 07-2564 **Report Number:** 18-11-03932

Project/Test Address: Prendergast; 59 Finney St.; Ansonia, CT

Lab Sample Number	Client Sample Number	Layer Type	Lab Gross Description	Asbestos	Other Materials
18-11-03932-021	21		Brown Granular; Homogeneous	NAD	1% Cellulose 99% Non-Fibrous
18-11-03932-022	22		Gray Granular; Homogeneous	NAD	2% Fibrous Glass 98% Non-Fibrous
18-11-03932-023	23		Gray Granular; Homogeneous	NAD	2% Fibrous Glass 98% Non-Fibrous
18-11-03932-024	24		Gray Granular; Homogeneous	NAD	2% Fibrous Glass 98% Non-Fibrous
18-11-03932-025	25		Gray Powder; Fibrous; Inhomogeneous	NAD	10% Cellulose 25% Fibrous Glass 65% Non-Fibrous
18-11-03932-026	26		Gray Powder; Fibrous; Inhomogeneous	NAD	10% Cellulose 25% Fibrous Glass 65% Non-Fibrous
18-11-03932-027	27		Gray Powder; Fibrous; Inhomogeneous	NAD	10% Cellulose 25% Fibrous Glass 65% Non-Fibrous
18-11-03932-028	28		Gray Powder; Fibrous; Inhomogeneous	NAD	10% Cellulose 25% Fibrous Glass 65% Non-Fibrous

Environmental Hazards Services, L.L.C

Client Number: 07-2564 **Report Number:** 18-11-03932

Project/Test Address: Prendergast; 59 Finney St.; Ansonia, CT

Lab Sample Number	Client Sample Number	Layer Type	Lab Gross Description	Asbestos	Other Materials
18-11-03932-029	29		Gray Powder; Fibrous; Inhomogeneous	NAD	10% Cellulose 25% Fibrous Glass 65% Non-Fibrous
18-11-03932-030	30		Gray Powder; Fibrous; Inhomogeneous	NAD	10% Cellulose 25% Fibrous Glass 65% Non-Fibrous

QC Sample: 22-M22011-2

QC Blank: SRM 1866 Fiberglass

Reporting Limit: 1% Asbestos

Method: EPA Method 600/R-93/116, EPA Method 600/M4-82-020

Analyst: Vickie Holmes

Reviewed By Authorized Signatory: Tasha Eaddy

Tasha Eaddy
QA/QC Clerk

The condition of the samples analyzed was acceptable upon receipt per laboratory protocol unless otherwise noted on this report. Each distinct component in an inhomogeneous sample was analyzed separately and reported as a composite. Results represent the analysis of samples submitted by the client. Sample location, description, area, volume, etc., was provided by the client. This report cannot be used by the client to claim product endorsement by NVLAP or any agency of the U.S. Government. This report shall not be reproduced except in full, without the written consent of the Environmental Hazards Service, L.L.C. California Certification #2319 NY ELAP #11714 NVLAP #101882-0 VELAP 460172. All information concerning sampling location, date, and time can be found on Chain-of-Custody. Environmental Hazards Services, L.L.C. does not perform any sample collection.

Environmental Hazards Services, L.L.C. recommends reanalysis by point count (for more accurate quantification) or Transmission Electron Microscopy (TEM), (for enhanced detection capabilities) for materials regulated by EPA NESHAP (National Emission Standards for Hazardous Air Pollutants) and found to contain less than ten percent (<10%) asbestos by polarized light microscopy (PLM). Both services are available for an additional fee.

400 Point Count Analysis, where noted, performed per EPA Method 600/R-93/116 with a Reporting Limit of 0.25%.

* All California samples analyzed by Polarized Light Microscopy, EPA Method 600/M4-82-020, Dec. 1982.

LEGEND: NAD = no asbestos detected

EHS Laboratories

Environmental Hazards Services, LLC

7469 Whitepine Rd
Richmond, VA
23237
(800)347-4010
(804)275-4907 (fax)

Asbestos Chain-of-Custody

18-11-03932

Due Date:
12/05/2018
(Wednesday)
AE

✓ 30 PLM

CompanyName: Mystic Air Quality Consultants Address: 1204 North Rd., Groton, CT 06340 City/state/zip: Groton, Ct. 06340

Phone: 860 449 8903 Fax: 860 449 8903 E-mail: maqc2@aol.com Acct Number: 07-2564

Project Name and Address: Pierkrgast, 59 Finney St. City/State(required) Ansonia, CT

Collected by: P. Wiseman Signature P. Wiseman Mystic Air Client: Ansonia BOE

Turn around time: Standard ✓ One day ____ (will call ahead)

No.	Client's Sample No.	Date Collected	PLM Analysis	Other Analysis Specify	Material Description	Sample Location	Comments
1	1-3	11/29/18	✓	5 Top	Packing	HB CT 11516 - Lower Headers	
2	4-6				Packing	" " Material Exterior Behind Fiberglass	
3	7-9				Coping	" " - Between Ribs	
4	10-12				Packing	" " - Top of Header	
5	13-15				Packing	HB CT 11517 - Lower Headers	
6	16-18				Coping	" " - Between Ribs	
7	19-21				Ribs	" " - Inside Boiler	
8	22-24				Fire Brick	" "	
9	25-27				Packing	" " Exterior Packing Behind Fiberglass	
10	28-30	↓	↓	↓	"	" " Top of Header	
11							
12							
13							
14							
15							

Released by: P. Wiseman Signature: P. Wiseman date: 11/29/18

Received by: T. Luhr Signature: T. Luhr date: 11/30/18 3p

DOCUMENT 004313 - BID SECURITY, PERFORMANCE AND PAYMENT FORMS

1.1 BID FORM SUPPLEMENT

A. A completed bid bond form is required to be attached to the Bid Form.

1.2 BID BOND FORM

A. AIA Document A310, "Bid Bond," is the recommended form for a bid bond. A bid bond acceptable to Owner, or other bid security as described in the Instructions to Bidders, is required to be attached to the Bid Form as a supplement.

B. A Performance Bond is required. AIA Document A312 “Performance Bond” is the required form.

C. A Payment Bond is required. AIA Document A312 “Payment Bond” is the required form.

D. Copies of AIA standard forms may be obtained from The American Institute of Architects; www.aia.org/contractdocs/purchase/index.htm; email: docspurchases@aia.org; (800) 942-7732.

END OF DOCUMENT 004313

Minimum Rates and Classifications for Building Construction

ID#: 20-11124

Connecticut Department of Labor
Wage and Workplace Standards Division

By virtue of the authority vested in the Labor Commissioner under provisions of Section 31-53 of the General Statutes of Connecticut, as amended, the following are declared to be the prevailing rates and welfare payments and will apply only where the contract is advertised for bid within 20 days of the date on which the rates are established. Any contractor or subcontractor not obligated by agreement to pay to the welfare and pension fund shall pay this amount to each employee as part of his/her hourly wages.

Project Number: Boiler Replacement
Project Town: Ansonia
State#: Prendergast
FAP#: Prendergast
Project: Prendergast School Boiler Replacement

CLASSIFICATION	Hourly Rate	Benefits
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**		
1c) Asbestos Worker/Heat and Frost Insulator	40.21	30.99
2) Boilermaker	38.34	26.01
3a) Bricklayer, Cement Mason, Concrete Finisher (including caulking), Stone Masons	35.71	33.31 + a
3b) Tile Setter	34.9	25.87
3c) Terrazzo Mechanics and Marble Setters	31.69	22.35
3d) Tile, Marble & Terrazzo Finishers	26.7	21.75
3e) Plasterer	33.48	32.06
------LABORERS------		
4) Group 1: Laborers (common or general), acetylene burners, carpenter tenders, concrete specialists, wrecking laborers, fire watchers.	30.75	20.84
4a) Group 2: Mortar mixers, plaster tender, power buggy operators, powdermen, fireproofer/mixer/nozzleman (Person running mixer and spraying fireproof only).	31.0	20.84

As of: March 12, 2020

4b) Group 3: Jackhammer operators/pavement breaker, mason tender (brick), mason tender (cement/concrete), forklift operators and forklift operators (masonry).	31.25	20.84
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.	31.75	20.84
4d) Group 5: Air track operator, sand blaster and hydraulic drills.	31.5	20.84
4e) Group 6: Blasters, nuclear and toxic waste removal.	33.75	20.84
4f) Group 7: Asbestos/lead removal and encapsulation (except it's removal from mechanical systems which are not to be scrapped).	31.75	20.84
4g) Group 8: Bottom men on open air caisson, cylindrical work and boring crew.	29.03	20.84
4h) Group 9: Top men on open air caisson, cylindrical work and boring crew.	28.49	20.84
4i) Group 10: Traffic Control Signalman	18.0	20.84
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.	33.53	25.66
5a) Millwrights	34.94	26.19
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)	38.5	28.61+3% of gross wage
7a) Elevator Mechanic (Trade License required: R-1,2,5,6)	55.12	34.765+a+b
-----LINE CONSTRUCTION----		
Groundman	26.5	6.5% + 9.00
Linemen/Cable Splicer	48.19	6.5% + 22.00
8) Glazier (Trade License required: FG-1,2)	38.18	21.80 + a

9) Ironworker, Ornamental, Reinforcing, Structural, and Precast Concrete Erection	36.67	35.77
----OPERATORS----		
Group 1: Crane handling or erecting structural steel or stone, hoisting engineer 2 drums or over, front end loader (7 cubic yards or over), work boat 26 ft. and over and Tunnel Boring Machines. (Trade License Required)	40.97	24.80 + a
Group 2: Cranes (100 ton rate capacity and over); Excavator over 2 cubic yards; Piledriver ($3.00 premium when operator controls hammer); Bauer Drill/Caisson. (Trade License Required)	40.64	24.80 + a
Group 3: Excavator; Backhoe/Excavator under 2 cubic yards; Cranes (under 100 ton rated capacity), Grader/Blade; 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 Fine Grade. (slopes, shaping, laser or GPS, etc.). (Trade License Required)	39.88	24.80 + a
Group 4: Trenching Machines; Lighter Derrick; Concrete Finishing Machine; CMI Machine or Similar; Koehring Loader (Skooper).	39.48	24.80 + a
Group 5: Specialty Railroad Equipment; Asphalt Paver; 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	38.87	24.80 + a
Group 5 continued: Side Boom; Combination Hoe and Loader; Directional Driller; Pile Testing Machine.	38.87	24.80 + a
Group 6: Front End Loader (3 up to 7 cubic yards); Bulldozer (rough grade dozer).	38.55	24.80 + a
Group 7: Asphalt roller, concrete saws and cutters (ride on types), vermeer concrete cutter, Stump Grinder; Scraper; Snooper; Skidder; Milling Machine (24	38.2	24.80 + a
Group 8: Mechanic, grease truck operator, hydroblaster; barrier mover; power stone spreader; welding; work boat under 26 ft.; transfer machine.	37.79	24.80 + a
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).	37.34	24.80 + a
Group 10: Vibratory hammer; ice machine; diesel and air, hammer, etc.	35.24	24.80 + a
Group 11: Conveyor, earth roller, power pavement breaker (whiphammer), robot demolition equipment.	35.24	24.80 + a

Group 12: Wellpoint operator.	35.18	24.80 + a
Group 13: Compressor battery operator.	34.58	24.80 + a
Group 14: Elevator operator; tow motor operator (solid tire no rough terrain).	33.41	24.80 + a
Group 15: Generator Operator; Compressor Operator; Pump Operator; Welding Machine Operator; Heater Operator.	32.99	24.80 + a
Group 16: Maintenance Engineer/Oiler.	32.32	24.80 + a
Group 17: Portable asphalt plant operator; portable crusher plant operator; portable concrete plant operator.	36.76	24.80 + a
Group 18: Power safety boat; vacuum truck; zim mixer; sweeper; (Minimum for any job requiring a CDL license).	34.26	24.80 + a
------PAINTERS (Including Drywall Finishing)------		
10a) Brush and Roller	34.62	21.80
10b) Taping Only/Drywall Finishing	35.37	21.80
10c) Paperhanger and Red Label	34.12	21.05
10e) Blast and Spray	36.62	21.05
11) Plumber (excluding HVAC pipe installation) (Trade License required: P-1,2,6,7,8,9 J-1,2,3,4 SP-1,2)	43.62	32.06
12) Well Digger, Pile Testing Machine	37.26	24.05 + a
Roofer: Cole Tar Pitch	41.5	17.00 + a
Roofer: Slate, Tile, Composition, Shingles, Singly Ply and Damp/Waterproofing	40.0	17.00 + a
15) Sheetmetal Worker (Trade License required for HVAC and Ductwork: SM-1,SM-2,SM-3,SM-4,SM-5,SM-6)	37.98	38.31
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)	43.62	32.06

As of: March 12, 2020

Project: Prendergast School Boiler Replacement

------TRUCK DRIVERS------

17a) 2 Axle	29.51	24.52 + a
17b) 3 Axle, 2 Axle Ready Mix	29.62	24.52 + a
17c) 3 Axle Ready Mix	29.67	24.52 + a
17d) 4 Axle, Heavy Duty Trailer up to 40 tons	29.72	24.52 + a
17e) 4 Axle Ready Mix	29.77	24.52 + a
17f) Heavy Duty Trailer (40 Tons and Over)	29.98	24.52 + a
17g) Specialized Earth Moving Equipment (Other Than Conventional Type on-the-Road Trucks and Semi-Trailers, Including Euclids)	29.77	24.52 + a
18) Sprinkler Fitter (Trade License required: F-1,2,3,4)	45.57	24.33 + a
19) Theatrical Stage Journeyman	25.76	7.34

Welders: Rate for craft to which welding is incidental.

**Note: Hazardous waste removal work receives additional $1.25 per hour for truck drivers.*

***Note: Hazardous waste premium $3.00 per hour over classified rate*

ALL Cranes: When crane operator is operating equipment that requires a fully licensed crane operator to operate he receives an extra $4.00 premium in addition to the hourly wage rate and benefit contributions:

1) Crane handling or erecting structural steel or stone; hoisting engineer (2 drums or over)

2) Cranes (100 ton rate capacity and over) Bauer Drill/Caisson

3) Cranes (under 100 ton rated capacity)

Crane with 150 ft. boom (including jib) - $1.50 extra
Crane with 200 ft. boom (including jib) - $2.50 extra
Crane with 250 ft. boom (including jib) - $5.00 extra
Crane with 300 ft. boom (including jib) - $7.00 extra
Crane with 400 ft. boom (including jib) - $10.00 extra

All classifications that indicate a percentage of the fringe benefits must be calculated at the percentage rate times the "base hourly rate".

Apprentices duly registered under the Commissioner of Labor's regulations on "Work Training Standards for Apprenticeship and Training Programs" Section 31-51-d-1 to 12, are allowed to be paid the appropriate percentage of the prevailing journeymen hourly base and the full fringe benefit rate, providing the work site ratio shall not be less than one full-time journeyperson instructing and supervising the work of each apprentice in a specific trade.

The Prevailing wage rates applicable to this project are subject to annual adjustments each July 1st for the duration of the project.

Each contractor 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 website.

The annual adjustments will be posted on the Department of Labor's Web page: www.ct.gov/dol. For those without internet access, please contact the division listed below.

The Department of Labor will continue to issue the initial prevailing wage rate schedule to the Contracting Agency for the project.

All subsequent annual adjustments will be posted on our Web Site for contractor access.

Contracting Agencies are under no obligation pursuant to State labor law to pay any increase due to the annual adjustment provision.

Effective October 1, 2005 - Public Act 05-50: any person performing the work of any mechanic, laborer, or worker shall be paid prevailing wage

All Person who perform work ON SITE must be paid prevailing wage for the appropriate mechanic, laborer, or worker classification.

All certified payrolls must list the hours worked and wages paid to All Persons who perform work ON SITE regardless of their ownership i.e.: (Owners, Corporate Officers, LLC Members, Independent Contractors, et. al)

Reporting and payment of wages is required regardless of any contractual relationship alleged to exist between the contractor and such person.

As of: March 12, 2020

Project: Prendergast School Boiler Replacement

~~Unlisted classifications needed for work not included within the scope of the classifications listed may be added after award only as provided in the labor standards contract clause (29 CFR 5.5 (a) (1) (ii)).

Please direct any questions which you may have pertaining to classification of work and payment of prevailing wages to the Wage and Workplace Standards Division, telephone (860)263-6790.

As of: March 12, 2020

SECTION 000115 - LIST OF DRAWING SHEETS

1.1 LIST OF DRAWINGS

A. Drawings: Drawings consist of the Contract Drawings and other drawings listed on the Table of Contents page of the separately bound drawing set titled PRENDERGAST SCHOOL; HOT WATER BOILER REPLACEMENT, dated April 1, 2020, as modified by subsequent Addenda and Contract modifications.

B. List of Drawings: Drawings consist of the following Contract Drawings and other drawings of type indicated:

MECHANICAL

MD-100	MECHANICAL BOILER ROOM DEMOLITION PLAN
MD-101	MECHANICAL FUEL OIL PIPING DEMOLITION PLAN
M-000	MECHANICAL LEGENDS & SCHEDULES
M-100	MECHANICAL BOILER ROOM NEW WORK PLAN
M-200	MECNANICAL DETAILS & DIAGRAMS

ELECTRICAL

ED-100	ELECTRICAL DEMOLITION PLAN
E-000	ELECTRICAL SYMBOLS, SCHEDULE & RISER DIAGRAM
E-100	ELECTRICAL PLAN
E-200	ELECTRICAL PARTIAL PLAN

END OF SECTION 000115

SECTION 012900 – PAYMENT PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. The Contractor, Subcontractors, and/or suppliers providing goods or services referenced in or related to this Section shall also be bound by the Documents identified in Division 01 Section "Summary", Paragraph 1.1A, entitled "Related Documents."

1.2 SUMMARY

A. This Section specifies administrative and procedural requirements necessary to prepare and process Applications for Payment.

1.3 DEFINITIONS

A. Schedule of Values: A statement furnished by Contractor allocating portions of the Contract Sum to various portions of the Work and used as the basis for reviewing Contractor's Applications for Payment.

1.4 SCHEDULE OF VALUES

A. Coordination: Coordinate preparation of the Schedule of Values with preparation of Contractor's Construction Schedule.

1. Correlate line items in the Schedule of Values with other required administrative forms and schedules, including the following:

    a. Application for Payment forms with Continuation Sheets.
    b. Submittals Schedule.
    c. Contractor's Construction Schedule.

2. Submit the Schedule of Values to the Architect at earliest possible date but no later than seven days before the date scheduled for submittal of initial Applications for Payment.

B. Format and Content: Use the Project Manual table of contents as a guide to establish line items for the Schedule of Values. Provide at least one line item for each Specification Section. For major trades with line item values greater than $25,000, provide a separate line item for units of work within each trade with a value not exceeding $25,000.

1. Identification: Include the following Project identification on the Schedule of Values:

    a. Project name and location.

b. Name of Architect.
c. Architect's project number.
d. Contractor's name and address.
e. Date of submittal.

2. Submit draft of AIA Document G702 and AIA Document G703 Continuation Sheets.
3. Arrange the Schedule of Values in tabular form with separate columns to indicate the following for each item listed:

a. Related Specification Section or Division.
b. Description of the Work.
c. Name of subcontractor.
d. Name of manufacturer or fabricator.
e. Name of supplier.
f. Change Orders (numbers) that affect value.
g. Dollar value.

1) Percentage of the Contract Sum to nearest one-hundredth percent, adjusted to total 100 percent.

4. Provide a breakdown of the Contract Sum in enough detail to facilitate continued evaluation of Applications for Payment and progress reports. Coordinate with the Project Manual table of contents. Provide several line items for principal subcontract amounts, where appropriate. Include the following line items as appropriate:

a. Mobilization.
b. Demobilization.
c. Builders Risk Insurance.
d. Bonds.
e. Coordination Drawings.
f. Scheduling.
g. Project record documents.
h. Operation and Maintenance manuals.
i. Field Engineering.
j. Daily Building Cleanup.
k. Safety Program.
l. Full-Time Project Manager.
m. Full-Time Project Superintendent.
n. Field Offices.
o. Dumpsters.
p. Cold Weather Protection.
q. Temporary Heat.
r. General Contract O&P (not to be included in each line item).

5. Round amounts to nearest whole dollar; total shall equal the Contract Sum.
6. Provide a separate line item in the Schedule of Values for each part of the Work where Applications for Payment may include materials or equipment purchased or fabricated and stored, but not yet installed.

a. Differentiate between items stored on-site and items stored off-site. If specified, include evidence of insurance or bonded warehousing.

7. Provide separate line items in the Schedule of Values for initial cost of materials, for each subsequent stage of completion, and for total installed value of that part of the Work.
8. Each item in the Schedule of Values and Applications for Payment shall be complete. Include total cost and proportionate share of general overhead and profit for each item.

   a. Temporary facilities and other major cost items that are not direct cost of actual work-in-place may be shown either as separate line items in the Schedule of Values or distributed as general overhead expense, at Contractor's option.

9. Schedule Updating: Update and resubmit the Schedule of Values before the next Applications for Payment when Change Orders or Construction Change Directives result in a change in the Contract Sum.

1.5 APPLICATIONS FOR PAYMENT

A. Each Application for Payment shall be consistent with previous applications and payments as certified by Architect and paid for by Owner.

   1. Initial Application for Payment, Application for Payment at time of Substantial Completion, and final Application for Payment involve additional requirements.

B. Payment Application Times: The date for each progress payment is indicated in the Agreement between Owner and Contractor. The period of construction work covered by each Application for Payment is the period indicated in the Agreement.

   1. At least ten days before the date established for each formal Application for Payment, the Contractor shall submit to the Architect an itemized preliminary application for payment for review and comment. The Contractor shall then revise the preliminary application and at least two days prior to the date established for formal application, shall submit to the Architect the revised preliminary application, to allow time for the Architect to prepare a written letter of explanation setting forth any objections and recommended changes to be forwarded along with the formal application to the owner.

C. Payment Application Forms: Use AIA Document G702 and AIA Document G703 Continuation Sheets as form for Applications for Payment.

D. Application Preparation: Complete every entry on form. Notarize and execute by a person authorized to sign legal documents on behalf of Contractor. Architect will return incomplete applications without action.

   1. Entries shall match data on the Schedule of Values and Contractor's Construction Schedule. Use updated schedules if revisions were made.
   2. Include amounts of Change Orders executed before last day of construction period covered by application.

E. Stored Materials: Include in Application for Payment amounts applied for materials or equipment purchased or fabricated and stored, but not yet installed. Differentiate between items stored on-site and items stored off-site.

1. Provide certificate of insurance, evidence of transfer of title to Owner, and consent of surety to payment, for stored materials.
2. Provide supporting documentation that verifies amount requested, such as paid invoices. Match amount requested with amounts indicated on documentation; do not include overhead and profit on stored materials.
3. Provide summary documentation for stored materials indicating the following:

    a. Value of materials previously stored and remaining stored as of date of previous Applications for Payment.
    b. Value of previously stored materials put in place after date of previous Application for Payment and on or before date of current Application for Payment.
    c. Value of materials stored since date of previous Application for Payment and remaining stored as of date of current Application for Payment.

F. Transmittal: Submit THREE (3) signed and notarized original copies of each Application for Payment to Architect by a method ensuring receipt within 24 hours. One copy shall include waivers of lien and similar attachments if required.

G. Waivers of Mechanic's Lien: With each Application for Payment, submit waivers of mechanic's lien from every entity who is lawfully entitled to file a mechanic's lien arising out of the Contract and related to the Work covered by the payment.

1. Submit partial waivers on each item for amount requested in previous application, after deduction for retainage, on each item.
2. When an application shows completion of an item, submit final or full waivers.
3. Owner reserves the right to designate which entities involved in the Work must submit waivers.
4. Submit final Application for Payment with or preceded by conditional final waivers from every entity involved with performance of the Work covered by the application who is lawfully entitled to a lien.
5. Waiver Forms: Submit waivers of lien on forms, executed in a manner acceptable to Owner.

H. Initial Application for Payment: Administrative actions and submittals that must precede or coincide with submittal of first Application for Payment include the following:

1. List of subcontractors.
2. Schedule of Values.
3. Contractor's Construction Schedule (preliminary if not final).
4. Products list.
5. Schedule of allowances.
6. Submittals Schedule (preliminary if not final).
7. List of Contractor's staff assignments.
8. List of Contractor's principal consultants.
9. Copies of building permits.

10. Copies of authorizations and licenses from authorities having jurisdiction for performance of the Work.
11. Initial progress report.
12. Report of preconstruction conference.
13. Certificates of insurance and insurance policies.
14. Performance and payment bonds.
15. Data needed to acquire Owner's insurance.

I. Application for Payment at Substantial Completion: After issuing the Certificate of Substantial Completion, submit an Application for Payment showing 100 percent completion for portion of the Work claimed as substantially complete.

1. Include documentation supporting claim that the Work is substantially complete and a statement showing an accounting of changes to the Contract Sum.

J. Final Payment Application: Submit final Application for Payment with releases and supporting documentation not previously submitted and accepted, including, but not limited, to the following:

1. Evidence of completion of Project closeout requirements.
2. Insurance certificates for products and completed operations where required and proof that taxes, fees, and similar obligations were paid.
3. Updated final statement, accounting for final changes to the Contract Sum.
4. AIA Document G706, "Contractor's Affidavit of Payment of Debts and Claims."
5. AIA Document G706A, "Contractor's Affidavit of Release of Liens."
6. AIA Document G707, "Consent of Surety to Final Payment."
7. Evidence that claims have been settled.
8. Final meter readings for utilities, a measured record of stored fuel, and similar data as of date of Substantial Completion or when Owner took possession of and assumed responsibility for corresponding elements of the Work.

K. At time of start of installation, the Contractor may submit the initial Application for Payment representing the value of materials on store on site but not yet installed. Because of the short project duration, it is expected that there will be only one intermediate Application for Payment at approximately the halfway point in the project followed by the final Application for Payment at substantial completion.

L. The retainage rate shall be 10% of the total Contract Price, reduced to 0% at the completion of all Punch List items.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 012900

SECTION 02 4119 – SELECTIVE DEMOLITION

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes selective demolition as indicated and required for installation of new work required for completion of the project and as specified.

1.2 DEFINITIONS

A. Remove: Detach items from existing construction and legally dispose of them off-site, at a permitted Landfill or State approved Disposal Facility.

B. Existing to Remain: Existing items of construction that are not to be removed and that are not otherwise indicated to be removed, removed and salvaged, or removed and reinstalled.

1.3 SUBMITTALS

A. Schedule of Selective Demolition Activities: Indicate the following:

1. For purposes of Owner's information only, sequence of selective demolition and removal work, with starting and ending dates for each activity. Ensure Owner's on-site operations are uninterrupted.

2. Notify Owner of possible Interruption of utility services. Indicate how long utility services will be interrupted.

3. Use of elevator and stairs if acceptable to the Owner.

4. Locations of work area, including proposed dust and noise control, scaffolding or other work Items necessary to complete the work.

5. Coordination of Owner's continuing occupancy of existing building during performance of project Scope of Work.

6. Means of protection for items to remain and items in path of waste removal from building.

B. Pre-demolition Photographs: Show existing conditions of adjoining construction and site work area improvements, including finish surfaces, that might be misconstrued as damage caused by selective demolition operations.

1.4 QUALITY ASSURANCE

A. Demolition Firm Qualifications: An experienced firm that has specialized in demolition work similar in material and extent to that indicated for this Project.

B. Regulatory Requirements: Comply with governing notification regulations before beginning selective demolition. Comply with hauling and disposal regulations of authorities having jurisdiction.

C. Standards: Comply with ANSI A10.6 and NFPA 241.

D. Pre-Demolition Conference: Conduct conference at Project Site to review methods and procedures related to selective demolition including, but not limited to, the following:

1. Inspect and discuss condition of construction to be selectively demolished.
2. Review and finalize selective demolition schedule and verify availability of materials, demolition personnel, equipment, and facilities needed to make progress and avoid delays.
3. Review requirements of work performed by other trades that rely on substrates exposed by selective demolition operations.
4. Review areas where existing construction is to remain and requires protection.

1.5 PROJECT CONDITIONS

A. Owner will occupy building during selective demolition area and all other work to be performed. Conduct selective demolition so Owner's operations will not be physically disrupted. **NOTIFY OWNER OF pending AUDIBLE, or other DISTURBANCES 2 weeks prior to their occurrence.**

B. Conditions existing at time of inspection for bidding purpose will be maintained by Owner as far as practical.

C. Notify Architect of discrepancies between existing conditions and Drawings before proceeding with selective demolition.

D. Hazardous Materials: To the best of the Owner’s knowledge, hazardous materials do not exist. Contractor may obtain copies of Owner’s Lead Paint Testing Reports on file. Immediately Notify the Owner or Architect should unforeseen hazardous materials be discovered.

1. If materials suspected of containing hazardous materials are encountered, do not disturb; immediately notify Architect and the Owner.

E. Storage or sale of removed items or materials on-site is not permitted.

F. Utility Service: Maintain existing utilities required to remain in service and protect them against damage during selective demolition operations.

1.6 EXISTING SYSTEMS

A. Prior to Start of Work, review with Owner systems that must be maintained operational during demolition. Such systems include security systems, access control systems, alarms and communication systems.

B. Develop a strategy with the Owner to maintain such systems operational during alterations including temporary re-working, unavoidable down time, acceptable discontinuing of service intervals and contingencies for notification of involved agencies.

C. Instruct every Subcontractor as to the procedures to be followed and supervise the process to ensure implementation.

D. Restore such systems and extend them into the altered area.

E. Include all services and materials in the Contract Sum.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 EXAMINATION

A. Survey existing conditions and correlate with requirements indicated to determine extent of selective demolition required.

B. When unanticipated mechanical, electrical, or structural elements that conflict with intended function or design are encountered, investigate and measure the nature and extent of conflict. Promptly submit a written report to Architect.

C. Survey of Existing Conditions: Record existing conditions by use of preconstruction Photographs.

1. Before selective demolition or removal of existing building elements that will be replaced in Final Work, make permanent record of measurements, materials, and

construction details required to make exact reproduction.

2. Perform surveys as the Work progresses to detect hazards resulting from selective demolition activities.

3.2 UTILITY SERVICES AND MECHANICAL/ELECTRICAL SYSTEMS

A. Existing Services / Systems: Maintain services / systems and protect them against damage during selective demolition operations.

3.3 PREPARATION

A. Site Access and Temporary Controls: Conduct selective demolition and debris-removal operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.

B. Temporary Facilities: Provide temporary barricades and other protection required to prevent injury to people and damage to adjacent buildings and facilities to remain.

1. Provide protection to ensure safe passage of people around selective demolition area and to and from occupied portions of building.

2. Provide temporary weather protection, during interval between selective demolition of existing construction on exterior surfaces and new construction, to prevent water leakage and damage to structure and interior areas.

3. Protect walls, and other existing finish work that are to remain or that are exposed during selective demolition operations.

4. Provide temporary enclosures, and dust control as required to insure the safety and well-being of nearby pedestrians and building occupants.

3.4 SELECTIVE DEMOLITION, GENERAL

A. General: Demolish and remove existing construction only to the extent required by new construction and as indicated. Use methods required to complete the Work within limitations of governing regulations and as follows:

1. Proceed with selective demolition systematically, from higher to lower level. Complete selective demolition operations above each floor or tier before disturbing supporting members on the next lower level.

2. Neatly cut openings square, and true to dimensions required. Use cutting methods least likely to damage construction to remain or adjoining construction. Use hand tools or small power tools designed for sawing or grinding, not hammering and chopping, to minimize disturbance of adjacent surfaces. Temporarily cover openings to remain.

3. Cut or drill from the exposed or finished side into concealed surfaces to avoid marring existing finished surfaces.

4. Do not use cutting torches or any other tools that may cause fire. Maintain portable fire-

suppression devices during project work.

6. Remove decayed, or otherwise dangerous or unsuitable materials and promptly dispose of off-site at a permitted facility.

7. Remove materials and lower to ground by method suitable to avoid free fall and to prevent ground impact or dust generation.

8. Locate selective demolition equipment and remove debris and materials so as not to impose excessive loads on supporting walls, floors, or framing.

9. Dispose of demolished items and materials at a permitted Disposal Facility promptly.

B. Existing Items to Remain: Protect construction indicated to remain against damage and soiling during selective demolition. Items may be removed to a suitable, protected storage location during selective demolition and cleaned and reinstalled in their original locations after selective demolition operations are complete.

3.5 SELECTIVE DEMOLITION PROCEDURES FOR SPECIFIC MATERIALS

A. Non-Structural Masonry & architectural materials

B. Flashing and associated materials

C. Miscellaneous Materials - Remove sealant, adhesives and other miscellaneous materials (interfering with new work) according to governing removal and disposal regulations and per recommendations.

D. Construction Debris

3.6 MANAGEMENT OF DEMOLISHED MATERIALS

A. PROCEDURE

1. Provide containers or other storage method for controlling demolished materials until they are removed from Project site.

2. Stockpile materials away from work area. Do not store within drip line of existing trees.

3. Store components off the ground and protect from the weather.

4. Transport materials off Owner’s property and legally dispose of all materials at a Permitted Landfill or Waste Disposal facility.

5. Remove from the site and legally dispose of non-recyclable debris, rubbish, and other materials resulting from demolition operations.

6. Burning: Do not burn demolished materials.

7. Disposal: Transport non-recyclable demolished materials off Owner's property and legally disposes of them per governing Codes and Agencies.

3.7 CLEANING

A. Clean adjacent surfaces and improvements of dust, dirt, and debris caused by selective demolition operations. Return adjacent areas to condition existing before selective demolition operations began.

END OF SECTION 024119

SECTION 23 0400 - GENERAL CONDITIONS FOR MECHANICAL TRADES

PART 1 GENERAL

1.1 RELATED REQUIREMENTS

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

B. This section applies to certain sections of Division 26, "Electrical," and this section applies to all sections of Division 23, "Mechanical" of this project specification unless specified otherwise in the individual sections.

C. The Drawings of other trades (Architectural, Structural, Landscape, Civil, Mechanical, Fire Protection and Plumbing) shall be examined for coordination and familiarity of work with other Contractors. Any duplication or omission of provisions in this project should be brought to the attention of the Owners prior to Bidding.

1.2 DESCRIPTION

A. The General Conditions and Supplementary General Conditions are a part of this Division and are to be considered a part of this Contract.

B. Where items of the General Conditions and Supplementary General Conditions are repeated in other Sections of the Specifications, it is merely intended to qualify or to call particular attention to them. It is not intended that any other parts of the General Conditions and Supplementary General Conditions shall be assumed to be omitted if not repeated therein. This Section applies equally and specifically to all Contractors supplying labor and/or equipment and/or materials as required under each Section of this Division. Where conflicts exist between the drawings and the specifications or between this section of the specifications and other sections, the more stringent or higher cost option shall apply.

1.3 INTENT

A. It is the intent of the Specifications and Drawings to call for finished work, tested and ready for operation.

B. Any apparatus, appliance, material or work not shown on drawings but mentioned in the specifications, or vice versa, or any incidental accessories necessary to make the

work complete and perfect in all respects and ready for operation as determined by good trade practice even if not particularly specified, shall be furnished, delivered and installed under their respective Divisions without any additional expense to the Owner.

C. Minor details not usually shown or specified but necessary for proper installation and operation shall be included in the work as though they were hereinafter shown or specified.

D. Work under each Section shall include giving written notice to the Owner and Engineer of any materials or apparatus believed inadequate or unsuitable; in violation of laws, ordinances, rules or regulations of authorities having jurisdiction; and any necessary items of work omitted. In the absence of such written notice, it is mutually agreed that work under each Section includes the cost of all required items for the accepted, satisfactory functioning of the entire system without extra compensation.

1.4 DEFINITIONS

A. No Exceptions Taken – reviewed and determined to be in general conformance with contract documents.

B. “Approved equal” mean any product which in the opinion of the Engineer is equal in quality, arrangement, appearance, and performance to the product specified.

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

D. “Finished” refers to all rooms and areas to be specified to receive architectural treatment as indicated on the drawings. All rooms and areas not covered, including underground tunnels and areas above ceilings shall be considered not finished, unless otherwise noted.

E. “Furnish” or “supply” shall mean purchase, deliver to, and off-load at the job site, ready to be installed including where appropriate all necessary interim storage and protection.

F. Indicated: The term "indicated" refers to graphic representations, notes, or schedules on the Drawings, other paragraphs or schedules in the Specifications, and similar requirements in the Contract Documents. Where terms such as "shown," "noted," "scheduled," and "specified" are used, it is to help the reader locate the reference; no limitation on location is intended.

G. "Install" shall mean set in place complete with all mounting facilities and connections as necessary ready for normal use or service.

H. "Product" shall mean any item of equipment, material, fixture, apparatus, appliance or accessory installed under this Division.

I. "Provide" shall mean furnish (or supply) and install as necessary.

J. Regulation: The term "Regulations" includes laws, ordinances, statutes, and lawful orders issued by authorities having jurisdiction, as well as rules, conventions, and agreements within the construction industry that control performance of the Work.

K. Remove: The term "remove" means "to disconnect from its present position, remove from the premises and to dispose of in a legal manner."

L. Special Warranties: The term "Special Warranties" are written warranties required by or incorporated in the Contract Documents, either to extend time limits provided by standard warranties or to provide greater rights for the Owner.

M. Standard Product Warranties: The term "Standard Product Warranties" are preprinted written warranties published by individual manufacturers for particular products and are specifically endorsed by the manufacturer to the Owner.

N. "Subcontractor" means specifically the subcontractor working under this Division. Other Contractors are specifically designated "Plumbing Subcontractor", "General Contractor" and so on. Note: Take care to ascertain limits of responsibility for connecting equipment which requires connections by two or more trades.

O. Substitutions: Requests for changes in products, materials, equipment, and methods of construction proposed by the Contractor are considered requests for "substitutions."

P. "Wiring" shall mean cable assembly, raceway, conductors, fittings and any other necessary accessories to make a complete wiring system.

1.5 DRAWINGS

A. Drawings are diagrammatic and indicate the general arrangement of systems and work included in the Contract. Consult the Architectural Drawings and Details for exact location of fixtures and equipment; where same are not definitely located, obtain this information from the Architect. (Do not scale the drawings)

B. Work under each Section shall closely follow Drawings in layout of work; check Drawings of other Divisions to verify spaces in which work will be installed. Maintain maximum headroom; where space conditions appear inadequate, Owner and Engineer shall be notified before proceeding with installations.

C. The Owner may, without extra charge, make reasonable modifications in the layout as needed to prevent conflict with work of other trades and/or for proper execution of the work.

D. Where variances occur between the Drawings and Specifications or within either of the Documents, the item or arrangement of better quality, shall be included in the Contract price. The Owner and Engineer shall decide on the item and the manner in which the work shall be installed.

1.6 SURVEYS AND MEASUREMENTS

A. Before submitting his Bid, the Contractors shall visit the site and become thoroughly familiar with all existing conditions under which work will be installed. This Contract includes all modifications of existing systems required for the installation of new equipment. This Contract includes all necessary offsets, transitions and modifications required to install all new equipment in existing spaces. All new and existing equipment and systems shall be fully operational under this Contract before the job is considered complete. The Contractors shall be held responsible for any assumptions he makes, any omissions or errors he makes as a result of his failure to become fully familiar with the existing conditions at the site and the Contract Documents.

B. The Contractor shall base all measurements, both horizontal and vertical, from established bench marks. All work shall agree with these established lines and levels. Verify all measurements at the site and check the correctness of same as related to the work.

C. Should the Contractor discover any discrepancies between actual measurements and those indicated which prevent following good practice or which interfere with the intent of the Drawings and Specifications, the Engineer will be notified and work will not proceed until instructions from the Engineer are received.

1.7 CODES AND STANDARDS

A. Reference Standard Compliance

1. Where equipment or materials are specified to conform to industry and technical society reference standards of the organizations such as American National Standards Institute (ANSI), American Society for Testing and Materials (ASTM), National Electrical Manufacturers Association (NEMA), and Underwriters Laboratories Inc. (UL), submit proof of such compliance. The label or listing by the specified organization will be acceptable evidence of compliance.

2. Independent Testing Organization Certificate: In lieu of the label or listing indicated above, submit a certificate from an independent testing organization, competent to perform testing, and approved by the Engineer. The certificate shall state that the item has been tested in accordance with the specified organization's test methods and that the item complies with the specified organization's reference standard.

B. The Following Codes and Standards for the state and local jurisdiction where the project is located as listed below apply to all mechanical work. Wherever Codes and/or Standards are mentioned in these Specifications, the latest applicable edition or revision shall be followed:

Connecticut School Construction Standards and Guidelines Building Standards Guidelines – Compliance for High Performance Buildings

The International Building Code

The International Mechanical Code

The International Plumbing Code

The International Energy Conservation Code

The National Electrical Code

NFPA edition as referenced by local building code

ASHRAE 90.1 and International Energy Conservation Code

C. The following Standards shall be used where referenced by the following abbreviations:

AABC	Associated Air Balance Council
ACGIH	American Conference of Governmental Industrial Hygienists

ADC	Air Diffusion Council
AGA	American Gas Association
AIA	American Institute of Architects
AMCA	Air Moving and Conditioning Association
ANSI	American National Standards Institute
API	American Petroleum Institute
ARI	Air Conditioning and Refrigeration Institute
ASHRAE	American Society of Heating, Refrigerating and Air Conditioning Engineers
ASME	American Society of Mechanical Engineers
ASPE	American Society of Plumbing Engineers
ASSE	American Society of Sanitary Engineers
ASTM	American Society of Testing and Materials
AWS	American Welding Society
AWWA	American Water Works Association
CGA	Compressed Gas Association
CSA	Canadian Standards Association
CISPI	Cast Iron Soil Pipe Institute
EJMA	Expansion Joint Manufacturing Association
EPA	Environmental Protection Agency
FM	Factory Mutual
FSSC	Federal Specification
HIS	Hydraulic Institute Standards
IEEE	Institute of Electrical and Electronics Engineers
IRI	Industrial Risk Insurers
ISO	Insurance Services Office

MCAA	Mechanical Contractors Association of America
NBS	National Bureau of Standards
NEBB	National Environmental Balancing Bureau
NEMA	National Electrical Manufacturers Association
NFPA	National Fire Protection Association
NOFI	National Oil Fuel Institute
NSC	National Safety Council
NSF	National Sanitation Foundation
OSHA	Occupational Safety and Health Administration
PDI	Plumbing and Drainage Institute
SBI	Steel Boiler Industry (Division of Hydronics Institute)
SMACNA	Sheet Metal and Air Conditioning Contractors National Association
STI	Steel Tank Institute
UL	Underwriters' Laboratories

D. All materials furnished and all work installed shall comply with the rules and recommendations of the NFPA, the requirements of the local utility companies, the recommendations of the fire insurance rating organization having jurisdiction and the requirements of all Governmental departments having jurisdiction.

E. The Contractor shall include in the work, without extra cost to the Owner, any labor, materials, services, apparatus and Drawings in order to comply with all applicable laws, ordinances, rules and regulations, whether shown on Drawings and/or specified or not.

1.8 PERMITS AND FEES

A. The Contractor shall give all necessary notices, obtain all permits; and pay all Government and State sales taxes and fees where applicable, and other costs, including utility connections or extensions in connection with the work, file all necessary Drawings, prepare all documents and obtain all necessary approvals of all Governmental and State departments having jurisdiction, obtain all required certificates of inspection for his work, and deliver a copy to the Owner and Engineer before request for acceptance and final payment for the work.

1.9 EQUIPMENT EQUIVALENTS AND SUBSTITUTIONS

A. Certain manufacturers of material, apparatus or appliances are indicated in the drawings and specifications for this project. These items have been used as the basis of design, and as a convenience in fixing the minimum standard of workmanship, finish and design that is required. If the Contractors uses an “approved equal” alternative to the basis of design, and if the features of that alternative have an impact on other components of the Project, the Contractor shall include the necessary adjustments in those components, whether for architectural, structural, mechanical, electrical, fire protection, or any other elements, plus any adjustments for difference in performance.

B. Where one name only is used and is followed by the words “or approved equal”, the Contractor must use the item named or he is required to apply for a substitution. Where one name only is used, the Contractor must use that item named.

C. Where no specific make of material, apparatus or appliance is mentioned, any first-class product made by a reputable manufacturer may be submitted for Architect and Engineer review.

D. Where the Contractor proposes to use an item that is different from the basis of design in the Drawings and specifications, and that will require the redesign of the structure,

partitions, foundations, piping, wiring or any other component of the mechanical, electrical, or architectural layout, the Contractor shall provide the necessary redesign of those components.

E. Where the Contractor proposes to deviate (provide an equivalent or request for substitution) from the basis of design scheduled equipment or materials as hereinafter specified or shown on the drawings, they are required to submit a requested for substitution in writing. The Contractor shall state in their request whether it is a substitution, equivalent or a non approved equivalent to that specified and the amount of credit or extra cost involved. A copy of said request shall be included in the Base Bid with manufacturer's equipment cuts. The Base Bid shall be based on using the materials and equipment as specified with no exceptions.

F. If an alternative or substitute item results in a difference in quantity and arrangement of piping, ductwork, valves, pumps, insulation, wiring, conduit, and equipment from that specified or indicated on the Drawings, the Contractor shall furnish and install any such additional equipment required by the system, at no additional cost to the Owner including any costs added to other trades due to the equivalent change from the basis of design detailed in the drawings or included within the specifications.

G. Equipment, material or devices submitted for review as an "equivalent" shall meet the following requirements:

1. The equivalent shall have the same construction features such as, but not limited to:
    a. Material thickness, gauge, weight, density, etc.
    b. Welded, riveted, bolted, etc., construction
    c. Finish, undercoating, corrosion protection
2. The equivalent shall perform with the same or better operating efficiency.
3. The equivalent shall be locally represented by the manufacturer for service, parts and technical information.
4. The equivalent shall bear the same labels of performance certification as is applicable to the specified item, such as UL or NEMA labels.

H. Equipment, material or devices submitted for review as a "substitution" shall meet the following requirements:

1. Substitution Request Submittal: Requests for substitution will be considered if received in writing 14 days before the bid date. Requests received later than 14 days before the bid date may be considered or rejected at the discretion of the Engineer/Owner. Once the Contractor submits a complete request for substitution as determined by the engineer, the engineer reserves the right to request the time necessary to evaluate the request for substitution and review it with the Owner.

2. Submit three (3) copies of each request for substitution for consideration.

3. Identify the product, or the fabrication or installation method to be replaced in each request. Include related Specification Section and Drawing numbers. Provide complete documentation showing compliance with the requirements for substitutions, and the following information, as appropriate:

    a. Product Data, including Drawings and descriptions of products, fabrication and installation procedures.

    b. Samples, where applicable or requested.

    c. A detailed comparison of significant qualities of the proposed substitution with those of the Work specified. Significant qualities may include elements such as size, weight, durability, performance and visual effect.

    d. Coordination information, including a list of changes or modifications needed to other parts of the Work and to construction performed by the Owner and separate Contractors that will become necessary to accommodate the proposed substitution.

    e. A statement indicating the substitution's effect on the Contractor's Construction Schedule compared to the schedule without approval of the substitution. Indicate the effect of the proposed substitution on overall Contract Time.

    f. Cost information, including a proposal of the net change, if any in the Contract Sum.

    g. Certification by the Contractor that the substitution proposed is equal-to or better in every significant respect to that required by the Contract Documents, and that it will perform adequately in the application indicated. Include the Contractor's waiver of rights to additional payment or time that may subsequently become necessary because of the failure of the substitution to perform adequately.

h. Engineer's Action: Within one week of receipt of the request for substitution, the Engineer will notify the Contractor of acceptance or rejection of the proposed substitution. If a decision on use of a proposed substitute cannot be made or obtained within the time allocated, use the product specified by name. Acceptance of a product substitution will be in the form of an Addendum.

i. Other Conditions: The Contractor's substitution request will be received and considered by the Engineer when one or more of the following conditions are satisfied, as determined by the Engineer; otherwise requests will be returned without action except to record noncompliance with these requirements.

1) The request is directly related to an "or equal" clause or similar language in the Contract Documents.

2) The specified product or method of construction cannot be provided within the Contract Time. The request will not be considered if the product or method cannot be provided as a result of failure to pursue the Work promptly or coordinate activities properly.

3) A substantial advantage is offered the Owner, in terms of cost, time, energy conservation or other considerations of merit, after deducting offsetting responsibilities the Owner may be required to bear. Additional responsibilities for the Owner may include additional compensation to the Engineer for redesign and evaluation services, increased cost of other construction by the Owner or separate Contractors, and similar considerations.

1.10 SUBMITTAL PROCEDURES

A. Provide Submittals in accordance with the requirements of Division 1 and as indicated in the following.

B. Coordination: Coordinate preparation and processing of submittals with performance of construction activities. Transmit each submittal sufficiently in advance of performance of related construction activities to avoid delay.

1. Coordinate each submittal with fabrication, purchasing, testing, delivery, other submittals and related activities that require sequential activity.

2. Coordinate transmittal of different types of submittals for related elements of the Work so processing will not be delayed by the need to review submittals

concurrently for coordination. The Engineer reserves the right to withhold action on a submittal requiring coordination with other submittals until related submittals are received.

C. Processing: Allow sufficient review time so that installation will not be delayed as a result of the time required to process submittals, including time for resubmittals.

1. Allow two weeks for initial review. Allow additional time if processing must be delayed to permit coordination with subsequent submittals. The Engineer will promptly advise the Contractor when a submittal being processed must be delayed for coordination.

2. If an intermediate submittal is necessary, process the same as the initial submittal.

3. Allow two weeks for reprocessing each submittal.

4. No extension of Contract Time will be authorized because of failure to transmit submittals to the Engineer sufficiently in advance of the Work to permit processing.

D. Submittal Preparation: Place a permanent label or title block on each submittal for identification. Indicate the name of the entity that prepared each submittal on the label or title block. Submittals shall be arranged in order of specification sections.

1. Include the following information on the label for processing and recording action taken.

a. Project name.

b. Date.

c. Name and address of Engineer.

d. Name and address of Contractor.

e. Name and address of subcontractor.

f. Name and address of supplier.

g. Name of manufacturer.

h. Number, title and paragraph of appropriate Specification Section.

i. Drawing number and detail references, as appropriate.

E. Submittal Transmittal: Package each submittal appropriately for transmittal and handling. Transmit each submittal from Contractor to Engineer using a transmittal form. Submittals received from sources other than the Contractor will be returned without action. On the transmittal, record relevant information and requests for data. On the form, or separate sheet, record deviations from Contract Document requirements, including minor variations and limitations. Include Contractor's certification that information complies with Contract Document requirements.

F. Except for submittals for record, information or similar purposes, the Engineer will review each submittal, mark to indicate action taken, and return promptly. Compliance with specified characteristics is the Contractor's responsibility.

G. Action Stamp: The Engineer will stamp each submittal with a uniform, self-explanatory action stamp. The stamp will be appropriately marked, to indicate the action taken.

1.11 SHOP DRAWINGS

A. Submit neatly prepared information, drawn to accurate scale. Highlight, encircle, or otherwise indicate deviations from the Contract Documents. Do not reproduce Contract Documents or copy standard information as the basis of Shop Drawings. Standard information prepared without specific reference to the Project is not considered Shop Drawings.

B. The Contractor shall submit for review detailed shop drawings of all equipment and material specified in each section and coordinated ductwork layouts. No material or equipment may be delivered to the job site or installed until the Contractor has received shop drawings for the particular material or equipment which have been properly reviewed. Shop drawings shall be submitted within 60 days after award of Contract before any material or equipment is purchased. The Contractor shall submit for review copies of all shop drawings to be incorporated in the Mechanical Contract. Refer to Division 1 for the quantity of copies required for submission. Where quantities are not specified, provide seven (7) copies for review.

C. Provide shop drawings for all devices specified under equipment specifications for all systems. Shop drawings shall include manufacturers' names, catalog numbers, cuts, diagrams, dimensions, identification of products and materials included, compliance with specified standards, notation of coordination requirements, notation of dimensions established by field measurement and other such descriptive data as may be required to identify and accept the equipment. A complete list in each category (example: all fixtures), of all shop drawings, catalog cuts, material lists, etc., shall be submitted to the

Engineer at one time. No consideration will be given to a partial shop drawing submittal.

D. When a submittal could involve more than one trade, e.g., valves, piping, etc., the submitted shall be separated by traded involved, ie. HVAC, plumbing, fire protection, etc.

E. Where multiple quantities or types of equipment are being submitted, provide a cover sheet (with a list of contents) on the submittal identifying the equipment or material being submitted.

F. The Contractor shall furnish all necessary templates, patterns, etc., for installation work and for the purpose of making adjoining work conform; furnish setting plans and shop details to other trades as required.

G. "No Exception Taken" rendered on shop drawings shall not be considered as a guarantee of measurements or building conditions. Where drawings are reviewed, review does not mean that drawings have been checked in detail; said approval does not in any way relieve the Contractor from his responsibility or necessity of furnishing material or performing work as required by the Contract Drawings and Specifications. Verify available space prior to submitting shop drawings. Review of shop drawings shall not apply to quantity of material.

H. After shop drawings have been reviewed, with no exceptions taken, no further changes will be allowed without the written consent of the Engineer.

I. Shop drawing submittal sheets which may show items that are not being furnished shall have those items crossed off to clearly indicate which items will be furnished.

J. Bidders shall not rely on any verbal clarification of the Drawings and/or Specifications. Any questions shall be referred to the Engineer in writing at least five (5) working days prior to Bidding to allow for issuance of an Addendum.

K. Do not use Shop Drawings without an appropriate final stamp indicating action taken in connection with construction.

L. Prepare sheetmetal and sprinkler shop drawings drawn in the latest Revit version at 1 to 1 (full) scale and submit hard copy print plotted at ¼" = 1' -0". Final approved drawings shall be turned over to the Owner on USB flash drive.

1.12 COORDINATION DRAWINGS

A. Prepare coordination drawings drawn in the latest Revit version in accordance with Division 1, at 1 to 1 (full) scale and submit hard copy plotted at ¼" = 1' -0" detailing major elements, components, and systems of mechanical equipment and materials in relationship with other systems, installations, and building components. Indicate locations where space is limited for installation and access and where sequencing and coordination of installations are of importance to the efficient flow of the Work, including (but not necessarily limited to) the following:

1. The Contractor shall indicate the proposed locations of piping, conduit, ductwork, equipment, and materials. Include the following:

a. Clearances for servicing and maintaining equipment, including tube removal, filter removal, and space for equipment disassembly required for periodic maintenance.

b. Equipment connections and support details.

c. Exterior wall and foundation penetrations.

d. Fire-rated wall and floor penetrations.

e. Sizes and locations of required concrete pads and bases.

B. Indicate scheduling, sequencing, movement, and positioning of large equipment into the building during construction.

C. Prepare floor plans, elevations, and details to indicate penetrations in floors, walls, and ceilings and their relationship to other penetrations and installations.

D. Prepare reflected ceiling plans to coordinate and integrate installations, air outlets and inlets, light fixtures, communication systems components, sprinklers, and other ceiling-mounted items.

E. The Contractor and each subcontractor shall sign and date each coordination drawing prior to submission.

F. Work shall not be performed until coordination drawings have been approved by the architect and engineer.

G. Electronic copies of the MEP floor plans are available to use as a basis for preparing coordination drawings and can be provided by the Engineer. If the Contractor elects to

obtain the Engineers electronic files an Electronic Drawing File Release Form must be submitted with payment. This form must be signed by the Contractor, Owner, and Architect. Upon receipt of a signed copy of the Electronic Drawing File Release Form, and payment, the Engineer will provide copies of the electronic files for the Contractor's use. A copy of the Electronic Drawing File Release Form is appended to the end of this specification section

1.13 COORDINATION WITH OTHER DIVISIONS

A. All work shall be carried out in conjunction with other trades and full cooperation shall be given in order that all work may proceed with a minimum of delay and interference. Particular emphasis is placed on timely installation of major apparatus and furnishing other Contractors, especially the Contractor or Construction Manager, with information as to openings, chases, sleeves, bases, inserts, equipment locations, panels, etc., required by other trades.

B. The Contractors are required to examine all of the Project Drawings and mutually arrange work so as to avoid interference with the work of other trades. In general, ductwork, HVAC piping, sprinkler piping and drainage lines take precedence over water, gas and electrical conduits. The Engineer shall make final decisions regarding the arrangement of work which cannot be agreed upon by the Contractors.

C. Where the work of the Contractor will be installed in close proximity to or will interfere with work of other trades, the Contractors will cooperate in working out space conditions to make a satisfactory adjustment.

D. If the work under a Section is installed before coordinating with other Divisions or Sections or so as to cause interference with work of other Sections, the necessary changes to correct the condition shall be made by the Contractor causing the interference without extra charge to the Owner.

1.14 WORKMANSHIP

A. Service Support: The equipment items shall be supported by service organizations which are reasonably convenient to the equipment installation in order to render satisfactory service to the equipment on a regular and emergency basis during the warranty period of the contract.

B. Modification of References: In each of the publications referred to herein, consider the advisory provisions to be mandatory, as though the word, "shall" had been substituted for "should" wherever it appears.

C. The Contractor shall furnish the services of an experienced superintendent who shall be constantly in charge of the installation of the work together with all skilled workmen, fitters, metal workers, welders, helpers and laborers required to unload, transfer, erect, connect, adjust, start, operate and test each system.

D. Unless otherwise specifically indicated on the Drawings or Specifications, all equipment and materials shall be installed with the acceptance of the Engineer and in accordance with the recommendations of the manufacturer. This includes the performance of such tests as the manufacturer recommends.

E. All labor for installation of mechanical systems shall be performed by experienced, skilled tradesmen under the supervision of a licensed journeyman foreman. All work shall be of a quality consistent with good trade practice and shall be installed in a neat, workmanlike manner. The Engineer reserves the right to reject any work which, in his opinion, has been installed in a substandard, dangerous or unserviceable manner. The Contractor shall replace said work in a satisfactory manner at no extra cost to the Owner.

1.15 SHUTDOWNS

A. When installation of a new system requires the temporary shutdown of an existing operating system, the connection of the new system shall be performed at such time as designated by the Owner.

B. The Engineer and the Owner shall be notified in writing of the estimated duration of the shutdown period at least ten (10) days in advance of the date the work is to be performed.

C. Work shall be arranged for continuous performance whenever possible. The Contractor shall provide all necessary labor, including overtime if required, to assure that existing operating services will be shut down only during the time actually required to make necessary connections.

1.16 TEMPORARY UTILITIES

A. General: Provide new materials and equipment; if acceptable to the Engineer, undamaged previously used materials in serviceable condition may be used. Provide materials suitable for the use intended.

B. Conditions of Use: Keep temporary services and facilities clean and neat in appearance. Operate in a safe and efficient manner. Take necessary fire prevention measures. Do not overload facilities, or permit them to interfere with progress. Do not allow hazardous dangerous or unsanitary conditions, or public nuisances to develop or persist on the site.

C. First Aid Supplies: Comply with governing regulations.

D. Fire Extinguishers: Provide hand-carried, portable UL-rated, class "A" fire extinguishers for temporary offices and similar spaces. In other locations provide hand-carried, portable, UL-rated, class "ABC" dry chemical extinguishers, or a combination of extinguishers of NFPA recommended classes for the exposures.

E. Utilities: Engage the appropriate local utility company to install temporary service or connect to existing service. Where the company provides only part of the service, provide the remainder with matching, compatible materials and equipment; comply with the company's recommendations.

1. Use Charges: Cost or use charges for temporary facilities are not chargeable to the Owner or Engineer, and will not be accepted as a basis of claims for a Change Order.

F. Water Service: Install water service and distribution piping of sizes and pressures adequate for construction until permanent water service is in use.

G. Temporary Heat-Cool-Dehumidification: Provide temporary services required by construction activities, for curing or drying of completed installations or protection of installed construction from adverse effects of low temperatures or high humidity. Select safe equipment that will not have a harmful effect on completed installations or elements being installed. Coordinate temporary services to produce the ambient condition required and minimize consumption of energy. The building’s permanent HVAC systems shall not be used for these purposes.

H. Environmental Protection: Provide protection, operate temporary facilities and conduct construction in ways and by methods that comply with environmental regulations, and

minimize the possibility that air, waterways and subsoil might be contaminated or polluted, or that other undesirable effects might result. Avoid use of tools and equipment which produce harmful noise. Restrict use of noise making tools and equipment to hours that will minimize complaints from persons or firms near the site.

I. Termination and Removal: Unless the Engineer requires that it be maintained longer, remove each temporary facility when the need has ended, or when replaced by authorized use of a permanent facility, or no later than Substantial Completion. Complete or, if necessary, restore permanent construction that may have been delayed because of interference with the temporary facility. Repair damaged Work, clean exposed surfaces and replace construction that cannot be satisfactorily repaired. Materials and facilities that constitute temporary facilities are property of the Contractor. The Owner reserves the right to take possession of Project identification signs.

1.17 PROTECTION OF MATERIALS AND EQUIPMENT

A. Work under each Section shall include protecting the work and material of all other Sections from damage by work or workmen and shall include making good all damage thus caused.

B. The Contractor shall be responsible for work and equipment until the facility has been accepted by the Owner. Protect work against theft, injury or damage and carefully store material and equipment received on site which is not immediately installed. Close open ends of work with temporary covers or plugs during construction to prevent entry of foreign material.

C. Work under each Section includes receiving, unloading, uncrating, storing, protecting, setting in place and completely connecting equipment supplied under each Section. Work under each Section shall also include exercising special care in handling and protecting equipment and fixtures, and shall include the cost of replacing any of the equipment and fixtures which are missing or damaged.

D. Equipment and material stored on the job site shall be protected from the weather, vehicles, dirt and/or damage by workmen or machinery. Insure that all electrical or absorbent equipment or material is protected from moisture during storage.

1.18 ADJUSTING AND TESTING

A. After all the equipment and accessories to be furnished are in place, they shall be put in final adjustment and subjected to such operating tests so as to assure the Engineer that they are in proper adjustment and in satisfactory, permanent operating condition.

B. Where requested by the Engineer, a factory-trained service representative shall inspect the installation and assist in the initial startup and adjustment to the equipment. The period of these services shall be for such time as necessary to secure proper installation and adjustments. After the equipment is placed in permanent operation, the service representative shall supervise the initial operation of the equipment and instruct personnel responsible for operation and maintenance of the equipment. The service representative shall notify the Contractor in writing that the equipment was installed according to manufacturer's recommendations and is operating as intended by the manufacturer.

1.19 CLEANING

A. The Contractor shall thoroughly clean and flush all piping, ducts and equipment of all foreign substances, oils, burrs, solder, flux, etc., inside and out before being placed in operation.

B. If any part of a system should be stopped or damaged by any foreign matter after being placed in operation, the system shall be disconnected, cleaned and reconnected wherever necessary to locate and/or remove obstructions. Any work damaged in the course of removing obstructions shall be repaired or replaced when the system is reconnected at no additional cost to the Owner.

C. During the course of construction, all ducts and pipes shall be capped in an acceptable manner to insure adequate protection against the entrance of foreign matter.

D. Upon completion of all work under the Contract, the Contractor shall remove from the premises all rubbish, debris and excess materials left over from his work. Any oil or grease stains on floor areas caused by the Contractor shall be removed and floor areas left clean.

E. Complete the following cleaning operations before requesting inspection for Certification of Substantial Completion.

1. Remove labels that are not permanent labels.

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

3. Clean exposed exterior and interior hard-surfaced finishes to a dust-free condition, free of stains, films and similar foreign substances. Restore reflective surfaces to their original reflective condition. Leave concrete floors broom clean. Vacuum carpeted surfaces.

4. Wipe surfaces of mechanical and electrical equipment. Remove excess lubrication and other substances. Clean plumbing fixtures to a sanitary condition. Clean light fixtures and lamps.

F. Comply with regulations of authorities having jurisdiction and safety standards for cleaning. Do not burn waste materials. Do not bury debris or excess materials on the Owner's property. Do not discharge volatile, harmful or dangerous materials into drainage systems. Remove and dispose of ALL waste materials, packaging material, skids etc. from the site and dispose of in a lawful manner in accordance with municipal, state and federal regulations.

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

1.20 OPERATING AND MAINTENANCE

A. Upon completion of all work and tests, the Contractor shall furnish the necessary skilled labor and helpers for operating his system and equipment for a period specified under each applicable Section of this Division. During this period, he shall fully instruct the Owner or the Owner’s representative in the operation, adjustment and maintenance of all equipment furnished. The Contractor shall give at least seven (7) days notice to the Owner and the Engineer in advance of this period.

B. The Contractor shall include the maintenance schedule for the principal items of equipment furnished under this Division.

C. The Contractor shall physically demonstrate procedures for all routine maintenance of all equipment furnished under each respective Section to assure accessibility to all devices.

D. An authorized manufacturer's representative shall attest in writing that the equipment has been properly installed prior to startup of any major equipment. The following equipment will require this inspection: pumps; air conditioning equipment, controls, air handling equipment, compressors, boilers etc. These letters shall be bound into the operating and maintenance books.

E. Refer to individual trade Sections for any other particular requirements related to operating instructions.

F. Demonstration shall be recorded on USB Flash drive turned over to the Owner.

1.21 OPERATING AND MAINTENANCE MANUALS

A. Prepare operating and maintenance manuals in accordance with the requirements of Division 1 and as follows. The Contractor shall prepare six (6) copies of a complete maintenance and operating instructions manual, bound in booklet form. Organize operating and maintenance data into suitable sets of manageable size. Bind properly indexed data in individual heavy-duty 3-ring vinyl-covered binders, with pocket folders for folded sheet information and designation partitions with identification tabs. Mark appropriate identification on front and spine of each binder.

B. Manual shall include the following:

1. Description of function, normal operating characteristics and limitations, performance curves, engineering data and tests, and complete nomenclature and commercial numbers of replacement parts.

2. Manufacturer's printed operating procedures to include start-up, break-in, and routine and normal operating instructions; regulation, control, stopping, shutdown, and emergency instructions; and summer and winter operating instructions.

3. Maintenance procedures for routine preventative maintenance and troubleshooting; disassembly, repair, and reassembly; aligning and adjusting instructions.

4. Servicing and operating instructions including lubrication charts and schedules.

5. Emergency and safety instructions.

6. Spare parts list.

7. Copies of warranties.

8. Wiring diagrams.

9. Recommended "turn around" cycles.

10. Inspection procedures.

11. Approved Shop Drawings and Product Data.

12. Equipment Start-up Reports.

13. Temperature control diagrams and written sequences of operations.

14. Balance reports.

C. Include in the manual, a tabulated equipment schedule for all equipment. Schedule shall include pertinent data such as: make, model number, serial number, voltage, normal operating current, belt size, filter quantities and sizes, bearing number, etc. Schedule shall include maintenance to be done and frequency.

D. Maintenance and instruction manuals shall be submitted to the Owner at the same time as the seven (7) day notice is given prior to the instruction period.

1.22 ACCEPTANCES

A. The equipment, materials, workmanship, design and arrangement of all work installed under the Mechanical Sections shall be subject to the review of the Engineer.

B. Within 30 days after the awarding of a Contract, the Mechanical Contractor shall submit to the Engineer, for review, a list of manufacturers of equipment proposed for the work under the Mechanical Sections. The intent to use the exact manufacturers and models specified does not relieve the Contractor of the responsibility of submitting such a list.

C. If extensive or unacceptable delivery time is expected on a particular item of equipment specified, the Contractor shall notify the Owner and Engineer, in writing, within 30 days of award of the Contract. In such instances, equipment substitutions may be made pending acceptance by the Engineer or the Owner’s representative.

D. Where any specific material, process or method of construction or manufactured article is specified by reference to the catalog number of a manufacturer, the Specifications are to be used as a guide and are not intended to take precedence over the basic duty and performance specified or noted on the Drawings. In all cases, the Mechanical Contractor shall verify the duty specified with the specific characteristics of the

equipment offered for review. Equipment characteristics are to be used as mandatory requirements where the Contractor proposes to use an acceptable equivalent.

E. If material or equipment is installed before it is reviewed and/or approved, the Contractor shall be liable for its removal and replacement at no extra charge to the Owner if, in the opinion of the Engineer, the material or equipment does not meet the intent of, or standard of quality implied by, the Drawings and Specifications.

F. Failure on the part of the Engineer to reject shop drawings or to reject work in progress shall not be interpreted as acceptance of work not in conformance with the Drawings and/or Specifications. Work not in conformance with the Drawings and/or Specifications shall be corrected whenever it is discovered.

1.23 RECORD DRAWINGS

A. General: Do not use record documents for construction purposes; protect from deterioration and loss in a secure, fire-resistive location; provide access to record documents for the Engineer's reference during normal working hours.

B. Maintain a clean, undamaged set of blue or black line white-prints of Contract Drawings and Shop Drawings. Mark the set to show the actual installation where the installation varies substantially from the Work as originally shown. Mark whichever drawing is most capable of showing conditions fully and accurately. Give particular attention to concealed elements that would be difficult to measure and record at a later date. Items to be indicated include but are not limited to:

1. Dimensional change
2. Revision to drawing detail
3. Location and depth of underground utility
4. Revision to pipe routing
5. Revision to electrical circuitry
6. Actual equipment location
7. Duct size and routing
8. Location of concealed internal utility
9. Changes made by Change Order

10. Details not on original Contract Drawing

11. Information on concealed elements which would be difficult to identify or measure later

C. Mark record sets with red erasable pencil; use other colors to distinguish between variations in separate categories of the Work.

D. Mark new information that is important to the Owner, but was not shown on Contract Drawings or Shop Drawings.

E. Note related Change Order numbers where applicable.

F. Organize record drawing sheets into manageable sets, bind with durable paper cover sheets, and print suitable titles, dates and other identification on the cover of each set.

G. These shall be clearly marked for Record Drawings on a clean set of reproducible paper copies at the completion of the work and turned over to the Owner.

H. Final record documents shall be prepared in the latest Revit version and on USB Flash drive of all drawings and a clean set of reproducible paper copies shall be turned over to the Owner at the completion of the work.

1.24 WARRANTIES AND BONDS

A. The following general administrative and procedural requirements for warranties and bonds required by the Contract Documents, including manufacturers standard warranties on products and special warranties are to be included:

1. General close-out requirements included in Division 1.

2. Specific requirements for warranties for the Work and products and installation that are specified to be warranted, are included in the individual Sections of Divisions-2 through -50.

3. Certifications and other commitments and agreements for continuing services to Owner are specified elsewhere in the Contract Documents.

B. Disclaimers and Limitations: Manufacturer's disclaimers and limitations on product warranties do not relieve the Contractor of the warranty on the Work that incorporates the products, nor does it relieve suppliers, manufacturers, and subcontractors required to countersign special warranties with the Contractor.

C. Separate Prime Contracts: Each prime Contractor is responsible for warranties related to its own Contract.

1.25 WARRANTY REQUIREMENTS

A. Related Damages and Losses: When correcting warranted Work that has failed, remove and replace other Work that has been damaged as a result of such failure or that must be removed and replaced to provide access for correction of warranted Work.

B. Reinstatement of Warranty: When Work covered by a warranty has failed and been corrected by replacement or rebuilding, reinstate the warranty by written endorsement. The reinstated warranty shall be equal to the original warranty with an equitable adjustment for depreciation.

C. Replacement Cost: Upon determination that Work covered by a warranty has failed, replace or rebuild the Work to an acceptable condition complying with requirements of Contract Documents. The Contractor is responsible for the cost of replacing or rebuilding defective Work regardless of whether the Owner has benefited from use of the Work through a portion of its anticipated useful service life.

D. Owner's Recourse: Written warranties made to the Owner are in addition to implied warranties, and shall not limit the duties, obligations, right and remedies otherwise available under the law, nor shall warranty periods be interpreted as limitations on time in which the Owner can enforce such other duties, obligations, rights, or remedies.

E. Rejection of Warranties: The Owner reserves the right to reject warranties and to limit selections to products with warranties not in conflict with requirements of the Contract Documents.

F. The Owner reserves the right to refuse to accept Work for the Project where a special warranty, certification, or similar commitment is required on such Work or part of the Work, until evidence is presented that entities required to countersign such commitments are willing to do so.

G. Submit written warranties to the Engineer prior to the date certified for Substantial Completion. If the Engineer's Certificate of Substantial Completion designates a commencement date for warranties other than the date of Substantial Completion for the Work, or a designated portion of the Work, submit written warranties upon request of the Engineer.

H. When a designated portion of the Work is completed and occupied or used by the Owner, by separate agreement with the Contractor during the construction period, submit properly executed warranties to the Engineer within fifteen days of completion of that designated portion of the Work.

I. When a special warranty is required to be executed by the Contractor, or the Contractor and a subcontractor, supplier or manufacturer, prepare a written document that contains appropriate terms and identification, ready for execution by the required parties. Submit a draft to the Owner through the Engineer for approval prior to final execution.

1. Refer to individual Sections of Divisions-1 through -50 for specific content requirements, and particular requirements for submittal of special warranties.

J. Form of Submittal: At Final Completion compile two copies of each required warranty and bond properly executed by the Contractor, or by the Contractor, subcontractor, supplier, or manufacturer. Organize the warranty documents into an orderly sequence based on the table of contents of the Project Manual.

K. Bind warranties and bonds in heavy-duty, commercial quality, durable 3-ring vinyl covered loose-leaf binders, thickness as necessary to accommodate contents, and sized to receive 8-1/2" by 11" paper.

1. Provide heavy paper dividers with celluloid covered tabs for each separate warranty. Mark the tab to identify the product or installation. Provide a typed description of the product or installation, including the name of the product, and the name, address and telephone number of the installer.

2. Identify each binder on the front and the spine with the typed or printed title "WARRANTIES AND BONDS," the Project title or name, and the name of the Contractor.

3. When operating and maintenance manuals are required for warranted construction, provide additional copies of each required warranty, as necessary, for inclusion in each required manual.

1.26 GUARANTEES

A. The Contractor shall guarantee all material and workmanship under these Specifications and the Contract for a period of one (1) year from the date of final acceptance by Owner. During this guarantee period, all defects developing through faulty equipment, materials or workmanship shall be corrected or replaced immediately by this Contractor

without expense to the Owner. Such repairs or replacements shall be made to the Engineer's satisfaction.

B. Contractor shall provide name, address, and phone number of all contractors and subcontractors and associated equipment they provided.

1.27 PROJECT CLOSE-OUT

A. Section 01 40 00 - Quality Requirements, Section 01 73 00 - Execution and Section 017700 Closeout Procedures.

B. Submit specific warranties, workmanship bonds, maintenance agreements, final certifications and similar documents in accordance with Division 1.

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

D. Complete start-up testing of systems, including measuring and documenting all required startup checklist requirements documented in installation and maintenance instructions by the equipment manufacturer, and instruction of the Owner's operating and maintenance personnel. Discontinue or change over and remove temporary facilities from the site, along with construction tools, mock-ups, and similar elements.

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

F. Field Observation Procedures: On receipt of a request for an Engineers Field Observation, the Engineer will advise the Contractor of unfulfilled requirements. The Engineer will advise the Contractor of construction that must be completed or corrected before the certificate will be issued.

1. The Engineer will repeat the Field Observation when requested and assured that the Work has been substantially completed.

2. Results of the completed list of unfulfilled items will form the basis of requirements for final acceptance.

END OF SECTION 23 0400

Electronic Drawing File Release Form

DELIVERY OF FILES FOR: _____

Project Name

In accepting and utilizing any drawings or other data on any form of electronic media generated and provided by the Design Professional, the Client covenants and agrees that all such drawings and data are instruments of service of the Design Professional, who shall be deemed the author of the drawings and data, and shall retain all common law, statutory law and other rights, including copyrights.

The Client further agrees not to use these drawings and data, in whole or in part, for any purpose or project other than the project which is the subject of this Agreement. The Client agrees to waive all claims against the Design Professional resulting in any way from any unauthorized changes or reuse of the drawings and data for any other project by anyone other than the Design Professional.

In addition, the Client agrees, to the fullest extent permitted by law, to indemnify and hold the Design Professional harmless from any damage, liability or cost, including reasonable attorneys' fees and costs of defense, arising from any changes made by anyone other than the Design Professional or from any reuse of the drawings and data without the prior written consent of the Design Professional.

Under no circumstances shall transfer of the drawings and other instruments of service on electronic media for use by the Client be deemed a sale by the Design Professional, and the Design Professional makes no warranties, either express or implied, of merchantability and fitness for any particular purpose.

_____ _____

Client's Signature Date

_____

Company - Title

_____ _____

Architects' Signature Date

_____

Firm - Title

_____ _____

Owner's Signature Date

_____

Company - Title

SECTION 23 0500 - COMMON WORK RESULTS FOR HVAC

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
1. Identification for HVAC Piping and Equipment.
2. Sleeves.
3. Mechanical sleeve seals.
4. Formed steel channel.

1.2 RELATED SECTIONS

A. 23 0553 - Identification for HVAC Piping and Equipment

1.3 SUBMITTALS

A. Shop Drawings: Submit for piping and equipment identification list of wording, symbols, letter size, and color coding for pipe identification and valve chart and schedule, including valve tag number, location, function, and valve manufacturer's name and model number.

B. Product Data for Pipe and Equipment Identification: Submit for mechanical identification manufacturers catalog literature for each product required.

1.4 QUALITY ASSURANCE

A. Perform Work in accordance with State of Connecticut building code standards and all applicable referenced codes.

B. Maintain one copy of each document on site.

PART 2 PRODUCTS

2.1 SLEEVES

A. Sleeves for Pipes Through Non-fire Rated Floors: 18 gage thick galvanized steel.

B. Sleeves for Pipes Through Non-fire Rated Beams, Walls, Footings, and Potentially Wet Floors: Steel pipe or 18 gage thick galvanized steel.

C. Sleeves for Round Ductwork: Galvanized steel.

D. Sleeves for Rectangular Ductwork: Galvanized steel or wood.

E. Sealant: Acrylic

2.2 MECHANICAL SLEEVE SEALS

A. Manufacturers:
1. Thunderline Link-Seal, Inc.
2. Fernco
3. BWM
4. Substitutions: Division 01, Section 012300 Alternates, Section 012500 – Substitution Procedures – Substitution Request Form and Section 016000 - Product Requirements

B. Product Description: Modular mechanical type, consisting of interlocking synthetic rubber links shaped to continuously fill annular space between object and sleeve, connected with bolts and pressure plates causing rubber sealing elements to expand when tightened, providing watertight seal and electrical insulation.

2.3 FORMED STEEL CHANNEL

A. Manufacturers:
1. Allied Tube & Conduit Corp.
2. B-Line Systems
3. Unistrut Corp.
4. Substitutions: Division 01, Section 012300 Alternates, Section 012500 – Substitution Procedures – Substitution Request Form and Section 016000 - Product Requirements

B. Product Description: Galvanized 12 gage) thick steel. With holes 1-1/2 inches on center.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify openings are ready to receive sleeves.

3.2 INSTALLATION - PIPING AND EQUIPMENT IDENTIFICATION

A. Install plastic nameplates with adhesive.

B. Install plastic tags with corrosion resistant metal chain.

3.3 INSTALLATION - SLEEVES

A. Exterior watertight entries: Seal with mechanical sleeve seals.

B. Set sleeves in position in forms. Provide reinforcing around sleeves.

C. Size sleeves large enough to allow for movement due to expansion and contraction. Provide for continuous insulation wrapping.

D. Extend sleeves through floors 1 inch above finished floor level. Caulk sleeves.

E. Where piping or ductwork penetrates floor, ceiling, or wall, close off space between pipe or duct and adjacent work with firestopping insulation and caulk airtight. Provide close fitting metal collar or escutcheon covers at both sides of penetration.
   1. Section 07 84 13 – Penetration Firestopping: Product requirements for firestopping for placement by this section.
   2. Section 07 84 46 – Fire-Resistive Joint Systems: Product requirements for firestopping for placement by this section.

F. Install chrome plated steel escutcheons at finished surfaces.

END OF SECTION 23 0500

SECTION 23 0523 - GENERAL-DUTY VALVES FOR HVAC PIPING

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
1. Gate valves.
2. Globe valves.
3. Ball valves.
4. Plug valves.
5. Butterfly valves.
6. Check valves.

B. Related Sections:
1. Section 23 04 00 – General Conditions for Mechanical Trades
2. Section 23 05 29 - Hangers and Supports for HVAC Piping and Equipment: Product and installation requirements for pipe hangers and supports.
3. Section 23 07 00 - HVAC Insulation: Product and installation requirements for insulation for valves.
4. Section 23 21 13 - Hydronic Piping: Product and installation requirements for piping used in hydronic piping systems.
5. Section 23 21 16 - Hydronic Piping Specialties: Product and installation requirements for piping specialties used in hydronic piping systems.

1.2 REFERENCES

A. ASTM International:
1. ASTM A216/A216M - Standard Specification for Steel Castings, Carbon, Suitable for Fusion Welding, for High-Temperature Service.
2. ASTM D1785 - Standard Specification for Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC) Compounds.
3. ASTM D4101 - Standard Specification for Propylene Injection and Extrusion Materials.

B. Manufacturers Standardization Society of the Valve and Fittings Industry:
1. MSS SP 67 - Butterfly Valves.
2. MSS SP 70 - Cast Iron Gate Valves, Flanged and Threaded Ends.
3. MSS SP 71 - Cast Iron Swing Check Valves, Flanged and Threaded Ends.
4. MSS SP 78 - Cast Iron Plug Valves, Flanged and Threaded Ends.
5. MSS SP 80 - Bronze Gate, Globe, Angle and Check Valves.
6. MSS SP 85 - Cast Iron Globe & Angle Valves, Flanged and Threaded.
7. MSS SP 110 - Ball Valves Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends.

C. Underwriters Laboratories Inc.:
   1. UL 842 - Valves for Flammable Fluids.

1.3 SUBMITTALS

A. Section 01 33 05 - Submittal Procedures: Requirements for submittals.

B. Product Data: Submit manufacturers catalog information with valve data and ratings for each service.

C. Manufacturer's Installation Instructions: Submit hanging and support methods, joining procedures.

D. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

1.4 CLOSEOUT SUBMITTALS

A. Section 01 73 00 - Execution and Section 017700 - Closeout Procedures: Requirements for submittals.

B. Project Record Documents: Record actual locations of valves.

C. Operation and Maintenance Data: Submit installation instructions, spare parts lists, exploded assembly views.

1.5 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing Products specified in this section with minimum three years experience.

1.6 PRE-INSTALLATION MEETINGS

A. Section 01 30 00 - Administrative Requirements: Pre-installation meeting.

B. Convene minimum one week prior to commencing work of this section.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Section 01 60 00 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.

B. Accept valves on site in shipping containers with labeling in place. Inspect for damage.

C. Provide temporary protective coating on cast iron and steel valves.

1.8 ENVIRONMENTAL REQUIREMENTS

A. Section 01 60 00 - Product Requirements: Environmental conditions affecting products on site.

B. Do not install valves underground when bedding is wet or frozen.

1.9 WARRANTY

A. Section 01 73 00 - Execution and Section 017700 - Closeout Procedures: Requirements for warranties.

B. Furnish one year manufacturer warranty for valves excluding packing.

C. Warranty shall include labor and materials for a minimum period of two (2) years unless otherwise specified. Warranty starts at date of Commissioning acceptance of a complete system and Owner approval

1.10 EXTRA MATERIALS

A. Section 01 73 00 - Execution and Section 017700 - Closeout Procedures: Requirements for extra materials.

B. Furnish two packing kits for each size valve.

PART 2 PRODUCTS

2.1 GATE VALVES

A. Manufacturers:
1. Crane Valve, North America
2. Victaulic
3. Milwaukee Valve Company
4. NIBCO, Inc.
5. Stockham Valves & Fittings
6. Watts Model
7. N-Vent Model
8. Substitutions: Division 01, Section 012300 Alternates, Section 012500 – Substitution Procedures – Substitution Request Form and Section 016000 - Product Requirements

B. GA-1 2 inches and Smaller: MSS SP 80, bronze body, bronze trim, union bonnet, rising stem, hand-wheel, inside screw, solid wedge disc, alloy seat rings, solder or threaded ends.

C. GA-2 2-1/2 inches and Larger: MSS SP 70, cast iron body, bronze trim, bolted bonnet, rising stem, hand-wheel, outside screw and yoke, solid wedge disc with bronze seat rings, flanged ends. Furnish chain-wheel operators for valves 6 inches and larger mounted over 8 feet above floor.

2.2 GLOBE VALVES

A. Manufacturers:
1. Crane Valve, North America
2. Victaulic
3. Milwaukee Valve Company
4. NIBCO, Inc.
5. Stockham Valves & Fittings
6. Watts
7. N-Vent
8. Substitutions: Division 01, Section 012300 Alternates, Section 012500 – Substitution Procedures – Substitution Request Form and Section 016000 - Product Requirements

B. GL-1 2 inches and Smaller: MSS SP 80, bronze body, bronze trim, union bonnet, hand wheel, Buna-N composition disc, solder or threaded ends.

C. GL-2 2-1/2 inches and Larger: MSS SP 85, cast iron body, bronze trim, hand wheel, outside screw and yoke, flanged ends. Furnish chain-wheel operators for valves 6 inches and larger mounted over 8 feet above floor.

2.3 BALL VALVES

A. Manufacturers:
1. Crane Valve, North America
2. Victaulic
3. Milwaukee Valve Company
4. NIBCO, Inc. Stockham Valves & Fittings
5. Watts
6. N-Vent
7. Substitutions: Division 01, Section 012300 Alternates, Section 012500 – Substitution Procedures – Substitution Request Form and Section 016000 - Product Requirements

B. BA-1 2 inches and Smaller: MSS SP 110, bronze, two piece body, chrome plated bronze ball, regular port, teflon seats, blow-out proof stem, solder or threaded ends with union, extended lever handle.

2.4 BUTTERFLY VALVES

A. Manufacturers:
1. Crane Valve, North America
2. Milwaukee Valve Company
3. NIBCO, Inc.
4. Stockham Valves & Fittings
5. Victaulic
6. Substitutions: Division 01, Section 012300 Alternates, Section 012500 – Substitution Procedures – Substitution Request Form and Section 016000 - Product Requirements

B. BF-1 2-1/2 inches and Larger: MSS SP 67, Class 150.
1. Body: Cast or ductile iron, lug or grooved ends, stainless steel stem, extended neck.
2. Disc: Chrome plated ductile iron.
3. Seat: Resilient replaceable EPDM.
4. Handle and Operator: 10 position lever handle. Furnish gear operators for valves 8 inches and larger, and chain-wheel operators for valves mounted over 8 feet above floor.

2.5 CHECK VALVES

A. Horizontal Swing Check Valves:
1. Manufacturers:
a. Crane Valve, North America
b. Hammond Valve
c. Milwaukee Valve Company
d. NIBCO, Inc.
e. Stockham Valves & Fittings
f. Watts
g. Substitutions: Division 01, Section 012300 Alternates, Section 012500 – Substitution Procedures – Substitution Request Form and Section 016000 - Product Requirements

2. CK-1 2 inches and Smaller: MSS SP 80, Class 150, bronze body and cap, bronze seat, Buna-N disc, solder or threaded ends.
3. CK-2 2-1/2 inches and Larger: MSS SP 71, Class 125, cast iron body, bolted cap, bronze or cast iron disc, [renewable disc seal and seat,] flanged ends.

B. Spring Loaded Check Valves:
1. Manufacturers:
a. Crane Valve, North America
b. Hammond Valve
c. Milwaukee Valve Company
d. NIBCO, Inc.

e. Stockham Valves & Fittings
f. Watts
g. Substitutions: Division 01, Section 012300 Alternates, Section 012500 – Substitution Procedures – Substitution Request Form and Section 016000 - Product Requirements

2. CK-6 2 inches and Smaller: MSS SP 80, Class 250, bronze body, in-line spring lift check, silent closing, Buna-N disc, integral seat, solder or threaded] ends.
3. CK-7 2-1/2 inches and Larger: MSS SP 71, Class 125, wafer globe style, cast iron body, bronze seat, center guided bronze disc, stainless steel spring and screws, flanged ends.

PART 3 EXECUTION

3.1 EXAMINATION

A. Section 01 30 00 - Administrative Requirements: Verification of existing conditions before starting work.

B. Verify piping system is ready for valve installation.

3.2 INSTALLATION

A. Install valves with stems upright or horizontal, not inverted.

B. Install brass male adapters each side of valves in copper piped system. Solder adapters to pipe.

C. Install 3/4 inch gate valves with cap for drains at main shut-off valves, low points of piping, bases of vertical risers, and at equipment.

D. Install valves with clearance for installation of insulation and allowing access.

E. Provide access where valves and fittings are not accessible. Coordinate size and location of access doors with Section 08 31 13.

F. Refer to Section 23 05 29 for pipe hangers.

G. Refer to Section 23 07 00 for insulation requirements for valves.

H. Refer to Section 23 05 03 for piping materials applying to various system types.

I. For installation of valves in hot water, chilled water piping systems refer to Section 23 21 13.

3.3 VALVE APPLICATIONS

A. Install shutoff and drain valves at locations indicated on Drawings in accordance with this Section.

B. Install butterfly valves (unless otherwise specified) for shut-off and to isolate equipment, part of systems, or vertical risers.

C. Install globe valves for throttling, bypass, or manual flow control services.

D. Install lug end butterfly valves adjacent to equipment when functioning to isolate equipment.

E. Install butterfly valves in heating, chilled and condenser water systems for shut-off service.

END OF SECTION 23 0523

SECTION 23 0529 - HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
1. Pipe hangers and supports.
2. Hanger rods.
3. Inserts.
4. Flashing.
5. Equipment curbs.
6. Sleeves.
7. Mechanical sleeve seals.
8. Formed steel channel.
9. Firestopping relating to HVAC work.
10. Firestopping accessories.
11. Equipment bases and supports.

B. Related Sections:
1. Section 03 30 00 - Cast-In-Place Concrete: Execution requirements for placement of concrete housekeeping pads specified by this section.
2. Section 07 84 13 – Penetration Firestopping: Product requirements for firestopping for placement by this section.
3. Section 07 84 46 – Fire-Resistive Joint Systems: Product requirements for firestopping for placement by this section.
4. Section 09 91 00 – Painting: Execution requirements for piping painting specified by this section.
5. Section 22 11 23 - Facility Natural-Gas Piping: Execution requirements for placement of hangers and supports specified by this section.
6. Section 23 04 00 – General Conditions for Mechanical Trades
7. Section 23 05 03 - Pipes and Tubes for HVAC Piping and Equipment: Execution requirements for placement of hangers and supports specified by this section.
8. Section 23 05 48 - Vibration and Seismic Controls for HVAC Piping and Equipment: Product and execution requirements for vibration isolators.
9. Section 23 21 13 - Hydronic Piping: Execution requirements for placement of hangers and supports specified by this section.

1.2 REFERENCES

A. American Society of Mechanical Engineers:
1. ASME B31.1 - Power Piping.
2. ASME B31.5 - Refrigeration Piping.
3. ASME B31.9 - Building Services Piping.

B. ASTM International:
   1. ASTM E119 - Standard Test Methods for Fire Tests of Building Construction and Materials.
   2. ASTM E814 - Standard Test Method for Fire Tests of Through Penetration Fire Stops.
   3. ASTM F708 - Standard Practice for Design and Installation of Rigid Pipe Hangers.
   4. ASTM E1966 - Standard Test Method for Fire-Resistive Joint Systems.

C. American Welding Society:
   1. AWS D1.1 - Structural Welding Code - Steel.

D. FM Global:
   1. FM - Approval Guide, A Guide to Equipment, Materials & Services Approved By Factory Mutual Research For Property Conservation.

E. Manufacturers Standardization Society of the Valve and Fittings Industry:
   1. MSS SP 58 - Pipe Hangers and Supports - Materials, Design and Manufacturer.
   2. MSS SP 69 - Pipe Hangers and Supports - Selection and Application.
   3. MSS SP 89 - Pipe Hangers and Supports - Fabrication and Installation Practices.

F. Underwriters Laboratories Inc.:
   1. UL 263 - Fire Tests of Building Construction and Materials.
   2. UL 723 - Tests for Surface Burning Characteristics of Building Materials.
   3. UL 1479 - Fire Tests of Through-Penetration Firestops.
   4. UL 2079 - Tests for Fire Resistance of Building Joint Systems.
   5. UL - Fire Resistance Directory.

G. Intertek Testing Services (Warnock Hersey Listed):
   1. WH - Certification Listings.

1.3 DEFINITIONS

A. Firestopping (Through-Penetration Protection System): Sealing or stuffing material or assembly placed in spaces between and penetrations through building materials to arrest movement of fire, smoke, heat, and hot gases through fire rated construction.

1.4 SYSTEM DESCRIPTION

A. Firestopping Materials: ASTM E119, ASTM E814, UL 263, UL 1479 to achieve fire ratings as noted on Drawings for adjacent construction, but not less than 1 hour fire rating.
   1. Ratings may be 3-hours for firestopping in through-penetrations of 4-hour fire rated assemblies unless otherwise required by applicable codes.

B. Firestop interruptions to fire rated assemblies, materials, and components.

1.5 PERFORMANCE REQUIREMENTS

A. Section 07 84 13 – Penetration Firestopping: Product requirements for firestopping for placement by this section.

B. Section 07 84 46 – Fire-Resistive Joint Systems: Product requirements for firestopping for placement by this section

C. Firestopping: Conform to applicable codes, FM and UL for fire resistance ratings and surface burning characteristics.

1.6 SUBMITTALS

A. Section 01 33 05 - Submittal Procedures: Submittal procedures.

B. Shop Drawings: Indicate system layout with location including critical dimensions, sizes, and pipe hanger and support locations and detail of trapeze hangers.

C. Product Data:
1. Hangers and Supports: Submit manufacturers catalog data including load capacity.
2. Firestopping: Submit data on product characteristics, performance and limitation criteria.

D. Firestopping Schedule: Submit schedule of opening locations and sizes, penetrating items, and required listed design numbers to seal openings to maintain fire resistance rating of adjacent assembly.

E. Design Data: Indicate load carrying capacity of trapeze, multiple pipe, and riser support hangers. Indicate calculations used to determine load carrying capacity of trapeze, multiple pipe, and riser support hangers.

F. Manufacturer's Installation Instructions:
1. Hangers and Supports: Submit special procedures and assembly of components.
2. Firestopping: Submit preparation and installation instructions.

G. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

H. Engineering Judgements: For conditions not covered by UL or WH listed designs, submit judgements by licensed professional engineer suitable for presentation to authority having jurisdiction for acceptance as meeting code fire protection requirements.

1.7 QUALITY ASSURANCE

A. Through Penetration Firestopping of Fire Rated Assemblies: UL 1479 or ASTM E814 with 0.10 inch water gage minimum positive pressure differential to achieve fire F-Ratings and temperature T-Ratings as indicated on Drawings, but not less than 1-hour.
   1. Wall Penetrations: Fire F-Ratings as indicated on Drawings, but not less than 1-hour.
   2. Floor and Roof Penetrations: Fire F-Ratings and temperature T-Ratings as indicated on Drawings, but not less than 1-hour.
      a. Floor Penetrations Within Wall Cavities: T-Rating is not required.

B. Through Penetration Firestopping of Non-Fire Rated Floor and Roof Assemblies: Materials to resist free passage of flame and products of combustion.
   1. Noncombustible Penetrating Items: Noncombustible materials for penetrating items connecting maximum of three stories.
   2. Penetrating Items: Materials approved by authorities having jurisdiction for penetrating items connecting maximum of two stories.

C. Fire Resistant Joints in Fire Rated Floor, Roof, and Wall Assemblies: ASTM E1966 or UL 2079 to achieve fire resistant rating as indicated on Drawings for assembly in which joint is installed.

D. Fire Resistant Joints Between Floor Slabs and Exterior Walls: ASTM E119 with 0.10 inch water gage minimum positive pressure differential to achieve fire resistant rating as indicated on Drawings for floor assembly.

E. Surface Burning Characteristics: Maximum 25/450 flame spread/smoke developed index when tested in accordance with ASTM E84.

F. Perform Work in accordance with applicable authority for welding hanger and support attachments to building structure.

1.8 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing Products specified in this section with minimum three years experience.

B. Installer: Company specializing in performing Work of this section with minimum three years documented experience.

1.9 PRE-INSTALLATION MEETINGS

A. Section 01 30 00 - Administrative Requirements: Pre-installation meeting.

B. Convene minimum one week prior to commencing work of this section.

1.10 DELIVERY, STORAGE, AND HANDLING

A. Section 01 60 00 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.

B. Accept materials on site in original factory packaging, labeled with manufacturer's identification.

C. Protect from weather and construction traffic, dirt, water, chemical, and damage, by storing in original packaging.

1.11 ENVIRONMENTAL REQUIREMENTS

A. Section 01 60 00 - Product Requirements: Environmental conditions affecting products on site.

B. Do not apply firestopping materials when temperature of substrate material and ambient air is below 60 degrees F.

C. Maintain this minimum temperature before, during, and for minimum 3 days after installation of firestopping materials.

1.12 FIELD MEASUREMENTS

A. Verify field measurements prior to fabrication.

1.13 WARRANTY

A. Section 01 73 00 - Execution and Section 017700 - Closeout Procedures: Product warranties and product bonds.

B. Furnish two year manufacturer warranty for pipe hangers and supports.

C. Warranty shall include labor and materials for a minimum period of two (2) years unless otherwise specified. Warranty starts at date of Commissioning acceptance of a complete system and Owner approval

PART 2 PRODUCTS

2.1 PIPE HANGERS AND SUPPORTS

A. Manufacturers:
1. Mifab
2. Nibco
3. Empire
4. Flex-Weld, Inc.
5. Glope Pipe Hanger Products Inc.

6. Michigan Hanger Co.
7. Superior Valve Co.
8. Substitutions: Division 01, Section 012300 Alternates, Section 012500 – Substitution Procedures – Substitution Request Form and Section 016000 - Product Requirements

B. Hydronic Piping:
1. Conform to ASME B31.9.
2. Hangers for Pipe Sizes 1/2 to 1-1/2 inch: Malleable iron or Carbon steel, adjustable swivel, split ring.
3. Hangers for Cold Pipe Sizes 2 inches and Larger: Carbon steel, adjustable, clevis.
4. Hangers for Hot Pipe Sizes 2 to 4 inches: Carbon steel, adjustable, clevis.
5. Hangers for Hot Pipe Sizes 6 inches and Larger: Adjustable steel yoke, cast iron roll, double hanger.
6. Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods.
7. Multiple or Trapeze Hangers for Hot Pipe Sizes 6 inches and Larger: Steel channels with welded spacers and hanger rods, cast iron roll.
8. Wall Support for Pipe Sizes 3 inches and Smaller: Cast iron hooks.
9. Wall Support for Pipe Sizes 4 inches and Larger: Welded steel bracket and wrought steel clamp.
10. Wall Support for Hot Pipe Sizes 6 inches and Larger: Welded steel bracket and wrought steel clamp with adjustable steel yoke and cast iron roll.
11. Vertical Support: Steel riser clamp.
12. Floor Support for Cold Pipe: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.
13. Floor Support for Hot Pipe Sizes 4 Inches and Smaller: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.
14. Floor Support for Hot Pipe Sizes 6 inches and Larger: Adjustable cast iron roll and stand, steel screws, and concrete pier or steel support.
15. Copper Pipe Support: Copper-plated, carbon steel ring.

C. Refrigerant Piping:
1. Conform to ASME B31.5.
2. Hangers for Pipe Sizes 1/2 to 1-1/2 inch: Malleable iron or Carbon steel, adjustable swivel, split ring.
3. Hangers for Pipe Sizes 2 inches and Larger: Carbon steel, adjustable, clevis.
4. Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods.
5. Wall Support for Pipe Sizes 3 inches and Smaller: Cast iron hook.
6. Wall Support for Pipe Sizes 4 inches and Larger: Welded steel bracket and wrought steel clamp.
7. Vertical Support: Steel riser clamp.
8. Floor Support: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.
9. Copper Pipe Support: Copper-plated carbon-steel ring.

2.2 TRAPEZE PIPE HANGERS

A. Pipe-support assembly in "Description" Paragraph below from Gripple, Inc. requires calculating and detailing at each use.

B. Description: MSS SP-58, pre-fabricated pipe-support assembly, made from 14-gage galvanized steel, with pipe clamp attachments. Assemblies are hung with trapeze hangers and adjustable fasteners, or with MSS SP-58 carbon-steel hanger rods, nuts, saddles, and U-bolts.
   1. Retain "Basis-of-Design Product" Subparagraph and list of manufacturers below to identify a specific product or a comparable product from manufacturers listed.
   2. Basis-of-Design Product: Subject to compliance with requirements, provide Gripple, Inc.; pre-fabricated pipe-support assemblies, Gripple Universal GC2-T clamps, Gripple Compact GC2-C clamps, and Gripple Trapeze, or comparable products.

2.3 FASTENER SYSTEMS

A. Cable Hanging System: Combination of adjustable fastener and wire rope with factory crimped end fixing on one end.
   1. Basis-of-Design Product: Subject to compliance with requirements, provide Gripple, Inc.; Gripple Adjustable Fastener Product Code and Gripple End Fixing Product Code fasteners systems, or comparable products.

2.4 EQUIPMENT SUPPORTS

A. Description: Combination of adjustable fastener and wire rope with factory crimped end fixing on one end.
   1. Basis-of-Design Product: Subject to compliance with requirements, provide Gripple, Inc.; Gripple Adjustable Fastener Product Code and Gripple End Fixing Product Code fasteners systems, or comparable products.

2.5 ACCESSORIES

A. Hanger Rods: Mild steel threaded both ends, threaded on one end, or continuous threaded.

2.6 INSERTS

A. Manufacturers:
   1. Thunderline Link Seal
   2. Fernco
   3. BWM
   4. Substitutions: Division 01, Section 012300 Alternates, Section 012500 – Substitution Procedures – Substitution Request Form and Section 016000 - Product Requirements

B. Inserts: Malleable iron case of galvanized steel shell and expander plug for threaded connection with lateral adjustment, top slot for reinforcing rods, lugs for attaching to forms; size inserts to suit threaded hanger rods.

2.7 FLASHING

A. Metal Flashing: 26 gage thick galvanized steel.

B. Metal Counterflashing: 22 gage thick galvanized steel.

C. Lead Flashing:
1. Waterproofing: 5 lb./sq. ft sheet lead.
2. Soundproofing: 1 lb./sq. ft sheet lead.

D. Flexible Flashing: 47 mil thick sheet butyl; compatible with roofing.

E. Caps: Steel, 22 gage minimum; 16 gage at fire resistant elements.

2.8 SLEEVES

A. Sleeves for Pipes Through Non-fire Rated Floors: 18 gage thick galvanized steel.

B. Sleeves for Pipes Through Non-fire Rated Beams, Walls, Footings, and Potentially Wet Floors: Steel pipe or 18 gage thick galvanized steel.

C. Sleeves for Round Ductwork: Galvanized steel.

D. Sleeves for Rectangular Ductwork: Galvanized steel or wood.

E. Sealant: Acrylic.

2.9 MECHANICAL SLEEVE SEALS

A. Manufacturers:
1. Thunderline Link-Seal, Inc.
2. NMP Corporation
3. Fernco
4. BWM
5. Substitutions: Division 01, Section 012300 Alternates, Section 012500 – Substitution Procedures – Substitution Request Form and Section 016000 - Product Requirements

B. Product Description: Modular mechanical type, consisting of interlocking synthetic rubber links shaped to continuously fill annular space between object and sleeve, connected with bolts and pressure plates causing rubber sealing elements to expand when tightened, providing watertight seal and electrical insulation.

2.10 FORMED STEEL CHANNEL

A. Manufacturers:
1. Allied Tube & Conduit Corp.
2. B-Line Systems
3. Midland Ross Corporation, Electrical Products Division
4. Unistrut Corp.
5. Substitutions: Division 01, Section 012300 Alternates, Section 012500 – Substitution Procedures – Substitution Request Form and Section 016000 - Product Requirements

B. Product Description: Galvanized 12 gage thick steel. With holes 1-1/2 inches on center.

2.11 FIRESTOPPING

A. Manufacturers:
1. Dow Corning Corp.
2. Fire Trak Corp.
3. Hilti Corp.
4. International Protective Coating Corp.
5. 3M fire Protection Products
6. Specified Technology, Inc.
7. Substitutions: Division 01, Section 012300 Alternates, Section 012500 – Substitution Procedures – Substitution Request Form and Section 016000 - Product Requirements

B. Product Description: Different types of products by multiple manufacturers are acceptable as required to meet specified system description and performance requirements; provide only one type for each similar application.
1. Silicone Firestopping Elastomeric Firestopping: Multiple component silicone elastomeric compound and compatible silicone sealant.
2. Foam Firestopping Compounds: Multiple component foam compound.
3. Formulated Firestopping Compound of Incombustible Fibers: Formulated compound mixed with incombustible non-asbestos fibers.
4. Fiber Stuffing and Sealant Firestopping: Composite of mineral fiber stuffing insulation with silicone elastomer for smoke stopping.
5. Mechanical Firestopping Device with Fillers: Mechanical device with incombustible fillers and silicone elastomer, covered with sheet stainless steel jacket, joined with collars, penetration sealed with flanged stops.
6. Intumescent Firestopping: Intumescent putty compound which expands on exposure to surface heat gain.
7. Firestop Pillows: Formed mineral fiber pillows.

C. Color: As selected from manufacturer’s full range of colors.

2.12 FIRESTOPPING ACCESSORIES

A. Primer: Type recommended by firestopping manufacturer for specific substrate surfaces and suitable for required fire ratings.

B. Installation Accessories: Provide clips, collars, fasteners, temporary stops or dams, and other devices required to position and retain materials in place.

C. General:
1. Furnish UL listed products.
2. Select products with rating not less than rating of wall or floor being penetrated.

D. Non-Rated Surfaces:
1. Stamped steel, chrome plated, hinged, split ring escutcheons or floor plates or ceiling plates for covering openings in occupied areas where piping is exposed.
2. For exterior wall openings below grade, furnish mechanical sealing device to continuously fill annular space between piping and cored opening or water-stop type wall sleeve.

PART 3 EXECUTION

3.1 EXAMINATION

A. Section 01 30 00 - Administrative Requirements: Verification of existing conditions before starting work.

B. Verify openings are ready to receive sleeves.

C. Verify openings are ready to receive firestopping.

3.2 PREPARATION

A. Clean substrate surfaces of dirt, dust, grease, oil, loose material, or other matter affecting bond of firestopping material.

B. Remove incompatible materials affecting bond.

C. Install backing materials to arrest liquid material leakage.

D. Obtain permission from Architect/Engineer before using powder-actuated anchors.

E. Obtain permission from Architect/Engineer before drilling or cutting structural members.

3.3 INSTALLATION - INSERTS

A. Install inserts for placement in concrete forms.

B. Install inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.

C. Provide hooked rod to concrete reinforcement section for inserts carrying pipe 4 inches and larger.

D. Where concrete slabs form finished ceiling, locate inserts flush with slab surface.

E. Where inserts are omitted, drill through concrete slab from below and provide through-bolt with recessed square steel plate and nut recessed into and grouted flush with slab.

3.4 INSTALLATION - PIPE HANGERS AND SUPPORTS

A. Install in accordance with ASME B31.1

B. Support horizontal piping as scheduled.

C. Install hangers with minimum 1/2 inch space between finished covering and adjacent work.

D. Place hangers within 12 inches of each horizontal elbow.

E. Use hangers with 1-1/2 inch minimum vertical adjustment.

F. Support vertical piping at every floor.

G. Where piping is installed in parallel and at same elevation, provide multiple pipe or trapeze hangers.

H. Support riser piping independently of connected horizontal piping.

I. Provide lead packing between hanger or support and piping.

J. Design hangers for pipe movement without disengagement of supported pipe.

K. Prime coat exposed steel hangers and supports. Refer to Section 09 90 00. Hangers and supports located in crawl spaces, pipe shafts, and suspended ceiling spaces are not considered exposed.

L. Provide clearance in hangers and from structure and other equipment for installation of insulation. Refer to Section 22 07 00.

3.5 INSTALLATION - EQUIPMENT BASES AND SUPPORTS

A. Provide housekeeping pads of concrete, minimum 4 inches thick and extending 6 inches beyond supported equipment. Refer to Section 03 30 00.

B. Using templates furnished with equipment, install anchor bolts, and accessories for mounting and anchoring equipment.

C. Provide rigid anchors for pipes after vibration isolation components are installed. Refer to Section 23 05 48.

3.6 INSTALLATION - FLASHING

A. Provide flexible flashing and metal Counterflashing where piping and ductwork penetrate weather or waterproofed walls, floors, and roofs.

B. Provide acoustical lead flashing around ducts and pipes penetrating equipment rooms for sound control.

C. Provide curbs for roof installations 16 inches minimum high above roofing surface. Flash and counter-flash with sheet metal; seal watertight. Attach Counterflashing to equipment and lap base flashing on roof curbs. Flatten and solder joints.

D. Adjust storm collars tight to pipe with bolts; caulk around top edge. Use storm collars above roof jacks. Screw vertical flange section to face of curb.

3.7 INSTALLATION - SLEEVES

A. Exterior watertight entries: Seal with mechanical sleeve seals.

B. Set sleeves in position in forms. Provide reinforcing around sleeves.

C. Size sleeves large enough to allow for movement due to expansion and contraction. Provide for continuous insulation wrapping.

D. Extend sleeves through floors 1 inch above finished floor level. Caulk sleeves.

E. Where piping or ductwork penetrates floor, ceiling, or wall, close off space between pipe or duct and adjacent work with stuffing firestopping insulation and caulk. Provide close fitting metal collar or escutcheon covers at both sides of penetration.

F. Install chrome plated steel escutcheons at finished surfaces.

3.8 INSTALLATION - FIRESTOPPING

A. Section 07 84 13 – Penetration Firestopping: Product requirements for firestopping for placement by this section.

B. Section 07 84 46 – Fire-Resistive Joint Systems: Product requirements for firestopping for placement by this section

C. Install material at fire rated construction perimeters and openings containing penetrating sleeves, piping, ductwork, and other items, requiring firestopping.

D. Apply primer where recommended by manufacturer for type of firestopping material and substrate involved, and as required for compliance with required fire ratings.

E. Remove dam material after firestopping material has cured.

F. Fire Rated Surface:
   1. Seal opening at floor, wall, partition, ceiling, and roof as follows:
      a. Install sleeve through opening and extending beyond minimum of 1 inch on both sides of building element.
      b. Size sleeve allowing minimum of 1 inch void between sleeve and building element.
      c. Pack void with backing material.
      d. Seal ends of sleeve with UL listed fire resistive silicone compound to meet fire rating of structure penetrated.

G. Non-Rated Surfaces:
   1. Seal opening through non-fire rated wall, partition, floor, ceiling, and roof opening as follows:
      a. Install sleeve through opening and extending beyond minimum of 1 inch on both sides of building element.
      b. Size sleeve allowing minimum of 1 inch void between sleeve and building element.
      c. Install type of firestopping material recommended by manufacturer.
   2. Install escutcheons where conduit, penetrates non-fire rated surfaces in occupied spaces. Occupied spaces include rooms with finished ceilings and where penetration occurs below finished ceiling.
   3. Exterior wall openings below grade: Assemble rubber links of mechanical sealing device to size of piping and tighten in place, in accordance with manufacturer's instructions.

3.9 FIELD QUALITY CONTROL

A. Section 01 40 00 - Quality Requirements, Section 01 73 00 - Execution and Section 017700 Closeout Procedures: Field inspecting, testing, adjusting, and balancing.

B. Inspect installed firestopping for compliance with specifications and submitted schedule.

3.10 CLEANING

A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for cleaning.

B. Clean adjacent surfaces of firestopping materials.

3.11 PROTECTION OF FINISHED WORK

A. Section 01 73 00 - Execution and Section 017700 - Closeout Procedures. Section 017423 - Final cleaning: Requirements for protecting finished Work.

B. Protect adjacent surfaces from damage by material installation.

3.12 SCHEDULES

A. Copper and Steel Pipe Hanger Spacing:

PIPE SIZE Inches	COPPER TUBING MAXIMUM HANGER SPACING Feet	STEEL PIPE MAXIMUM HANGER SPACING Feet	COPPER TUBING HANGER ROD DIAMETER Inches	STEEL PIPE HANGER ROD DIAMETER Inches
1/2	5	7	3/8	3/8
3/4	5	7	3/8	3/8
1	6	7	3/8	3/8
1-1/4	7	7	3/8	3/8
1-1/2	8	9	3/8	3/8
2	8	10	3/8	3/8
2-1/2 (Note 2)	9	11	1/2	1/2
3	10	12	1/2	1/2
4	12	14	1/2	5/8
5	13	16	1/2	5/8
6	14	17	5/8	3/4
8	16	19	3/4	7/8

B. Note 1: Refer to manufacturer's recommendations for grooved end piping systems.

C. Note 2: 20 feet maximum spacing, minimum of one hanger for each pipe section close to joint behind bell. Provide hanger at each change of direction and each branch connection. For pipe sizes 6 inches and smaller, subjected to loadings other than weight of pipe and contents, limit span to maximum spacing for water service steel pipe.

END OF SECTION 23 0529

SECTION 23 0548 - VIBRATION AND SEISMIC CONTROLS FOR HVAC PIPING AND EQUIPMENT

PART 1 GENERAL

1.1 INTENT

A. All mechanical equipment, piping and ductwork as noted on the equipment schedule or in the specification shall be mounted on vibration isolators to prevent the transmission of vibration and mechanically transmitted sound to the building structure. Vibration isolators shall be selected in accordance with the weight distribution so as to produce reasonably uniform deflections.

B. All isolators and isolation materials shall be of the same manufacturer and shall be certified by the manufacturer.

C. It is the intent of the seismic portion of this specification to keep all mechanical and electrical building system components in place during a seismic event.

D. All such systems must be installed in strict accordance with seismic codes, component manufacturer's recommendations and building construction standards. Whenever a conflict occurs between the manufacturer's recommendations or construction standards, the most stringent shall apply.

E. This specification is considered to be minimum requirements for seismic consideration and is not intended as a substitute for legislated, more stringent, national, state or local construction requirements (i.e. California Title 24, California OSHPD, Canadian Building Codes, or other requirements).

F. Any variance or non-compliance with these specification requirements shall be corrected by the contractor in an approved manner.

1.2 SUMMARY

A. Section Includes:
   1. Certification of seismic restraint designs and installation supervision.
   2. Certification of seismic attachment of housekeeping pads.
   3. NOTE: For all mechanical and electrical systems. Equipment buried underground is excluded but entry of services through the foundation wall is included.
   4. Seismic restraint products
      a. Vibration isolation elements.
      b. Equipment isolation bases.
      c. Piping flexible connections.
      d. Seismic restraints for isolated and non-isolated mechanical and electrical items.

5. Acoustic reduction products
   a. Duct silencers.
   b. Cross-talk silencers.
   c. Acoustic housings.
   d. Ductwork lagging.
   e. Acoustical louvers.

B. Related Sections:
1. Section 03 30 00 - Cast-In-Place Concrete: Product requirements for concrete for placement by this section.
2. Section 07 84 13 – Penetration Firestopping: Product requirements for firestopping for placement by this section.
3. Section 07 84 46 – Fire-Resistive Joint Systems: Product requirements for firestopping for placement by this section.
4. Section 23 04 00 – General Conditions for Mechanical Trades
5. Section 23 05 16 - Expansion Fittings and Loops for HVAC Piping: Product requirements for anchors and piping expansion compensation.
6. Section 23 05 29 - Hangers and Supports for HVAC Piping and Equipment: Product requirements for pipe hangers and supports.
7. Section 23 05 93 - Testing, Adjusting, and Balancing for HVAC: Requirements for sound and vibration measurements performed independent of this section.
8. Section 23 33 00 - Air Duct Accessories: Product requirements for both solid and flexible duct connectors for duct silencers specified for placement by this section.

1.3 REFERENCES

A. Air Movement and Control Association International, Inc.:
1. AMCA 300 - Reverberant Room Method for Sound Testing of Fans.

B. American National Standards Institute:
1. ANSI S1.4 - Sound Level Meters.
2. ANSI S1.8 - Reference Quantities for Acoustical Levels.
3. ANSI S1.13 - Methods for the Measurement of Sound Pressure Levels in Air.
4. ANSI S12.36 - Survey Methods for the Determination of Sound Power Levels of Noise Sources.

C. Air-Conditioning and Refrigeration Institute:
1. ARI 575 - Method of Measuring Machinery Sound within Equipment Space.

D. American Society of Heating, Refrigerating and:
1. ASHRAE 68 - Laboratory Method of Testing In-Duct Sound Power Measurement Procedure for Fans.
2. ASHRAE Handbook - HVAC Applications.

E. ASTM International:
1. ASTM E90 - Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements.

2. ASTM E477 - Standard Test Method for Measuring Acoustical and Airflow Performance of Duct Liner Materials and Prefabricated Silencers.
3. ASTM E596 - Standard Test Method for Laboratory Measurement of the Noise Reduction of Sound-Isolating Enclosures.

F. Sheet Metal and Air Conditioning Contractors':
1. SMACNA - HVAC Duct Construction Standard - Metal and Flexible.

1.4 RELATED WORK

A. Housekeeping Pads
1. Housekeeping pad reinforcement and monolithic pad attachment to the structure details and design shall be prepared by the restraint vendor if not already indicated on the drawings.
2. Housekeeping pads shall be coordinated with restraint vendor and sized to provide a minimum edge distance of ten (10) bolt diameters all around the outermost anchor bolt to allow development of full drill-in wedge anchor ratings. If cast-in anchors are to be used, the housekeeping pads shall be sized to accommodate the ACI requirements for bolt coverage and embedment.

B. Supplementary Support Steel
1. Contractor shall supply supplementary support steel for all equipment, piping, ductwork, etc. including roof mounted equipment, as required or specified.

C. Attachments
1. Contractor shall supply restraint attachment plates cast into housekeeping pads, concrete inserts, double sided beam clamps, etc. in accordance with the requirements of the vibration vendor's calculations.

1.5 SEISMIC FORCE LEVELS

A. Installations shall be designed to safely accept external forces determined in accordance with the International Building Code –2015 w/2018 CT Supplement, Section 1621 in any direction for all rigidly supported equipment without failure and permanent displacement of the equipment. Seismic restraints shall not short circuit vibration isolation systems or transmit objectionable vibration or noise.

1.6 PERFORMANCE REQUIREMENTS

A. Provide vibration isolation on motor driven equipment over 0.5 hp, plus connected piping and ductwork.

B. Provide minimum static deflection of isolators for equipment as follows:
1. Basement, Under 20 hp
a. 400 - 600 rpm: 1 inch
b. 600 - 800 rpm: 0.5 inch
c. 800 - 900 rpm: 0.2 inch

d. 1100 - 1500 rpm: 0.14 inch
e. Over 1500 rpm: 0.1 inch

2. Basement, Over 20 hp
   a. 400 - 600 rpm: 2 inch
   b. 600 - 800 rpm: 1 inch
   c. 800 - 900 rpm: 0.5 inch
   d. 1100 - 1500 rpm: 0.2 inch
   e. Over 1500 rpm: 0.15 inch
3. Upper Floors, Normal
   a. 400 - 600 rpm: 3.5 inch
   b. 600 - 800 rpm: 2 inch
   c. 800 - 900 rpm: 1 inch
   d. 1100 - 1500 rpm: 0.5 inch
   e. Over 1500 rpm: 0.2 inch
4. Upper Floors, Critical
   a. 600 - 800 rpm: 3.5 inch
   b. 800 - 900 rpm: 2 inch
   c. 1100 - 1500 rpm: 1 inch
   d. Over 1500 rpm: 0.5 inch

C. Consider upper floor locations critical unless otherwise indicated.

D. Use concrete inertia bases for fans having static pressure in excess of 3.5 inches water column or motors in excess of 40 hp, and on base mounted pumps over 10 hp.

E. Maintain sound level of spaces at levels not to exceed those listed below by utilizing acoustical devices.

F. Maintain rooms at following maximum sound levels, in Noise Criteria (NC) as defined by ASHRAE Handbook., HVAC Applications.
   1. Schools
      a. Lecture and classrooms: 30
      b. Open-plan classrooms: 30

1.7 DEFINITIONS

A. Life Safety Systems:
   1. All systems involved with and/or connected to emergency power supply including all generators, transfer switches, transformers and all flow paths to fire protection and/or emergency lighting systems.
   2. All medical and life support systems.
   3. Fresh air relief systems on emergency control sequence including air handlers, conduit, duct, dampers, etc.

B. Positive Attachment:
   1. A positive attachment is defined as a cast-in anchor, a drill-in wedge anchor, a double sided beam clamp loaded perpendicular to a beam, or a welded or bolted connection to structure. Single sided "C" type beam clamps for support rods of overhead piping, ductwork, fire protection, electrical conduit, bus duct, or cable trays, or any other equipment are not acceptable on this project as seismic anchor points.

C. Transverse Bracing:
   1. Restraint(s) applied to limit motion perpendicular to the centerline of the pipe, duct or conduit.

D. Longitudinal Bracing:
   1. Restraint(s) applied to limit motion parallel to the centerline of the pipe, duct or conduit.

E. Failure
   1. For the purposes of this project, failure is defined as the discontinuance of any attachment point between equipment or structure, vertical permanent deformation greater than 1/8" (3mm) and/or horizontal permanent deformation greater that 1/4" (6mm).

1.8 SUBMITTALS

A. Section 01 33 05 - Submittal Procedures: Submittal procedures.

B. Shop Drawings:
   1. Submit fabrication details for equipment bases including dimensions, structural member sizes and support point locations.
   2. Provide Drawings showing methods of suspension and support guides for conduit, piping, ductwork and ceiling hung equipment.
   3. Record actual locations and installation of vibration isolators and seismic restraints including attachment points.
   4. Where walls, floors, slabs or supplementary steel work are used for seismic restraint locations, details of acceptable attachment methods for ducts, conduit and pipe must be included and approved before the condition is accepted for installation. Restraint manufacturers' submittals must include spacing, static loads and seismic loads at all attachment and support points.
   5. Provide specific details of seismic restraints and anchors; include number, size and locations for each piece of equipment.
   6. Drawings showing methods for isolation of conduits, pipes and ductwork penetrating walls and floor slabs.
   7. Specific details of restraints including anchor bolts for mounting and maximum loading at each location, for each piece of equipment and/or pipe and duct locations.

C. Product Data: Submit schedule of vibration isolator type with location and load on each. Submit catalog information indicating, materials, dimensional data, pressure losses, and acoustical performance for standard sound attenuation products.

D. Seismic Certification and Analysis:
   1. Seismic restraint calculations must be provided for all connections of equipment to the structure. Calculations must be stamped by a registered professional engineer with at least five years of seismic design experience, licensed in the state of the job location.
   2. All restraining devices shall have a preapproval number from California OSHPD or some other recognized government agency showing maximum restraint ratings. Preapprovals based on independent testing are preferred to preapprovals based on calculations. Where preapproved devices are not available, submittals based on independent testing are preferred. Calculations (including the combining of tensile and shear loadings) to support seismic restraint designs must be stamped by a registered professional engineer with at least five years of seismic design experience and licensed in the state of the job location. Testing and calculations must include both shear and tensile loads as well as one test or analysis at 45 degrees to the weakest mode.
   3. Analysis must indicate calculated dead loads, static seismic loads and capacity of materials utilized for connections to equipment and structure. Analysis must detail anchoring methods, bolt diameter, embedment and/or welded length. All seismic restraint devices shall be designed to accept, without failure, the forces detailed in section 1.06 acting through the equipment center of gravity. Overturning moments may exceed forces at ground level.

E. Design Data: Submit calculations indicating maximum room sound levels are not exceeded. The silencer manufacturer shall provide, for approval, acoustical system calculations for all duct systems with silencers to demonstrate that the submitted silencers will reduce mechanical fan noise to the NC values stated below in the occupied space. Use sound power levels of actual equipment to be installed on project. Analysis shall include breakout noise calculations. In the absence of specified background sound level criteria, the guidelines as express in Table 34 of Chapter 47, “Sound and Vibration Control” of the 2003 ASHRAE Handbook – HVAC Applications, shall be used.

F. Test Reports: Indicate dynamic insertion loss and noise generation values of silencers.

G. Manufacturer's Installation Instructions: Submit special procedures and setting dimensions. Indicate installation requirements maintaining integrity of sound isolation.

H. Manufacturer's Certificate: Certify isolators meet or exceed specified requirements.

I. Manufacturer's Field Reports: Indicate sound isolation installation is complete and in accordance with instructions.

1.9 CLOSEOUT SUBMITTALS

A. Section 01 73 00 - Execution and Section 017700 - Closeout Procedures: Closeout procedures.

1.10 QUALITY ASSURANCE

A. Perform Work in accordance with ANSI S12.36 standards and recommendations of ASHRAE 68.

B. Maintain one copy of each document on site.

1.11 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years experience.

B. Installer: Company specializing in performing Work of this section with minimum three years experience.

C. Design application of duct silencers and seismic snubbers under direct supervision of Professional Engineer experienced in design of this Work and licensed in State of Connecticut.

1.12 PRE-INSTALLATION MEETINGS

A. Section 01 30 00 - Administrative Requirements: Pre-installation meeting.

B. Convene minimum one week prior to commencing work of this section.

1.13 FIELD MEASUREMENTS

A. Verify field measurements prior to fabrication.

1.14 CONTRACTOR’S RESPONSIBILITIES

A. Contractor shall have the following responsibilities:
1. Determine vibration isolation and seismic restraint sizes and locations per specifications.
2. Provide and install isolation systems and seismic restraints as scheduled or specified.
3. Guarantee specified isolation system deflection.
4. Provide installation instructions, drawings and field supervision to assure proper installation and performance.
5. Provide installation instructions, drawings and trained field supervision to insure proper installation and performance.
6. Substitution of "Internally Isolated" mechanical equipment in lieu of the specified isolation of this section is acceptable

1.15 WARRANTY

A. Section 01 73 00 - Execution and Section 017700 - Closeout Procedures: Product warranties and product bonds.

B. Furnish five year manufacturer warranty for inertia bases.

C. Warranty shall include labor and materials for a minimum period of two (2) years unless otherwise specified. Warranty starts at date of Commissioning acceptance of a complete system and Owner approval

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Mason Industries Inc. models listed below.

B. Other approved manufacturers providing equivalent products include:
1. Vibro Acoustics
2. Vibration Eliminator Co.
3. Amber/Booth Co.
4. Substitutions: Division 01, Section 012300 Alternates, Section 012500 – Substitution Procedures – Substitution Request Form and Section 016000 - Product Requirements

2.2 PRODUCT DESCRIPTIONS

A. Vibration Isolators and Seismic Restraint Specifications – Products used are listed in table at the end of this section.
1. Specification 1 - Neoprene Pad
   a. Two layers of 3/4" (19mm) thick neoprene pad consisting of 2" (50mm) square waffle modules separated horizontally by a 16 (1.5mm) gauge galvanized shim. Load distribution plates shall be used as required.
   b. Pads shall be Type Super "W" as manufactured by Mason Industries, Inc.
   c. Substitutions: Division 01, Section 012300 Alternates, Section 012500 – Substitution Procedures – Substitution Request Form and Section 016000 - Product Requirements
2. Specification 2 - Bridge-Bearing Neoprene Mountings
   a. Bridge-bearing neoprene mountings shall have a minimum static deflection of 0.2" (5mm) and all directional seismic capability. The mount shall consist of a ductile iron casting containing two separated and opposing molded neoprene elements. The elements shall prevent the central threaded sleeve and attachment bolt from contacting the casting during normal operation. The shock absorbing neoprene materials shall be compounded to bridge-bearing specifications. Mountings shall have an Anchorage

Preapproval "R" Number from OSHPD in the State of California verifying the maximum certified horizontal and vertical load ratings.

b. Mountings shall be Type BR as manufactured by Mason Industries, Inc.
c. Substitutions: Division 01, Section 012300 Alternates, Section 012500 – Substitution Procedures – Substitution Request Form and Section 016000 - Product Requirements

3. Specification 3 – Bushing Assemblies
   a. Sheet metal panels shall be bolted to the walls or supporting structure by assemblies consisting of a neoprene bushing cushioned between 2 steel sleeves. The outer sleeve prevents the sheet metal from cutting into the neoprene. Enlarge panel holes as required. Neoprene elements pass over the bushing to cushion the back panel horizontally. A steel disc covers the inside neoprene element and the inner steel sleeve is elongated to act as a stop so tightening the anchor bolts does not interfere with panel isolation in 3 planes. Bushing assemblies can be applied to the ends of steel cross members where applicable. All neoprene shall be bridge bearing quality.
   b. Bushing assemblies shall be type PB as manufactured by Mason Industries, Inc.
   c. Substitutions: Division 01, Section 012300 Alternates, Section 012500 – Substitution Procedures – Substitution Request Form and Section 016000 - Product Requirements
4. Specification 4 - Neoprene Bushing
   a. A one piece molded bridge bearing neoprene washer/bushing. The bushing shall surround the anchor bolt and have a flat washer face to avoid metal to metal contact.
   b. Neoprene bushings shall be type HG as manufactured by Mason Industries, Inc.
   c. Substitutions: Division 01, Section 012300 Alternates, Section 012500 – Substitution Procedures – Substitution Request Form and Section 016000 - Product Requirements
5. Specification 5 – Spring Isolators
   a. Spring isolators shall be free standing and laterally stable without any housing and complete with a molded neoprene cup or 1/4" (6mm) neoprene acoustical friction pad between the baseplate and the support. All mountings shall have leveling bolts that must be rigidly bolted to the equipment. Spring diameters shall be no less than 0.8 of the compressed height of the spring at rated load. Springs shall have a minimum additional travel to solid equal to 50% of the rated deflection. Submittals shall include spring diameters, deflection, compressed spring height and solid spring height.
   b. Mountings shall be Type SLF as manufactured by Mason Industries, Inc.
   c. Substitutions: Division 01, Section 012300 Alternates, Section 012500 – Substitution Procedures – Substitution Request Form and Section 016000 - Product Requirements
6. Specification 6 – Restrained Spring Mountings
   a. Restrained spring mountings shall have an SLF mounting as described in Specification 5, within a rigid housing that includes vertical limit stops to

prevent spring extension when weight is removed. The housing shall serve as blocking during erection. A steel spacer shall be removed after adjustment. Installed and operating heights are equal. A minimum clearance of 1/2" (12mm) shall be maintained around restraining bolts and between the housing and the spring so as not to interfere with the spring action. Limit stops shall be out of contact during normal operation. Since housings will be bolted or welded in position there must be an internal isolation pad. Housing shall be designed to resist all seismic forces. Mountings shall have Anchorage Preapproval "R" Number from OSHPD in the state of California certifying the maximum certified horizontal and vertical load ratings.

b. Mountings shall be SLR as manufactured by Mason Industries, Inc.
c. Substitutions: Division 01, Section 012300 Alternates, Section 012500 – Substitution Procedures – Substitution Request Form and Section 016000 - Product Requirements

7. Specification 7 – Spring Mountings
   a. Spring mountings as in specification 5 built into a ductile iron or steel housing to provide all directional seismic snubbing. The snubber shall be adjustable vertically and allow a maximum of 1/4" (6mm) travel in all directions before contacting the resilient snubbing collars. Mountings shall have an Anchorage Preapproval "R" number from OSHPD in the State of California verifying the maximum certified horizontal and vertical load ratings.
   b. Mountings shall be SSLFH as manufactured by Mason Industries, Inc.
   c. Substitutions: Division 01, Section 012300 Alternates, Section 012500 – Substitution Procedures – Substitution Request Form and Section 016000 - Product Requirements
8. Specification 8 – Air Springs
   a. Air Springs shall be manufactured with upper and lower steel sections connected by a replaceable flexible nylon reinforced neoprene element. Air spring configuration shall be multiple bellows to achieve a maximum natural frequency of 3 Hz. Air Springs shall be designed for a burst pressure that is a minimum of three times the published maximum operating pressure. All air spring systems shall be connected to either the building control air or a supplementary air supply and equipped with three leveling valves to maintain leveling within plus or minus 1/8" (3mm). Submittals shall include natural frequency, load and damping tests performed by an independent lab or acoustician.
   b. Air Springs shall be Type MT and leveling valves Type LV as manufactured by Mason Industries, Inc.
   c. Substitutions: Division 01, Section 012300 Alternates, Section 012500 – Substitution Procedures – Substitution Request Form and Section 016000 - Product Requirements
9. Specification 9 – Restrained Air Springs
   a. Restrained air spring mountings shall have an MT air spring as described in Specification 8, within a rigid housing that includes vertical limit stops to prevent air spring extension when weight is removed. The housing shall

serve as blocking during erection. A steel spacer shall be removed after adjustment. Installed and operating heights are equal. A minimum clearance of 1/2" (12mm) shall be maintained around restraining bolts and between the housing and the air spring so as not to interfere with the air spring action. Limit stops shall be out of contact during normal operation. Housing shall be designed to resist all seismic forces.

b. Mountings shall be SLR-MT as manufactured by Mason Industries, Inc.

c. Substitutions: Division 01, Section 012300 Alternates, Section 012500 – Substitution Procedures – Substitution Request Form and Section 016000 - Product Requirements

10. Specification 10 – Hangers
    a. Hangers shall consist of rigid steel frames containing minimum 1 1/4" (32mm) thick neoprene elements at the top and a steel spring with general characteristics as in specification 5 seated in a steel washer reinforced neoprene cup on the bottom. The neoprene element and the cup shall have neoprene bushings projecting through the steel box. To maintain stability the boxes shall not be articulated as clevis hangers nor the neoprene element stacked on top of the spring. Spring diameters and hanger box lower hole sizes shall be large enough to permit the hanger rod to swing through a 30o arc from side to side before contacting the rod bushing and short circuiting the spring. Submittals shall include a hanger drawing showing the 30o capability.
    b. Hangers shall be type 30N as manufactured by Mason Industries, Inc.
    c. Substitutions: Division 01, Section 012300 Alternates, Section 012500 – Substitution Procedures – Substitution Request Form and Section 016000 - Product Requirements
11. Specification 11 – Hangers
    a. Hangers shall be as described in 10, but they shall be precompressed and locked at the rated deflection by means of a resilient seismic upstop to keep the piping or equipment at a fixed elevation during installation. The hangers shall be designed with a release mechanism to free the spring after the installation is complete and the hanger is subjected to its full load. Deflection shall be clearly indicated by means of a scale. Submittals shall include a drawing of the hanger showing the 30o capability.
    b. Hangers shall be type PC30N as manufactured by Mason Industries, Inc.
    c. Substitutions: Division 01, Section 012300 Alternates, Section 012500 – Substitution Procedures – Substitution Request Form and Section 016000 - Product Requirements
12. Specification 12 - Seismic Cable Restraints
    a. Seismic Cable Restraints shall consist of galvanized steel aircraft cables sized to resist seismic loads with a minimum safety factor of two and arranged to provide all-directional restraint. Cables must be prestretched to achieve a certified minimum modulus of elasticity. Cable end connections shall be steel assemblies that swivel to final installation angle and utilize two clamping bolts to provide proper cable engagement. Cables must not be allowed to bend across sharp edges. Cable assemblies shall have an

Anchorage Preapproval "R" Number from OSHPD in the State of California verifying the maximum certified load ratings.

b. Cable assemblies shall be Type SCB at the ceiling and at the clevis bolt, SCBH between the hanger rod nut and the clevis or SCBV if clamped to a beam all as manufactured by Mason Industries, Inc.

c. Substitutions: Division 01, Section 012300 Alternates, Section 012500 – Substitution Procedures – Substitution Request Form and Section 016000 - Product Requirements

13. Specification 13 – Seismic Solid Braces
    a. Seismic solid braces shall consist of steel angles or channels to resist seismic loads with a minimum safety factor of 2 and arranged to provide all directional restraint. Seismic solid brace end connectors shall be steel assemblies that swivel to the final installation angle and utilize two through bolts to provide proper attachment. Seismic solid brace assembly shall have anchorage preapproval "R" number from OSHPD in the state of California verifying the maximum certified load ratings.
    b. Solid seismic brace assemblies shall be type SSB as manufactured by Mason Industries, Inc.
    c. Substitutions: Division 01, Section 012300 Alternates, Section 012500 – Substitution Procedures – Substitution Request Form and Section 016000 - Product Requirements
14. Specification 14 – Rod Clamp Assemblies
    a. Steel angles, sized to prevent buckling, shall be clamped to pipe or equipment rods utilizing a minimum of three ductile iron clamps at each restraint location when required. Welding of support rods is not acceptable. Rod clamp assemblies shall have an Anchorage Preapproval "R" Number from OSHPD in the State of California.
    b. Rod clamp assemblies shall be Type SRC as manufactured by Mason Industries, Inc.
    c. Substitutions: Division 01, Section 012300 Alternates, Section 012500 – Substitution Procedures – Substitution Request Form and Section 016000 - Product Requirements
15. Specification 15 – Clevis Hanger Cross Brace
    a. Pipe clevis cross bolt braces are required in all restraint locations. They shall be special purpose preformed channels deep enough to be held in place by bolts passing over the cross bolt. Clevis cross braces shall have an Anchorage Preapproval "R" Number from OSHPD in the State of California.
    b. Clevis cross brace shall be type CCB as manufactured by Mason Industries, Inc.
    c. Substitutions: Division 01, Section 012300 Alternates, Section 012500 – Substitution Procedures – Substitution Request Form and Section 016000 - Product Requirements
16. Specification 16 - All-Directional Seismic Snubbers – Small Neoprene
    a. All-directional seismic snubbers shall consist of interlocking steel members restrained by a one-piece molded neoprene bushing of bridge bearing neoprene. Bushing shall be replaceable and a minimum of 1/4" (6mm)

thick. Rated loadings shall not exceed 1000 psi (.7kg/mm2). A minimum air gap of 1/8" (3mm) shall be incorporated in the snubber design in all directions before contact is made between the rigid and resilient surfaces. Snubber end caps shall be removable to allow inspection of internal clearances. Neoprene bushings shall be rotated to insure no short circuits exist before systems are activated. Snubbers shall have an Anchorage Preapproval "R" Number from OSHPD in the State of California verifying the maximum certified horizontal and vertical load ratings.

b. Snubber shall be Type Z-1225 as manufactured by Mason Industries, Inc.
c. Substitutions: Division 01, Section 012300 Alternates, Section 012500 – Substitution Procedures – Substitution Request Form and Section 016000 - Product Requirements

17. Specification 17 - All-Directional Seismic Snubbers – Large Rubber
    a. All directional seismic snubbers shall consist of interlocking steel members restrained by shock absorbent rubber materials compounded to bridge bearing specifications. Elastomeric materials shall be replaceable and a minimum of 3/4" (19mm) thick. Rated loadings shall not exceed 1000 psi (.7kg/mm2). Snubbers shall be manufactured with an air gap between hard and resilient material of not less than 1/8" (3mm) nor more that 1/4" (6mm). Snubbers shall be installed with factory set clearances. The capacity of the seismic snubber at 3/8" (9mm) deflection shall be equal or greater than the load assigned to the mounting grouping controlled by the snubber multiplied by the applicable "G" force. Submittals shall include the load deflection curves up to 1/2" (12mm) deflection in the x, y and z planes. Snubbers shall have an anchorage preapproval "R" number from OSHPD in the state of California verifying the maximum certified horizontal and vertical load ratings.
    b. Snubbers shall be series Z-1011 as manufactured by Mason Industries, Inc.
    c. Substitutions: Division 01, Section 012300 Alternates, Section 012500 – Substitution Procedures – Substitution Request Form and Section 016000 - Product Requirements
18. Specification 18 – Stud Wedges
    a. Stud wedge anchors shall be manufactured from full diameter wire, not from undersized wire that is "rolled up" to create the thread. The stud anchor shall also have a safety shoulder which fully supports the wedge ring under load. The stud anchors shall have an evaluation report number from the I.C.B.O Evaluation Service, Inc. verifying its allowable loads.
    b. Drill-in stud wedge anchors shall be type SAS as manufactured by Mason Industries, Inc.
    c. Substitutions: Division 01, Section 012300 Alternates, Section 012500 – Substitution Procedures – Substitution Request Form and Section 016000 - Product Requirements
19. Specification 19 – Female Wedge Anchors
    a. Female wedge anchors are preferred in floor locations so isolators or equipment can be slid into place after the anchors are installed. Anchors shall be manufactured from full diameter wire, and shall have a safety shoulder to fully support the wedge ring under load. Female wedge anchors

shall have an evaluation report number from the I.C.B.O Evaluation Service, Inc. verifying to its allowable loads.

b. Drill-in female wedge anchors shall be type SAB as manufactured by Mason Industries, Inc.

c. Substitutions: Division 01, Section 012300 Alternates, Section 012500 – Substitution Procedures – Substitution Request Form and Section 016000 - Product Requirements

20. Specification 20 – Equipment Bases

a. Vibration isolation manufacturer shall furnish integral structural steel bases. Rectangular bases are preferred for all equipment. Centrifugal refrigeration machines and pump bases may be T or L shaped where space is a problem. Pump bases for split case pump shall include supports for suction and discharge elbows. All perimeter members shall be steel beams with a minimum depth equal to 1/10 of the longest dimension of the base. Base depth need not exceed 14" (350mm) provided that the deflection and misalignment is kept within acceptable limits as determined by the manufacturer. Height saving brackets shall be employed in all mounting locations to provide a base clearance of 1" (25mm).

b. Bases shall be type WF as manufactured by Mason Industries, Inc.

c. Substitutions: Division 01, Section 012300 Alternates, Section 012500 – Substitution Procedures – Substitution Request Form and Section 016000 - Product Requirements

21. Specification 21 – Inertia Foundations

a. Vibration isolation manufacturer shall furnish rectangular steel concrete pouring forms for floating and inertia foundations. Bases for split case pumps shall be large enough to provide for suction and discharge elbows. Bases shall be a minimum of 1/12 of the longest dimension of the base but not less than 6" (150mm). The base depth need not exceed 12" (300mm) unless specifically recommended by the base manufacturer for mass or rigidity. Forms shall include minimum concrete reinforcing consisting of 1/2" (12mm) bars welded in place on 6" (150mm) centers running both ways in a layer 1 1/2" (38mm) above the bottom. Forms shall be furnished with steel templates to hold the anchor bolts sleeves and anchors while concrete is being poured. Height saving brackets shall be employed in all mounting locations to maintain a 1" (25mm) clearance below the base. Wooden formed bases leaving a concrete rather then a steel finish are not acceptable.

b. Base shall be type BMK or K as manufactured by Mason Industries, Inc.

c. Substitutions: Division 01, Section 012300 Alternates, Section 012500 – Substitution Procedures – Substitution Request Form and Section 016000 - Product Requirements

22. Specification 22 – Curbs

a. Curb mounted rooftop equipment shall be mounted on spring isolation curbs. The lower member shall consist of a sheet metal Z section containing adjustable and removable steel springs that support the upper floating section. The upper frame must provide continuous support for the equipment and must be captive so as to resiliently resist wind and seismic

forces. All directional neoprene snubber bushings shall be a minimum of 1/4" (6mm) thick. Steel springs shall be laterally stable and rest on 1/4" (6mm) thick neoprene acoustical pads. Hardware must be plated and the springs provided with a rust resistant finish. The curbs waterproofing shall consist of a continuous galvanized flexible counter flashing nailed over the lower curbs waterproofing and joined at the corners by EPDM bellows. All spring locations shall have access ports with removable waterproof covers. Lower curbs shall have provision for 2" (50mm) of insulation. The roof curbs shall be built to seismically contain the rooftop unit. The unit must be solidly fastened to the top floating rail, and the lower Z section anchored to the roof structure. Curb shall have anchorage preapproval "R" from OSHPD in the state of California attesting to the maximum certified horizontal and vertical load ratings.

b. Curb shall be type RSC as manufactured by Mason Industries, Inc.
c. Substitutions: Division 01, Section 012300 Alternates, Section 012500 – Substitution Procedures – Substitution Request Form and Section 016000 - Product Requirements

23. Specification 23 – Expansion Joints
    a. Flexible spherical expansion joints shall employ peroxide cured EPDM in the covers, liners and Kevlar7 tire cord frictioning. Any substitutions must have equal or superior physical and chemical characteristics. Solid steel rings shall be used within the raised face rubber flanged ends to prevent pullout. Flexible cable bead wire is not acceptable. Sizes 2" (50mm) and larger shall have two spheres reinforced with a ductile iron external ring between spheres. Flanges shall be split ductile iron or steel with hooked or similar interlocks. Sizes 16" (400mm) to 24" (600mm) may be single sphere. Sizes 3/4" (19mm) to 1 2" (38mm) may have threaded two piece bolted flange assemblies, one sphere and cable retention. Connectors shall be rated at 250 psi (1.72MPa) up to 170o F (77oC) with a uniform drop in allowable pressure to 215 psi (1.48MPa)at 250o F (121oC) in sizes through 14"(350mm). 16" (400mm) through 24" (600mm) single sphere minimum ratings are 180 psi (1.24MPa) at 170o F (77oC) and 150 psi (1.03 MPa) at 250o F (121oC). Higher rated connectors may be used to accommodate service conditions. All expansion joints must be factory tested to 150% of rated pressure for 12 minutes before shipment. Safety factors to burst and flange pullout shall be a minimum of 3/1. Concentric reducers to the above ratings may be substituted for equal ended expansion joints.
    b. Expansion joints shall be installed in piping gaps equal to the length of the expansion joints under pressure. Control rods need only be used in unanchored piping locations where the manufacturer determines the installation exceeds the pressure requirement without control rods. If control rods are used, they must have 2" (12mm) thick Neoprene washer bushings large enough in diameter to take the thrust at 1000 psi (.7 kg/mm2) maximum on the washer area.
    c. Submittals shall include two test reports by independent consultants showing minimum reductions of 20 DB in vibration accelerations and 10 DB in sound pressure levels at typical blade passage frequencies on this or

a similar product by the same manufacturer. All expansion joints shall be installed on the equipment side of the shut off valves.

d. Expansion joints shall be SAFEFLEX SFDEJ, SFEJ, SFDCR or SFU and Control Rods CR as manufactured by Mason Industries, Inc.

e. Substitutions: Division 01, Section 012300 Alternates, Section 012500 – Substitution Procedures – Substitution Request Form and Section 016000 - Product Requirements

24. Specification 24 – Flexible Stainless Steel Hoses

a. Flexible stainless steel hose shall have stainless steel braid and carbon steel fittings. Sizes 3" (75mm) and larger shall be flanged. Smaller sizes shall have male nipples. Minimum lengths shall be as tabulated:

Flanged		Male Nipples	
3 x 14	10 x 26	1/2 x 9	1 1/2 x 13
4 x 15	12 x 28	3/4 x 10	2 x 14
5 x 19	14 x 30	1 x 11	2 1/2 x 18
6 x 20	16 x 32	1 1/4 x 12	
8 x 22			

b. Hoses shall be installed on the equipment side of the shut-off valves horizontally and parallel to the equipment shafts wherever possible.

c. Hoses shall be type BSS as manufactured by Mason Industries, Inc.

d. Substitutions: Division 01, Section 012300 Alternates, Section 012500 – Substitution Procedures – Substitution Request Form and Section 016000 - Product Requirements

25. Specification 25 - All-Directional Acoustical Pipe Anchor

a. All-directional acoustical pipe anchor, consisting of two sizes of steel tubing separated by a minimum 1/2" (12mm) thick 60 durometer neoprene. Vertical restraint shall be provided by similar material arranged to prevent vertical travel in either direction. Allowable loads on the isolation material should not exceed 500 psi (.35 kg/mm2) and the design shall be balanced for equal resistance in any direction.

b. All-directional anchors shall be type ADA as manufactured by Mason Industries, Inc.

c. Substitutions: Division 01, Section 012300 Alternates, Section 012500 – Substitution Procedures – Substitution Request Form and Section 016000 - Product Requirements

26. Specification 26 – Pipe Guides

a. Pipe guides shall consist of a telescopic arrangement of two sizes of steel tubing separated by a minimum 1/2" (12mm) thickness of 60 durometer neoprene. The height of the guides shall be preset with a shear pin to allow vertical motion due to pipe expansion or contraction. Shear pin shall be removable and reinsertable to allow for selection of pipe movement. Guides shall be capable of + 1 5/8" (41mm) motion, or to meet location requirements.

b. Pipe guides shall be type VSG as manufactured by Mason Industries, Inc.
c. Substitutions: Division 01, Section 012300 Alternates, Section 012500 – Substitution Procedures – Substitution Request Form and Section 016000 - Product Requirements

27. Specification 27 - Split Wall Seals
    a. Split Wall Seals consist of two bolted pipe halves with minimum 3/4" (19mm) thick neoprene sponge bonded to the inner faces. The seal shall be tightened around the pipe to eliminate clearance between the inner sponge face and the piping. Concrete may be packed around the seal to make it integral with the floor, wall or ceiling if the seal is not already in place around the pipe prior to the construction of the building member. Seals shall project a minimum of l" (25mm) past either face of the wall. Where temperatures exceed 240o F (115oC), 10# (4.5kg) density fiberglass may be used in lieu of the sponge.
    b. Seals shall be Type SWS as manufactured by Mason Industries, Inc.
    c. Substitutions: Division 01, Section 012300 Alternates, Section 012500 – Substitution Procedures – Substitution Request Form and Section 016000 - Product Requirements
28. Specification 28 - Horizontal Thrust Restraint
    a. The horizontal thrust restraint shall consist of a spring element in series with a neoprene molded cup as described in specification 5 with the same deflection as specified for the mountings or hangers. The spring element shall be designed so it can be preset for thrust at the factory and adjusted in the field to allow for a maximum of 1/4" (6mm) movement at start and stop. The assembly shall be furnished with 1 rod and angle brackets for attachment to both the equipment and the duct work or the equipment and the structure. Horizontal restraints shall be attached at the centerline of thrust and symmetrical on either side of the unit.
    b. Horizontal thrust restraints shall be type WBI/WBD as manufactured by Mason Industries, Inc.
    c. Substitutions: Division 01, Section 012300 Alternates, Section 012500 – Substitution Procedures – Substitution Request Form and Section 016000 - Product Requirements

B. Table for Project: the list of Product Specification Type 1 through Type 28 to be used for project is located in at the end of the EXECUTION section.

PART 3 EXECUTION

3.1 EXAMINATION

A. Section 01 30 00 - Administrative Requirements: Coordination and project conditions.

B. Verify equipment, ductwork and piping is installed before work in this section is started.

3.2 EXISTING WORK

A. Provide access to existing piping and ductwork and other installations remaining active and requiring access.

B. Extend existing piping and ductwork installations using materials and methods.

3.3 INSTALLATION OF VIBRATION ISOLATORS

A. Vibration isolators and seismic restraint systems shall control excessive noise and vibration in the buildings due to the operation of machinery or equipment, and/or due to interconnected piping, ductwork, or conduit. The installation of all vibration isolators and seismic restraint units, and associated hangers and bases, shall be under the direct supervision of the vibration isolation manufacturer's representative.

B. All vibration isolators and seismic restraint systems must be installed in strict accordance with the manufacturers written instructions and all certified submittal data.

C. Installation of vibration isolators and seismic restraints must not cause any change of position of equipment, piping or ductwork resulting in stresses or misalignment.

D. No rigid connections between equipment and the building structure shall be made that degrades the noise and vibration control system herein specified.

E. The contractor shall not install any equipment, piping, duct or conduit that makes rigid connections with the building unless isolation is not specified. "Building" includes, but is not limited to, slabs, beams, columns, studs and walls.

F. Coordinate work with other trades to avoid rigid contact with the building.

G. Any conflicts with other trades that will result in rigid contact with equipment or piping due to inadequate space or other unforeseen conditions should be brought to the architects/engineers attention prior to installation. Corrective work necessitated by conflicts after installation shall be at the responsible contractors expense.

H. Bring to the architects/engineers attention any discrepancies between the specifications and the field conditions or changes required due to specific equipment selection, prior to installation. Corrective work necessitated by discrepancies after installation shall be at the responsible contractors expense.

I. Correct, at no additional cost, all installations that are deemed defective in workmanship and materials at the contractor’s expense.

J. Overstressing of the building structure must not occur because of overhead support of equipment. Contractor must submit loads to the structural engineer of record for approval. Generally bracing may occur from:
   1. Flanges of structural beams.
   2. Upper truss cords in bar joist construction.

3. Cast in place inserts or wedge type drill-in concrete anchors.

K. Specification 12 cable restraints shall be installed slightly slack to avoid short circuiting the isolated suspended equipment, piping or conduit.

L. Specification 12 cable assemblies are installed taut on non-isolated systems. Specification 13 seismic solid braces may be used in place of cables on rigidly attached systems only.

M. At locations where specification 12 or 13 restraints are located, the support rods must be braced when necessary to accept compressive loads with specification 14 braces.

N. At all locations where specification 12 or 13 restraints are attached to pipe clevis's, the clevis cross bolt must be reinforced with specification type 15 braces.

O. Drill-in concrete anchors for ceiling and wall installation shall be specification type 18, and specification type 19 female wedge type for floor mounted equipment.

P. Vibration isolation manufacturer shall furnish integral structural steel bases as required. Independent steel rails are not permitted on this project. Each fan and motor assembly shall be supported on a single structural steel frame.

Q. Hand built elastomeric expansion joints may be used when pipe sizes exceed 24" or specified movements exceed specification 23 capabilities.

R. Where piping passes through walls, floors or ceilings the vibration isolation manufacturer shall provide specification 27 wall seals.

S. Air handling equipment and centrifugal fans shall be protected against excessive displacement which results from high air thrust in relation to the equipment weight. Horizontal thrust restraint shall be specification type 28 (see selection guide).

T. Install isolation for motor driven equipment.

U. Bases:
1. Set steel bases for 1 inch clearance between housekeeping pad and base.
2. Set concrete inertia bases for 2 inch clearance between housekeeping pad and base.

V. Adjust equipment level and install spring hangers without binding. On closed spring isolators, adjust so side stabilizers are clear under normal operating conditions. Locate isolation hangers as near to the overhead support structure as possible.

W. Prior to making piping connections to equipment with operating weights substantially different from installed weights, block up equipment with temporary shims to final height. When full load is applied, adjust isolators to load to allow shim removal.

X. Provide pairs of horizontal limit springs on fans with more than 6.0 inch static pressure, and on hanger supported, horizontally mounted axial fans.

Y. Provide resiliently mounted equipment, piping, and ductwork with seismic snubbers. Provide each inertia base with minimum of four seismic snubbers located close to isolators. Snub equipment designated for post disaster use to 0.05 inch maximum clearance. Provide other snubbers with clearance between 0.15 inch and 0.25 inch.

Z. Support piping connections to isolated equipment resiliently as follows:
1. Up to 4 inch Diameter: First three points of support.
2. 5 to 8 inch Diameter: First four points of support.
3. 10 inch Diameter and Over: First six points of support.
4. Select three hangers closest to vibration source for minimum 1.0 inch static deflection or static deflection of isolated equipment. Select remaining isolators for minimum 1.0 inch static deflection or 1/2 static deflection of isolated equipment.

3.4 INSTALLATION OF ACOUSTIC PRODUCTS

A. Support duct silencers independent of ductwork .With flexible duct connections, lagged with leaded vinyl sheet on inlet and outlet. Refer to Section 23 33 00.

B. Install cross-talk silencers in wall. Calk wall penetrations; refer to Section 07 90 00.

C. Lag ductwork, where indicated by wrapping with insulation and covering. Apply covering to be airtight. Do not attach covering rigidly to ductwork. Coordinate with vapor barrier(s) requirements in other specification sections and as scheduled on drawings.

D. Attach ductwork to acoustic louvers with flexible duct connections. Refer to Section 23 33 00.

3.5 FIELD QUALITY CONTROL

A. Section 01 73 00 - Execution and Section 017700 - Closeout Procedures: Field inspecting, testing, adjusting, and balancing.

B. Inspect isolated equipment after installation and submit report. Include static deflections.

C. After start-up, final corrections and balancing of systems take octave band sound measurements over full audio frequency range in areas adjacent to mechanical equipment rooms, duct and pipe shafts, and other critical locations. Provide one-third octave band measurements of artificial sound sources in areas indicated as having critical requirements. Submit complete report of test results including sound curves.

D. Furnish services of testing agency to take noise measurement. Use meters meeting requirements of ANSI S1.4.

E. Pipe Isolation Schedule:

Pipe Size Inch	Isolated Distance from Equipment diameters
1	120
2	90 diameters
3	80 diameters
4	75 diameters
6	60 diameters
8	60 diameters

3.6 VIBRATION ISOLATION AND SEISMIC RESTRAINT INSTALLATION

A. Horizontal pipe isolation: The first three pipe hangers in the main lines near the mechanical equipment shall be as described in specification 11. Specification 11 hangers must also be used in all transverse braced isolated locations. Brace hanger rods with SRC clamps specification 14. Floor supported piping shall rest on isolators as described in specification 6. Heat exchanger's and expansion tanks are considered part of the piping run. The first three isolators from the isolated equipment will have the same static deflection as specified for the mountings under the connected equipment. If piping is connected to equipment located in basements and hangs from ceilings under occupied spaces the first three hangers shall have 0.75" (19mm) deflection for pipe sizes up to and including 3" (75mm), 1 1/2" (38mm) deflection for pipe sizes up to and including 6" (150mm), and 2 1/2" (64mm) deflection thereafter. Hangers shall be located as close to the overhead structure as practical. Where piping connects to mechanical equipment install specification 23 expansion joints or specification 24 stainless hoses if 23 is not suitable for the service.

B. Riser isolation: Risers shall be suspended from specification 10 hangers or supported by specification 5 mountings, anchored with specification 25 anchors, and guided with specification 26 sliding guides. Steel springs shall be a minimum of 0.75" (19mm) except in those expansion locations where additional deflection is required to limit load changes to $\pm$ 25% of the initial load. Submittals must include riser diagrams and calculations showing anticipated expansion and contraction at each support point, initial and final loads on the building structure, spring deflection changes and seismic loads. Submittal data shall include certification that the riser system has been examined for excessive stresses and that none will exist in the proposed design.

C. Seismic Restraint of Piping
1. Seismically restrain all piping listed as a, b or c below. Use specification 12 cables if isolated. Specification 12 or 13 restraints may be used on unisolated piping.
a. Fuel oil piping, gas piping, medical gas piping, and compressed air piping that is 1" (25mm) I.D. or larger.

b. Piping located in boiler rooms, mechanical equipment rooms, and refrigeration equipment rooms that is 1 1/4" (32mm) I.D. and larger.
c. All other piping 2 1/2" (64mm) diameter and larger.

2. Transverse piping restraints shall be at 40' (12m) maximum spacing for all pipe sizes, except where lesser spacing is required to limit anchorage loads.
3. Longitudinal restraints shall be at 80' (24m) maximum spacing for all pipe sizes, except where lesser spacing is required to limit anchorage loads.
4. Where thermal expansion is a consideration, guides and anchors may be used as transverse and longitudinal restraints provided they have a capacity equal to or greater than the restraint loads in addition to the loads induced by expansion or contraction.
5. For fuel oil and all gas piping transverse restraints must be at 20' (6m) maximum and longitudinal restraints at 40' (12m) maximum spacing.
6. Transverse restraint for one pipe section may also act as a longitudinal restraint for a pipe section of the same size connected perpendicular to it if the restraint is installed within 24" (600m) of the elbow or TEE or combined stresses are within allowable limits at longer distances.
7. Hold down clamps must be used to attach pipe to all trapeze members before applying restraints in a manner similar to clevis supports.
8. Branch lines may not be used to restrain main lines.
9. Cast iron pipe of all types, glass pipe and any other pipes joined with a four band shield and clamp assembly in Zones 2B, 3 and 4 shall be braced as in sections 3.2.D.2 and 3. For Zones 0, 1 and 2A, 2 band clamps may be used with reduced spacings of 1/2 of those listed in sections 3.2.D.2 and 3.

D. Vibration Isolation of Ductwork
1. All discharge runs for a distance of 50' (15m) from the connected equipment shall be isolated from the building structure by means of specification 10 hangers or specification 5 floor isolators. Spring deflection shall be a minimum of 0.75" (19mm).
2. All duct runs having air velocity of 1000 fpm (5 m/s) or more shall be isolated from the building structure by specification 11 hangers or specification 5 floor supports. Spring deflection shall be a minimum of 0.75" (19mm).
3. Flexible duct connections shall be provided at inlet and discharge ducts. Refer to Section 15910.

E. Seismic Restraint of Ductwork
1. Seismically restrain all duct work with specification 12 or 13 restraints as listed below:
   a. Restrain rectangular ducts with cross sectional area of 6 sq.ft. (.5 m^2) or larger.
   b. Restrain round ducts with diameters of 28" (700mm) or larger.
   c. Restrain flat oval ducts the same as rectangular ducts of the same nominal size.
2. Transverse restraints shall occur at 30' (9mm) intervals or at both ends of the duct run if less than the specified interval. Transverse restraints shall be installed at each duct turn and at each end of a duct run.

3. Longitudinal restraints shall occur at 60' (18m) intervals with at least one restraint per duct run. Transverse restraints for one duct section may also act as a longitudinal restraint for a duct section connected perpendicular to it if the restraints are installed within 4' (1.2m) of the intersection of the ducts and if the restraints are sized for the larger duct. Duct joints shall conform to SMACNA duct construction standards.
4. The ductwork must be reinforced at the restraint locations. Reinforcement shall consist of an additional angle on top of the ductwork that is attached to the support hanger rods. Ductwork is to be attached to both upper angle and lower trapeze.
5. A group of ducts may be combined in a larger frame so that the combined weights and dimensions of the ducts are less than or equal to the maximum weight and dimensions of the duct for which bracing details are selected.
6. Walls, including gypsum board non bearing partitions, which have ducts running through them may replace a typical transverse brace. Provide channel framing around ducts and solid blocking between the duct and frame.
7. Chimneys and stacks passing through floors are to be bolted at each floor level or secured above and below each floor with riser clamps and specification type 13 for seismic solid brace restraints.
8. Chimneys and stacks running horizontally to be braced every 30’ with specification type 12 seismic cable restraints or specification type 13 for seismic solid brace restraints.

F. Vibration Isolation and Seismic Restraint of Mechanical Equipment
1. All mechanical equipment shall be vibration isolated and seismically restrained as per the schedules in part 3.5 of this specification.
2. Equipment mounted on housekeeping pads: Pads shall be properly doweled or expansion shielded to deck to meet acceleration criteria.
3. Requirements for installation on concrete inertia bases shall be as follows:
    a. Minimum operating clearance between concrete inertia and base and housekeeping pad or floor shall be 2".
    b. The equipment structural steel or concrete inertia base shall be placed in position and supported temporarily by blocks or shims, as appropriate, prior to the installation of the machine or isolators.
    c. The isolators shall be installed without raising the machine and frame assembly.
    d. After the entire installation is complete and under full operational load, the isolators shall be adjusted so that the load is transferred from the blocks to the isolators. When all isolators are properly adjusted, the blocks or shims shall be barely free and shall be removed.
    e. Install equipment with flexibility in wiring connection.
    f. Verify that all installed isolator and mounting systems permit equipment motion in all directions. Adjust or provide additional resilient restraints to flexibly limit start-up equipment lateral motion to 1/4".
    g. Prior to start-up, clean out all foreign matter between bases and equipment. Verify that there are no isolation short circuits in the base, isolators, or seismic restraints.

3.6 SEISMIC RESTRAINT EXCLUSIONS

A. General: All mechanical and electrical components and systems that are considered exempt from the requirement for seismic restraint, in accordance with The International Building Code –2015 w/2018 CT Supplement, Section.1621 and all related State of Connecticut Supplements, shall not require seismic restraint.

B. Piping
1. Piping in boiler and mechanical rooms less than 1 1/4" (32mm) inside diameter.
2. All other piping less than 2 1/2" (64mm) inside diameter.
3. All piping suspended by individual hangers 12" (300mm) or less as measured from the top of the pipe to the bottom of the support where the hanger is attached. However, if the 12" (300mm) limit is exceeded by any hanger in the run, seismic bracing is required for the run.
4. The 12" (300mm) exemption applies for trapeze supported systems if the top of each item supported by the trapeze qualifies.

C. Ductwork
1. Rectangular and square and ducts that are less than 6 square feet in cross sectional area.
2. Oval ducts that are less than 6 square feet (.5m^2) in cross sectional area based on nominal size.
3. Round duct less than 28" (.5m^2) in diameter.
4. All duct suspended by hangers 12" (300mm) or less in length as measured from the top of the duct to the point of attachment to the structure. Hangers must be attached within 2" (50mm) of the top of the duct with a minimum of two #10 sheet metal screws. If the 12" (300mm) limit is exceeded by any hanger in the run, seismic bracing is required for the run.

3.7 INSPECTION

A. Examine systems under provisions of Division 1.

B. On completion of installation of all vibration isolation devices herein specified, the local representative shall inspect the completed system and report in writing any installation error, improperly elected isolation devices, or other faults in the system that could affect the performance of the system. Contractor shall submit a report to the Owner, including the manufacturers representatives' final report, indicating all isolation reported as properly installed or requiring correction, and include a report by the Contractor on steps taken to properly complete the isolation work.

3.8 SCHEDULES

	ISOLATION, DEFLECTION AND SEISMIC RESTRAINT CRITERIA FOR SOLID CONCRETE FLOORS 4" AND THICKER (NOTE 7)									
	Ground Supported Slab or Basement		20' Floor Span Possible Floor Defl. – 0.67"		30' Floor Span Possible Floor Defl. – 1.0"		40' Floor Span Possible Floor Defl. – 1.33"		50' Floor Span Possible Floor Defl. – 1.67"	
SPECIFICATION SELECTION GUIDE	Isol. & Seismic Spec.	Isol. Defl.	Isol. & Seismic Spec.	Isol. Defl.	Isol. & Seismic Spec.	Isol. Defl.	Isol. & Seismic Spec.	Isol. Defl.	Isol. & Seismic Spec.	Isol. Defl.
REFRIG. MACHINES										
Centrifugal Chillers or Heat Pumps										
Cooler Condenser Mounted Hermetic Compressors	2-20-23	0.35	6-20-23	0.75	6-20-23	1.5	6-23	1.5	6-20-23	2.5
Cooler Condenser Alongside Hermetic Compressor	2-23	0.35	6-23	0.75	6-23	1.5	6-23	1.5	6-23	2.5
Open Type Compressor (note 3)	2-23	0.35	6-23	0.75	6-23	1.5	6-20-23	1.5	6-20-23	2.5
Refrig. Reciprocating Compressors										
500 rpm to 750 rpm	6-23	0.75	6-23	1.5	6-23	1.5	6-20-23	2.5	6-20-23	3.5
751 rpm and Over	6-23	0.75	6-23	0.25	6-23	1.5	6-20-23	2.5	6-20-23	3.5
Reciprocating Chillers or Heat Pumps										
500 rpm to 750 rpm	6-23	0.75	6-23	1.5	6-23	1.5	6-20-23	2.5	6-20-23	3.5
751 rpm and Over	6-23	0.75	6-23	0.75	6-20-23	1.5	6-20-23	2.5	6-20-23	3.5

	ISOLATION, DEFLECTION AND SEISMIC RESTRAINT CRITERIA FOR SOLID CONCRETE FLOORS 4" AND THICKER (NOTE 7)									
	Ground Supported Slab or Basement		20' Floor Span Possible Floor Defl. – 0.67"		30' Floor Span Possible Floor Defl. – 1.0"		40' Floor Span Possible Floor Defl. – 1.33"		50' Floor Span Possible Floor Defl. – 1.67"	
SPECIFICATION SELECTION GUIDE	Isol. & Seismic Spec.	Isol. Defl.	Isol. & Seismic Spec.	Isol. Defl.	Isol. & Seismic Spec.	Isol. Defl.	Isol. & Seismic Spec.	Isol. Defl.	Isol. & Seismic Spec.	Isol. Defl.
PUMPS										
Closed Coupled										
Thru 5 hp	2-21-23	0.35	5-16-21-23	0.75	5-16-21-23	0.75	5-16-21-23	1.5	5-16-21-23	1.5
7 ½ hp and Larger	5-16-21-23	0.75	5-16-21-23	0.75	5-16-21-23	1.5	5-16-21-23	1.5	5-16-21-23	2.5
Base Mounted (note 2)										
Thru 60 hp	5-16-21-23	0.75	5-16-21-23	0.75	5-16-21-23	1.5	5-16-21-23	1.5	5-16-21-23	2.5
75 hp and Larger	5-16-21-23	0.75	5-16-21-23	1.5	5-16-21-23	2.5	5-16-21-23	2.5	5-16-21-23	3.5
Suspended Units (for Fan Heads see Blowers Guide)										
Thru 5 hp	10-12	1.0	10-12	1.0	10-12	1.0	10-12	1.0	10-12	1.0
7 ½ hp and Larger – 275 rpm to 400 rpm	10-12	1.5	10-12	1.5	10-12	1.5	10-12	1.5	10-12	1.5
7 ½ hp and Larger – 401 rpm and Over	10-12	1.0	10-12	1.0	10-12	1.0	10-12	1.5	10-12	2.5
Floor Mounted Units (for Fan Heads see Blowers Guide)										
Thru 5 hp	2	0.35	7	0.75	7	0.75	7	0.25	7	0.75

	ISOLATION, DEFLECTION AND SEISMIC RESTRAINT CRITERIA FOR SOLID CONCRETE FLOORS 4" AND THICKER (NOTE 7)									
	Ground Supported Slab or Basement		20' Floor Span Possible Floor Defl. – 0.67"		30' Floor Span Possible Floor Defl. – 1.0"		40' Floor Span Possible Floor Defl. – 1.33"		50' Floor Span Possible Floor Defl. – 1.67"	
SPECIFICATION SELECTION GUIDE	Isol. & Seismic Spec.	Isol. Defl.	Isol. & Seismic Spec.	Isol. Defl.	Isol. & Seismic Spec.	Isol. Defl.	Isol. & Seismic Spec.	Isol. Defl.	Isol. & Seismic Spec.	Isol. Defl.
7 ½ hp and Larger – 275 rpm to 400 rpm	2	0.35	7	1.5	7	1.5	7	1.5	7	1.5
7 ½ hp to 40 hp – 401 rpm and Over	2	0.35	7	0.75	7	0.75	7	1.5	5-16-20	2.5
50 hp and Larger – 401 rpm and Over	2	0.35	7	0.75	7	1.5	5-16-20	2.5	5-16-20	3.5

	DEFLECTION AND MOUNTING CRITERIA FOR SOLID CONCRETE FLOORS 4" OR THICKER (NOTE 7)					
	Ground Supported Slab or Basement		20' Floor Span Possible Floor Defl. – 0.67"	30' Floor Span Possible Floor Defl. – 1.0"	40' Floor Span Possible Floor Defl. – 1.33"	50' Floor Span Possible Floor Defl. – 1.67"
SPECIFICATION SELECTION GUIDE	Engr Spec	Min Static Defl (in) (note 1)	Engineer Specifications and Minimum Static Deflection as tabulated below (note 1)			
Blowers						
Utilities Set						
Floor Mounted (note 5)	2	0.35	Spec 7 for 0.75" and 1/5" deflection and Spec 5-20-16 for over 1.5" deflection with deflection from Blower Minimum Deflection Guide, but not to exceed 2.5"			
Roof Mounted			Spec 5-21-16 with deflection from Blower Minimum Deflection Guide. If roof will not handle concrete base load use Spec 6 for 0.75 and 1.5" deflection and Spec 6-20 for over 1.5" deflection			
Suspended Unit (note 5)			Spec 10-12 with deflection from Blower Minimum Deflection Guide, not to exceed 2.5" deflection			

	DEFLECTION AND MOUNTING CRITERIA FOR SOLID CONCRETE FLOORS 4" OR THICKER (NOTE 7)					
	Ground Supported Slab or Basement		20' Floor Span Possible Floor Defl. – 0.67"	30' Floor Span Possible Floor Defl. – 1.0"	40' Floor Span Possible Floor Defl. – 1.33"	50' Floor Span Possible Floor Defl. – 1.67"
SPECIFICATION SELECTION GUIDE	Engr Spec	Min Static Defl (in) (note 1)	Engineer Specifications and Minimum Static Deflection as tabulated below (note 1)			
Centrifugal Blowers (note 6)	2-21	0.35	Spec 5-21-16 with deflection from Blower Minimum Deflection Guide			
Fan Heads						
Floor Mounted	2-28	0.35	Spec 7-28 if 0.75" or 1.5" deflection or Spec 5-20-16-28 for deflection over 1.5" to 4.5" from Blower Minimum Deflection Guide.			
Suspended Units			Spec 10-12-28 with deflection from Blower Minimum Deflection Guide			
Tubular Centrifugal and Axial Fans						
Suspended Units			Spec 10-12 with deflection from Blower Minimum Deflection Guide, Spec 10-12-28 for over 4" static pressure			
Floor Mounted with Motor on/in Fan Casing	2	0.35	Spec 7 for 0.75" to 1.5" deflection and Spec 5-20-16 for over 1/5" deflection with deflection from Blower Minimum Deflection Guide, Spec 5-21-16 or 5-16-28 for over 4" static pressure			
Floor Mounted Arrangement 1 or any Separately Mounted Motor	2-21	0.35	Spec 5-21-16 with deflection from Blower Minimum Deflection Guide			
Cooling Towers & Condensing Units	2	0.35	Spec 6 with deflection from Blower Minimum Deflection Guide			

Blower Minimum Deflection Guide					
Fan Speed RPM	**Required Deflection for Ground**	**Required Deflection for 20' Floor Span**	**Required Deflection for 30' Floor Span**	**Required Deflection for 40' Floor Span**	**Required Deflection for 50' Floor Span**

	Supported Slab or Basement				
500 and up	0.35”	0.75”	1.5”	2.5”	3.5”
375-499	0.35”	1.5”	2.5”	3.5”	3.5”
300-374	0.35”	2.5”	2.5”	3.5”	3.5”
225-299	0.35”	3.5”	3.5”	3.5”	3.5”
175-225	0.35”	3.5”	4.5”	4.5”	4.5”
When blowers are 60 HP or larger, select deflection requirements for next larger span. A minimum of 2.5" should be used unless larger deflections are called for on the chart or these fans are located in the lowest sub-basement or on a slab on grade.					

Notes:

1. Minimum deflection called for in this specification are not 'nominal' but certifiable minimums. The 0.75", 1.5", 2.5", 3.5", and 4.5" minimums should be selected from manufacturers nominal 1", 2", 3", 4" and 5" series respectively. Air spring isolation specifications 8 & 9 may be substituted for steel springs above in highly sensitive noise free locations.

2. Vacuum, Condensate or Boiler Feed Pumps shall be mounted with their tanks on a common spec. 21 base with deflections as specified for base mounted pumps.

3. The base described in specification 20 is used under the drive side. Individual mountings as described in specification 6 are used under the Cooler and Condenser.

4. This type of compressor is highly unbalanced and sometimes requires inertia bases weighing 5 to 7 times equipment weight to reduce running motion.

5. Limit deflection f or utility sets 18" wheel diameter and smaller to 1 1/2".

6. FLOATING CONCRETE INERTIA BASES. Floating concrete inertia bases do not reduce vibration transmitted to the structure through the mountings. These bases will reduce vibratory motion, provide a very rigid machine base and minimize spring reactions to fan thrust. Engineers preferring steel bases rather than the concrete mentioned above in specification 5-21 should change the designation to 5-20. Concrete is preferred for all fans operating at static pressure above 4" and on roof tops.

7. LIGHT FLOOR CONSTRUCTION. When floors or roofs are lighter than 4" solid concrete a localized mass shall be introduce under the vibration mountings in the form of a sub-base. This sub-base should be 12" thick and 12" longer and wider than the mechanical equipment above it. When this mass is provided the 30' minimum static deflection requirements will suffice even in longer bays. The mass is also useful for unusually large bays over 50'. When floors are lighter than the 4" concrete or the location is in a particularly sensitive area and the mass described above cannot be introduced, select deflection requirements for the next larger span.

8. For equipment where increased resiliency and decreased accelerations are required change specification 16 snubbers to specification 17 snubbers.

END OF SECTION 23 0548

SECTION 23 0553 - IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
1. Nameplates.
2. Tags.
3. Stencils.
4. Pipe markers.
5. Ceiling tacks.
6. Labels.
7. Lockout devices.

B. Related Sections:
1. Section 09 91 00 – Painting: Execution requirements for piping painting specified by this section.
2. Section 23 04 00 – General Conditions for Mechanical Trades

1.2 REFERENCES

A. American Society of Mechanical Engineers:
1. ASME A13.1 - Scheme for the Identification of Piping Systems.

1.3 SUBMITTALS

A. Section 01 33 05 - Submittal Procedures: Submittal procedures.

B. Product Data: Submit manufacturers catalog literature for each product required.

C. Shop Drawings: Submit list of wording, symbols, letter size, and color coding for mechanical identification and valve chart and schedule, including valve tag number, location, function, and valve manufacturer's name and model number.

D. Samples: Submit two tags, labels, & pipe markers size used on project.

E. Manufacturer's Installation Instructions: Indicate installation instructions, special procedures, and installation.

F. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

1.4 CLOSEOUT SUBMITTALS

A. Section 01 73 00 - Execution and Section 017700 - Closeout Procedures: Closeout procedures.

B. Project Record Documents: Record actual locations of tagged valves; include valve tag numbers.

1.5 QUALITY ASSURANCE

A. Conform to ASME A13.1 for color scheme for identification of piping systems and accessories.

B. Maintain one copy of each document on site.

1.6 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience.

B. Installer: Company specializing in performing Work of this section with minimum three years documented experience approved by manufacturer.

1.7 PRE-INSTALLATION MEETINGS

A. Division 1 - Administrative Requirements: Pre-installation meeting.

B. Convene minimum one week prior to commencing work of this section.

1.8 FIELD MEASUREMENTS

A. Verify field measurements prior to fabrication.

1.9 EXTRA MATERIALS

A. Section 01 73 00 - Execution and Section 017700 - Closeout Procedures: Spare parts and maintenance products.

B. Furnish two containers of spray-on adhesive.

PART 2 PRODUCTS

2.1 NAMEPLATES

A. Manufacturers:
1. Brady Corporation: www.bradycorp.com

2. Campion America, Inc: www.Champion-America.com.
3. Craftmark Identification Systems.
4. Safety Sign Co.
5. Seton Identification Products.
6. Substitutions: Division 01, Section 012300 Alternates, Section 012500 – Substitution Procedures – Substitution Request Form and Section 016000 - Product Requirements.

B. Description: Laminated three-layer plastic with engraved letters.
1. Letter Color: White
2. Letter Height: ¼ inch
3. Background Color: Black

2.2 TAGS

A. Plastic Tags:
1. Manufacturers:
a. Craftmark Identification Systems
b. Safety Sign Co.
c. Seton Identification Products
d. Substitutions: Division 01, Section 012300 Alternates, Section 012500 – Substitution Procedures – Substitution Request Form and Section 016000 - Product Requirements.
2. Laminated three-layer plastic with engraved black letters on light contrasting background color. Tag size minimum 1-1/2 inches diameter.

B. Metal Tags:
1. Manufacturers:
a. Craftmark Identification Systems.
b. Safety Sign Co.
c. Seton Identification Products.
d. Substitutions: Division 01, Section 012300 Alternates, Section 012500 – Substitution Procedures – Substitution Request Form and Section 016000 - Product Requirements.
2. Brass with stamped letters; tag size minimum 1-1/2 inch diameter with smooth edges.

C. Information Tags:
1. Manufacturers:
a. Craftmark Identification Systems
b. Safety Sign Co.
c. Seton Identification Products.
d. Substitutions: Division 01, Section 012300 Alternates, Section 012500 – Substitution Procedures – Substitution Request Form and Section 016000 - Product Requirements.

2. Clear plastic with printed "Danger," "Caution," or "Warning" and message; size 3-1/4 x 5-5/8 inches with grommet and self-locking nylon ties.

D. Tag Chart: Typewritten list in anodized frame.

2.3 STENCILS

A. Manufacturers:
1. Craftmark Identification Systems
2. Safety Sign Co.
3. Seton Identification Products.
4. Substitutions: Division 01, Section 012300 Alternates, Section 012500 – Substitution Procedures – Substitution Request Form and Section 016000 - Product Requirements.

B. Stencils: With clean cut symbols and letters of following size:
1. ¾ tp 1-1/4 inch Outside Diameter of Insulation or Pipe: 8 inch long color field, ½ inch high letters
2. 1-1/2 to 2 inch Outside Diameter of Insulation or Pipe: 8 inch long color field, ¾ inch high letters.
3. 2-1/2 to 6 inch Outside Diameter of Insulation or Pipe: 12 inch long color field, 1-1/4 inch high letters.

C. Stencil Paint: As specified in Division 9, semi-gloss enamel, colors and lettering size conforming to ASME A13.1.

2.4 PIPE MARKERS

A. Color and Lettering: Conform to ASME A13.1.

B. Plastic Pipe Markers:
1. Manufacturers:
a. Craftmark Identification Systems.
b. Safety Sign Co.
c. Seton Identification Products.
d. Substitutions: Division 01, Section 012300 Alternates, Section 012500 – Substitution Procedures – Substitution Request Form and Section 016000 - Product Requirements.
2. Factory fabricated, flexible, semi-rigid plastic, preformed to fit around pipe or pipe covering. Larger sizes may have maximum sheet size with spring fastener.

C. Plastic Tape Pipe Markers:
1. Manufacturers:
a. Craftmark Identification Systems.
b. Safety Sign Co.
c. Seton Identification Products.

d. Substitutions: Division 01, Section 012300 Alternates, Section 012500 – Substitution Procedures – Substitution Request Form and Section 016000 - Product Requirements.

2. Flexible, vinyl film tape with pressure sensitive adhesive backing and printed markings.

D. Plastic Underground Pipe Markers:

1. Manufacturers:
   a. Seaton Model.
   b. Electro Tape.
   c. Pratt Tyco.
   d. Substitutions: Division 01, Section 012300 Alternates, Section 012500 – Substitution Procedures – Substitution Request Form and Section 016000 - Product Requirements.
2. Bright colored continuously printed plastic ribbon tape, minimum 6 inches wide by 4 mil thick, manufactured for direct burial service.

2.5 CEILING TACKS

A. Manufacturers:

1. Craftmark Identification Systems.
2. Safety Sign Co.
3. Seton Identification Products.
4. Substitutions: Division 01, Section 012300 Alternates, Section 012500 – Substitution Procedures – Substitution Request Form and Section 016000 - Product Requirements.

B. Description: Steel with 3/4 inch diameter color-coded head.

C. Color code as follows:

1. HVAC equipment: Yellow.
2. Fire dampers/smoke dampers: Red.
3. Plumbing valves: Green.
4. Heating/cooling valves: Blue.

2.6 LABELS

A. Manufacturers:

1. Craftmark Identification Systems
2. Safety Sign Co.
3. Seton Identification Products.
4. Substitutions: Division 01, Section 012300 Alternates, Section 012500 – Substitution Procedures – Substitution Request Form and Section 016000 - Product Requirements.

B. Description: Laminated Mylar, size 1.9 x 0.75 inches, adhesive backed with printed identification and bar code.

2.7 LOCKOUT DEVICES

A. Lockout Hasps:
1. Manufacturers:
a. Craftmark Identification Systems
b. Safety Sign Co.
c. Seton Identification Products
d. Substitutions: Division 01, Section 012300 Alternates, Section 012500 – Substitution Procedures – Substitution Request Form and Section 016000 - Product Requirements
2. Reinforced nylon hasp with erasable label surface; size minimum 7-1/4 x 3 inches.

B. Valve Lockout Devices:
1. Manufacturers:
a. Craftmark Identification Systems
b. Safety Sign Co.
c. Seton Identification Products.
d. Substitutions: Refer to Division 1 - Product Requirements .
2. Nylon device preventing access to valve operator, accepting lock shackle.

PART 3 EXECUTION

3.1 PREPARATION

A. Section 09 91 00 – Painting: Execution requirements for piping painting specified by this section

B. Degrease and clean surfaces to receive adhesive for identification materials.

C. Prepare surfaces in accordance with Division 9 for stencil painting.

3.2 INSTALLATION

A. Section 09 91 00 – Painting: Execution requirements for piping painting specified by this section.

B. Apply stencil painting in accordance with Division 9.

C. Install identifying devices after completion of coverings and painting.

D. Install plastic nameplates with corrosive-resistant mechanical fasteners, or adhesive.

E. Install labels with sufficient adhesive for permanent adhesion and seal with clear lacquer. For unfinished canvas covering, apply paint primer before applying labels.

F. Install tags using corrosion resistant chain. Number tags consecutively by location.

G. Install underground plastic pipe markers 6 to 8 inches below finished grade, directly above buried pipe.

H. Identify air handling units, pumps, heat transfer equipment, tanks, and water treatment devices with plastic nameplates. Identify in-line pumps and other small devices with tags.

I. Identify control panels and major control components outside panels with plastic nameplates.

J. Identify valves in main and branch piping with tags.

K. Identify air terminal units and radiator valves with numbered tags.

L. Tag automatic controls, instruments, and relays. Key to control schematic.

M. Identify piping, concealed or exposed, with plastic pipe markers, plastic tape pipe markers or stenciled painting. Use tags on piping 3/4 inch diameter and smaller. Identify service, flow direction, and pressure. Install in clear view and align with axis of piping. Locate identification not to exceed 20 feet on straight runs including risers and drops, adjacent to each valve and tee, at each side of penetration of structure or enclosure, and at each obstruction.

N. For exposed natural gas lines other than steel pipe, attach yellow pipe labels with "GAS" in black lettering, at maximum 5 foot spacing.

O. Identify ductwork with stenciled painting. Identify with air handling unit identification number and area served. Locate identification at air handling unit, at each side of penetration of structure or enclosure, and at each obstruction.

P. Provide ceiling tacks to locate valves or dampers above T-bar type panel ceilings. Locate in corner of panel closest to equipment.

END OF SECTION 23 0553

SECTION 23 0593 - TESTING, ADJUSTING, AND BALANCING FOR HVAC

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
1. Testing adjusting, and balancing of air systems.
2. Testing adjusting, and balancing of hydronic and refrigerating systems.
3. Measurement of final operating condition of HVAC systems.
4. Sound measurement of equipment operating conditions.
5. Vibration measurement of equipment operating conditions.

B. Related Sections:
1. Section 019113 – General Commissioning Requirements Certificate of Readiness
2. Section 23 04 00 – General Conditions for Mechanical Trades
3. Section 23 08 00 – Commissioning of HVAC
4. Section 23 09 00 - Direct-Digital Control System for HVAC: Requirements for coordination between DDC system and testing, adjusting, and balancing work.
5. Section 23 09 95 - Sequence of Operations for HVAC Controls: Sequences of operation for HVAC equipment.

1.2 REFERENCES

A. Associated Air Balance Council:
1. AABC MN-1 - National Standards for Testing and Balancing Heating, Ventilating, and Air Conditioning Systems.

B. American Society of Heating, Refrigerating and Air-Conditioning Engineers:
1. ASHRAE 111 - Practices for Measurement, Testing, Adjusting and Balancing of Building Heating, Ventilation, Air-Conditioning and Refrigeration Systems.

C. Natural Environmental Balancing Bureau:
1. NEBB - Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems.

1.3 SUBMITTALS

A. Section 01 33 05 - Submittal Procedures: Submittal procedures.

B. Prior to commencing Work, submit proof of latest calibration date of each instrument.

C. Wherever tests, checks, inspections or start-up procedures by equipment manufacturers are required, submit written reports to Architect certifying that such procedures have been completed and including pertinent information.

D. Submit schematic flow diagrams for each system showing equipment, components, controls, sensors, etc., in their proper relationship, clearly labeled and identified. Diagrams shown on Contract Drawings may be used/modified when applicable.
   1. Show major branch ducts, and identify areas served by each branch.
   2. List individual supply air outlets and return air intakes in table form.
   3. Show system pressures, damper positions, and valve positions.

E. Submit, for review, test and balance reports in tabulated form, as follows and as detailed under PART 3.
   1. Preliminary report of all operating conditions. Submit 3 copies.
   2. Final report of all operating conditions after balancing adjustments are completed. Submit 6 copies.
   3. Record report updating Final Report to show any modifications and adjustments made as a result of final overall system performance and acceptance tests. Issue record report to Owner.

F. Test Reports: Indicate data on AABC MN-1 National Standards for Total System Balance forms or NEBB Report forms. Field Reports: Indicate deficiencies preventing proper testing, adjusting, and balancing of systems and equipment to achieve specified performance.

G. Prior to commencing Work, submit report forms or outlines indicating adjusting, balancing, and equipment data required. Include detailed procedures, agenda, sample report forms and copy of AABC National Project Performance Guaranty or a Copy of NEBB Certificate of Conformance Certification.

H. Submit draft copies of report for review prior to final acceptance of Project.

I. Furnish reports in soft cover, letter size, 3-ring binder manuals, complete with table of contents page and indexing tabs, with cover identification at front and side. Include set of reduced drawings with air outlets and equipment identified to correspond with data sheets, and indicating thermostat locations.

1.4 CLOSEOUT SUBMITTALS

A. Section 01 73 00 - Execution and Section 017700 - Closeout Procedures: Closeout procedures.

B. Project Record Documents: Record actual locations of flow measuring stations, balancing valves and rough setting.

C. Operation and Maintenance Data: Furnish final copy of testing, adjusting, and balancing report inclusion in operating and maintenance manuals.

1.5 QUALITY ASSURANCE

A. Perform Work in accordance with State of Connecticut standard.

B. Perform Work in accordance with AABC MN-1 National Standards for Field Measurement and Instrumentation, Total System Balance and NEBB Procedural Standards for Testing, Balancing and Adjusting of Environmental Systems.

C. Maintain one copy of each document on site.

D. Prior to commencing Work, calibrate each instrument to be used. Upon completing Work, recalibrate each instrument to assure reliability.

1.6 QUALIFICATIONS

A. Work of this section shall be provided by a firm with a minimum of 10 years experience in testing and balancing of HVAC systems following procedures and guidelines of Associated air Balance Council, National Environmental Balancing Bureau, and this specification. Adjustment and balancing of HVAC water and air systems shall be done by contractor hired by commissioning agent.

B. Perform Work under supervision of AABC Certified Test and Balance Engineer or NEBB Certified Testing, Balancing and Adjusting Supervisor.

1.7 PRE-INSTALLATION MEETINGS

A. Section 01 31 00 – Project Management.

B. Convene minimum one week prior to commencing work of this section.

1.8 SEQUENCING

A. Division 01 - Summary: Work sequence.

B. Sequence balancing between completion of systems tested and Date of Substantial Completion.

1.9 SCHEDULING

A. Division 01 - Administrative Requirements: Coordination and project conditions.

B. Schedule and provide assistance in final adjustment and test of smoke control system with Fire Authority.

1.10 SCOPE

A. Provide labor, materials, equipment, services and transportation necessary to complete balancing, adjustment and performance tests for HVAC systems, as indicated on Contract Drawings and specified herein, including but not limited to following:
   1. Hot water heating system
   2. Air supply, return and exhaust systems

B. Work of this section shall include coordinating the efforts of all trades associated with start-up and commissioning activities, and certifying that necessary pre-startup and pre-commissioning activities have been satisfactorily completed.

PART 2 PRODUCTS

Not Used.

PART 3 EXECUTION

3.1 EXAMINATION

A. Division 01 - Administrative Requirements: Coordination and project conditions.

B. Verify systems are complete and operable before commencing work. Verify the following:
1. Systems are started and operating in safe and normal condition.
2. Temperature control systems are installed complete and operable.
3. Proper thermal overload protection is in place for electrical equipment.
4. Final filters are clean and in place. If required, install temporary media in addition to final filters.
5. Duct systems are clean of debris.
6. Fans are rotating correctly.
7. Fire and volume dampers are in place and open.
8. Air coil fins are cleaned and combed.
9. Access doors are closed and duct end caps are in place.
10. Air outlets are installed and connected.
11. Duct system leakage is minimized.
12. Hydronic systems are flushed, filled, and vented.
13. Pumps are rotating correctly.
14. Proper strainer baskets are clean and in place or in normal position.
15. Service and balancing valves are open.

3.2 PREPARATION

A. Furnish instruments required for testing, adjusting, and balancing operations.

B. Make instruments available to Architect/Engineer to facilitate spot checks during testing.

3.3 INSTALLATION TOLERANCES

A. Air Handling Systems: Adjust to within plus or minus 10 percent of design.

B. Air Outlets and Inlets: Adjust total to within plus 10 percent and minus 5 percent of design to space. Adjust outlets and inlets in space to within plus or minus 10 percent of design.

C. Hydronic Systems: Adjust to within plus or minus 10 percent of design.

3.4 ADJUSTING

A. Section 01 73 00 - Execution and Section 017700 - Closeout Procedures: Testing, adjusting, and balancing.

B. Verify recorded data represents actual measured or observed conditions.

C. Permanently mark settings of valves, dampers, and other adjustment devices allowing settings to be restored. Set and lock memory stops.

D. After adjustment, take measurements to verify balance has not been disrupted. If disrupted, verify correcting adjustments have been made.

E. Report defects and deficiencies noted during performance of services, preventing system balance.

F. Leave systems in proper working order, replacing belt guards, closing access doors, closing doors to electrical switch boxes, and restoring thermostats to specified settings.

G. At final inspection, recheck random selections of data recorded in report. Recheck points or areas as selected and witnessed by Owner.

H. Check and adjust systems approximately six months after final acceptance and submit report.

3.5 GENERAL

A. Adjustment and balancing of HVAC water and air systems shall be done by independent firm according to this Specification and either (1) procedures and guidelines of Associated Air Balance Council, or (2) procedures and guidelines of National TAB Certification Board, or (3) procedures and guidelines of ASHRAE.

B. Balancing firm shall be one acceptable to Owner and Architect. Work shall be done by technicians certified under nationally recognized certification program for balancing, adjusting and testing (e.g., TAB certification).

3.6 WATER SYSTEMS

A. Prior to start of balancing work, ensure that following items of work have been completed:
   1. Piping system installed with hand valves, balance valves, automatic valves, flow measuring devices, gauges, thermometers and control devices in place.
   2. Equipment installation completed and in safe operating condition.
   3. Pressure tests and chemical cleaning completed.
   4. Strainers installed in place and clean.
   5. Systems filled, vented and pressurized.

6. Equipment lubricated as required by manufacturer.
7. Electrical protective equipment and wiring completed.
8. Automatic control system operable so that flows can be directed and maintained as required for test measurements at simulated full load and part load conditions.

B. Initial flow balancing may be done with systems at ambient temperature. Final performance tests, control adjustments and fine tuning shall be done at systems' normal operating temperatures.

C. Trades which performed installations of equipment, controls, piping and electrical work shall assist Balancing Firm as required.

D. Test reports shall include pressures, flow rates and motor amperes. Preliminary report shall be submitted and accepted before making adjustments. Notify Engineer immediately in writing, if major discrepancies are found during preliminary work.

E. Balance Procedure: With normally open valves open and full flow through heat transfer equipment, balance system to obtain specified design flows.
1. Full flow tests shall be made with system pumps running at full speed.
2. During full-flow test: Adjust equipment and control valve bypasses which have permanent balance valves, for 75% to 100% of full flow. Adjust bypasses with 3-way valves in full bypass position, for approximately 50% of full flow.
3. Each pump of multiple-pump system shall be tested. Multiple-pump system shall be tested independently with only one pump operating at a time. These tests shall be performed after completion of full-flow balancing with all pumps operating.
4. Readjust, fine tune and trim systems as necessary to obtain desired overall system performance, quiet operation and maximum efficiency.

F. Balance Reports shall include following:
1. Equipment and motor nameplate data stating manufacturer, model, size, amperes, voltage, phase and horsepower.
2. Actual motor amperes per phase and line-to-line voltage for each test condition.
3. System static pressure.
4. Suction and discharge flow pressures and gpm at each pump for each test condition.
5. Inlet and outlet pressures and gpm at each piece of heat transfer equipment.
6. gpm at each flow measuring station.
7. Final position of each balance valve.
8. Temperatures at each thermometer and sensor location, at system operating conditions.

3.7 AIR SYSTEM BALANCING – GENERAL

A. Prior to start of balancing work, ensure that following items of work have been completed:
   1. Ducts and plenums installed with manual dampers, fire dampers, automatic dampers, gauges, thermometers and control devices in place.
   2. Equipment installation completed and in safe operating condition.
   3. Grilles, registers, diffusers and louvers installed.
   4. Clean filters installed.
   5. Ducts, louvers, coils, etc., free from obstructions.
   6. Dampers in full open position.
   7. Equipment lubricated as recommended by manufacturer.
   8. Electrical protective equipment and wiring completed.
   9. Fan wheels rotating freely and in proper direction.
   10. V-belt drives installed, properly tensioned; no loose sheaves.
   11. Automatic control system operable so that air flows can be directed and maintained as required for making test measurements under constant simulated full flow conditions and, if necessary, fixed part load conditions.
   12. Variable frequency drives set at 60 Hertz.
   13. Plenums and housings cleaned of debris.
   14. Excessive or undesirable system leakage eliminated.
   15. Each and every fire damper physically inspected and operationally verified under air systems' normal operating mode.

B. Initial balancing shall be done with systems at ambient temperature. Final performance tests, fine tuning and adjustments shall be done at systems' normal operating temperatures.

C. Trades which performed installations of controls, sheet metal and electrical work shall assist Balancing Firm as required.

D. Replace drive sheaves and belts as required to develop full design cfm.

E. Air balance supply and return air fans, with following allowances in fan speeds for dirty filters, damper sequencing, duct leakage and building pressurization. System design fan pressures and cfm flow requirements are based on dirty filters; initial readings with clean filters should be established at approximately 105% to 110% of supply fan volume shown on Contract Drawings Schedule.

F. Preliminary balancing may be done individually by system, but final balancing shall be made with all air systems including exhaust systems operating during balancing procedure for each system. Final balancing of exhaust system shall be done while supply systems are running with minimum outside air.

G. Verify air distribution in each room and area; readjust diffuser deflectors and blank-off sheets and grille face bars as necessary to obtain best air distribution and minimize drafts.

Where these adjustments can change delivered cfm, perform final air balancing after said adjustments.

H. Do NOT exceed exhaust system register and fan design air volumes.

I. Visually and mechanically verify that automatic dampers operate as intended, without binding, and are properly positioned during air system tests and balancing procedures.

J. Prepare system pressure profiles: On schematic fan system diagrams, show STATIC pressure readings taken at following points.
1. Fan discharge
2. Fan discharge plenum or main duct in fan room
3. Fan inlet plenum
4. Inlet and outlet plenum space on each side of each heating coil, cooling coil and filter
5. Return air/outside air mixing plenum
6. Duct or plenum immediately behind outside air louver
7. Return/exhaust fan inlet
8. Return/exhaust fan outlet
9. Each main branch duct takeoff at each floor
10. Within 3 feet of last supply air outlet connection in most remote duct

K. Preliminary report shall be submitted and accepted before making adjustments. Notify Engineer immediately in writing, if major discrepancies are found during preliminary work.

L. Reports shall be organized by system and by fan number and shall include following:
1. Manufacturer's name, model and size of each fan.
2. Number and location of each fan.
3. Nameplate amperes, voltage, phase and horsepower for each fan motor.
4. Actual amperes for each phase, for each fan motor: at high speed and low speed for multi-speed motors, at VAV maximum air flow and at VAV minimum air flow.
5. Inlet static pressure and discharge static pressure, for each fan: at high speed and low speed for multi-speed motors, at VAV minimum air flow and at VAV maximum air flows.
6. Design and actual cfm air flow for each fan: at high speed or maximum air flow.
7. Design and actual RPM of each fan, at high speed and low speed.
8. Pressure profiles and static pressure readings for each air system.
9. Building pressurization readings for each floor.
10. Design and actual cfm air flow at maximum system design flow: for each supply air outlet, for each return air inlet, for each exhaust air inlet, total of supply outlet readings for each system, and total of return and exhaust inlets for each system.
11. Readings shall be identified by both room and equipment number used in Contract Drawings. Pressure readings shall be indicated as either single point reading or as average of number of readings, as appropriate. Individual register readings shall be grouped by volume control boxes, by fan and by system.

3.8 STABILIZING SUPPLY AND RETURN FANS

A. Stabilizing of supply and return fans shall be done after preliminary system pressure and flow readings have been taken and before proceeding with final system adjustment, by following methods.

B. Measure suction pressure in 0A/RA mixing plenum. Pressure shall be approximately 0.10" to 0.15" w.g. negative to atmosphere, during minimum outside air operating mode.
1. If pressure is higher (less negative with respect to atmosphere), find and identify leaks into mixing plenum. If there are no leaks, adjust return fan RPM to reduce return air cfm.
2. If this pressure is lower (more negative with respect to atmosphere), increase fan RPM to increase return cfm.

C. Establish minimum outside air as per cent of design cfm, by accurate air volume measurement. If minimum outside air is higher than design minimum, find and seal leakage through outside air dampers and mixing plenum. Adjust minimum outside air damper position by installing open position stops or by revising linkage adjustments.

D. Sequence outside air dampers, return air dampers and exhaust air dampers from minimum outside air to maximum outside air, and from maximum outside air to minimum outside air. Continuously monitor pressure and flow readings. Static pressure readings in mixed air plenum with respect to atmosphere during damper modulation sequence should not vary by more than 0.1" w.g.

E. Sequence outside air dampers from fully closed to fully open, with return damper closed and exhaust damper open; full fan suction pressure should occur in outside air and mixed air duct and plenum. Record these pressure and flow readings.
1. Dampers shall close and open against this pressure without binding or lag in movement.
2. Check damper mounting.
3. Find and identify leakage into ducts and plenums.

3.9 BALANCING SUPPLY, RETURN AIR AND EXHAUST AIR REGISTERS

A. With supply and return air balancing dampers in maximum open position, and with supply system operating normally on minimum outside air, measure air flow through supply diffusers and grilles. Measure flow by neck velocity, tip velocity or any other acceptable method of measuring air flow. Record air flows.

B. At this time, use register readings on VAV systems with variable volume control boxes to verify accuracy, capacity and calibration of zone volume controls.

C. Determine diffuser or grille outlet with lowest per cent design flow on each branch duct. Adjust balancing dampers in other branch ducts to attain same percentage of design flow as measured through outlet with lowest flow. Balancing dampers in duct with most critical flow or lowest percent design flow shall remain in maximum open position.

D. Adjust balancing dampers for outlets to attain percent design flow, averaged from previous measurements for all outlets. Balancing dampers for outlet with most critical flow or lowest percent design flow shall remain in maximum open position. If average per cent design flow is less than that shown on Contract Drawings:
   1. Check that VAV supply fan is operating at maximum speed/output.
   2. Adjust fan motor sheave to speed up or slow down both supply and return air fans as required to get total system design cfm.
   3. Repeat measurements for critical and representative grilles and diffusers.

3.10 BALANCING VARIABLE AIR VOLUME SYSTEMS

A. Coordinate balancing work with temperature control work. Take pressure and velocity readings as required for control work.

B. Supply fan speed shall be positioned as part of temperature control work as required to satisfy zone airflow requirements with minimum static pressure in the duct system.

C. Adjust lab exhaust fan staging and bypass dampers to sequence smoothly between minimum and maximum flow.

D. After initial set-up of supply air zone volume controls and fan static pressure controls:
   1. Sequence systems from maximum to minimum cfm.
   2. Verify that air flow delivered in each zone meets design requirements for maximum airflow, minimum airflow, differential airflow and pressurization.
   3. For office air system(s) verify that return fan cfm always follows supply cfm changes, based on relative percentage of design return/supply air flows and that outside air quantity varies based on differential CO2 load to ensure proper outside air quality.

3.11 BUILDING PRESSURIZATION

A. When all systems have been balanced and are operating on minimum outside air:
   1. Close outside doors and windows.
   2. Measure and record building pressure with respect to atmosphere, for each floor and area in building.

B. On calm day, building pressure shall average 0.02” to 0.04” w.g. higher than atmosphere.

C. If measured building pressure is lower than design, check suction pressure between outside air dampers and filters, and between return air dampers and filters. Pressure shall be negative to atmosphere as specified in paragraph___, STABILIZING FANS. (Negative building pressure usually indicates either minimum air quantities are too low or exhaust air quantities are too high.)

D. If measured building pressure is higher than design, check that all exhaust fans are running. Check suction pressure between outside air dampers and filters, and between return air dampers and filters. Pressure shall be negative to atmosphere as specified in

paragraph___, STABILIZING FANS. (High positive building pressure usually indicates either minimum air quantities are too high or exhaust air quantities are too low.)

E. Determine area with lowest interior pressure with respect to atmosphere and reduce return air volume until this area attains pressure slightly higher than pressure averaged for all areas. Repeat for next three lowest pressure areas. Areas with highest pressure shall have return air dampers in maximum open position.

3.12 SPACE TEMPERATURE CONTROL AND TROUBLE SHOOTING

A. Upon completion of testing, balancing and adjusting of HVAC systems, trades which installed systems shall cooperate in fine tuning of HVAC systems to ensure that proper space conditions will be maintained.

END OF SECTION 23 0593

SECTION 23 0700 - HVAC INSULATION

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
1. HVAC piping insulation, jackets and accessories.
2. HVAC equipment insulation, jackets and accessories.
3. HVAC ductwork insulation, jackets, and accessories.

B. Related Sections:
1. Section 07 84 13 – Penetration Firestopping: Product requirements for firestopping for placement by this section.
2. Section 07 84 46 – Fire-Resistive Joint Systems: Product requirements for firestopping for placement by this section.
3. Section 09 91 00 – Painting: Execution requirements for piping painting specified by this section.
4. Section 23 04 00 – General Conditions for Mechanical Trades

1.2 REFERENCES

A. ASTM International:
1. ASTM A240/A240M - Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications.
2. ASTM A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar.
3. ASTM B209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
4. ASTM C195 - Standard Specification for Mineral Fiber Thermal Insulating Cement.
5. ASTM C449/C449M - Standard Specification for Mineral Fiber Hydraulic-Setting Thermal Insulating and Finishing Cement.
6. ASTM C450 - Standard Practice for Fabrication of Thermal Insulating Fitting Covers for NPS Piping, and Vessel Lagging.
7. ASTM C533 - Standard Specification for Calcium Silicate Block and Pipe Thermal Insulation.
8. ASTM C534 - Standard Specification for Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form.
9. ASTM C547 - Standard Specification for Mineral Fiber Pipe Insulation.
10. ASTM C553 - Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications.
11. ASTM C578 - Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation.

12. ASTM C585 - Standard Practice for Inner and Outer Diameters of Rigid Thermal Insulation for Nominal Sizes of Pipe and Tubing (NPS System).
13. ASTM C591 - Standard Specification for Unfaced Preformed Rigid Cellular Polyisocyanurate Thermal Insulation.
14. ASTM C612 - Standard Specification for Mineral Fiber Block and Board Thermal Insulation.
15. ASTM C795 - Standard Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel.
16. ASTM C921 - Standard Practice for Determining the Properties of Jacketing Materials for Thermal Insulation.
17. ASTM C1071 - Standard Specification for Thermal and Acoustical Insulation (Glass Fiber, Duct Lining Material).
18. ASTM C1136 - Standard Specification for Flexible, Low Permeance Vapor Retarders for Thermal Insulation.
19. ASTM C1290 - Standard Specification for Flexible Fibrous Glass Blanket Insulation Used to Externally Insulate HVAC Ducts.
20. ASTM D1785 - Standard Specification for Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC) Compounds.
21. ASTM D4637 - Standard Specification for EPDM Sheet Used in Single-Ply Roof Membrane.
22. ASTM E96/E96M - Standard Test Methods for Water Vapor Transmission of Materials.
23. ASTM E162 - Standard Test Method for Surface Flammability of Materials Using a Radiant Heat Energy Source.

B. Sheet Metal and Air Conditioning Contractors':
   1. SMACNA - HVAC Duct Construction Standard - Metal and Flexible.

C. Underwriters Laboratories Inc.:
   1. UL 1978 - Standard for Safety for Grease Ducts.

1.3 SUBMITTALS

A. Section 01 33 05 - Submittal Procedures: Submittal procedures.

B. Product Data: Submit product description, thermal characteristics and list of materials and thickness for each service, and location.

C. Samples: Submit two samples of representative size illustrating each insulation type.

D. Manufacturer's Installation Instructions: Submit manufacturers published literature indicating proper installation procedures.

E. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

1.4 QUALITY ASSURANCE

A. Test pipe insulation for maximum flame spread index of 25 and maximum smoke developed index of not exceeding 50 in accordance with ASTM E84.

B. Pipe insulation manufactured in accordance with ASTM C585 for inner and outer diameters.

C. Factory fabricated fitting covers manufactured in accordance with ASTM C450.

D. Duct insulation, Coverings, and Linings: Maximum 25/50 flame spread/smoke developed index, when tested in accordance with ASTM E84, using specimen procedures and mounting procedures of ASTM E 2231.

E. Maintain one copy of each document on site.

1.5 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience.

B. Applicator: Company specializing in performing Work of this section with minimum three years documented experience approved by manufacturer.

1.6 PRE-INSTALLATION MEETINGS

A. Section 01 30 00 - Administrative Requirements: Pre-installation meeting.

B. Convene minimum one week prior to commencing work of this section.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Section 01 60 00 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.

B. Accept materials on site in original factory packaging, labeled with manufacturer's identification, including product density and thickness.

C. Protect insulation from weather and construction traffic, dirt, water, chemical, and damage, by storing in original wrapping.

1.8 ENVIRONMENTAL REQUIREMENTS

A. Section 01 60 00 - Product Requirements: Environmental conditions affecting products on site.

B. Install insulation only when ambient temperature and humidity conditions are within range recommended by manufacturer.

C. Maintain temperature before, during, and after installation for minimum period of 24 hours.

1.9 FIELD MEASUREMENTS

A. Verify field measurements prior to fabrication.

1.10 WARRANTY

A. Section 01 73 00 - Execution and Section 017700 - Closeout Procedures: Product warranties and product bonds.

B. Furnish five year manufacturer warranty for manmade fiber.

C. Warranty shall include labor and materials for a minimum period of two (2) years unless otherwise specified. Warranty starts at date of Commissioning acceptance of a complete system and Owner approval

PART 2 PRODUCTS

2.1 MANUFACTURER

A. Manufacturers for Glass Fiber and Mineral Fiber Insulation Products:
1. CertainTeed.
2. Knauf.
3. Johns Manville.
4. Owens-Corning.
5. Substitutions: Division 01, Section 012300 Alternates, Section 012500 – Substitution Procedures – Substitution Request Form and Section 016000 - Product Requirements

B. Manufacturers for Closed Cell Elastomeric Insulation Products:
1. Aeroflex. Aerocell.
2. Armacell, LLC. Armaflex.
3. Nomaco. K-flex.
4. Substitutions: Division 01, Section 012300 Alternates, Section 012500 – Substitution Procedures – Substitution Request Form and Section 016000 - Product Requirements

C. Manufacturers for Polyisocyanurate Foam Insulation Products:
1. Dow Chemical Company.
2. Substitutions: Division 01, Section 012300 Alternates, Section 012500 – Substitution Procedures – Substitution Request Form and Section 016000 - Product Requirements

D. Manufacturers for Extruded Polystyrene Insulation Products:
1. Dow Chemical Company.
2. Johns Manville
3. Green Poly ISO
4. Substitutions: Division 01, Section 012300 Alternates, Section 012500 – Substitution Procedures – Substitution Request Form and Section 016000 - Product Requirements

2.2 PIPE INSULATION

A. TYPE P-1: ASTM C547, molded glass fiber pipe insulation.
1. Thermal Conductivity: 0.23 at 75 degrees F.
2. Operating Temperature Range: 0 to 850 degrees F.
3. Vapor Barrier Jacket: ASTM C1136, Type I, factory applied reinforced foil kraft with self-sealing adhesive joints.
4. Jacket Temperature Limit: minus 20 to 150 degrees F.

B. TYPE P-5: ASTM C534, Type I, flexible, closed cell elastomeric insulation, tubular.
1. Thermal Conductivity: 0.27 at 75 degrees F.
2. Operating Temperature Range: Range: Minus 70 to 180 degrees F.

2.3 PIPE INSULATION JACKETS

A. Vapor Retarder Jacket:
1. ASTM C921, white Kraft paper with glass fiber yarn, bonded to aluminized film.
2. Water Vapor Permeance: ASTM E96/E96M; 0.02 perms.

B. PVC Plastic Pipe Jacket:
1. Product Description: ASTM D1785, One piece molded type fitting covers and sheet material, off-white color.
2. Thickness: 10 mil.
3. Connections: Brush on welding adhesive.

C. Aluminum Pipe Jacket:
1. ASTM B209.
2. Thickness: 0.020 inch thick sheet.
3. Finish: Smooth.
4. Joining: Longitudinal slip joints and 2 inch laps.
5. Fittings: 0.02 inch thick die shaped fitting covers with factory attached protective liner.
6. Metal Jacket Bands: 3/8 inch wide; 0.016 inch thick aluminum.

2.4 PIPE INSULATION ACCESSORIES

A. Vapor Retarder Lap Adhesive: Compatible with insulation.

B. Covering Adhesive Mastic: Compatible with insulation.

C. Piping 1-1/2 inches diameter and smaller: Galvanized steel insulation protection shield. MSS SP-69, Type 40. Length: Based on pipe size and insulation thickness.

D. Piping 2 inches diameter and larger: Wood insulation saddle, hard maple. Inserts length: not less than 6 inches long, matching thickness and contour of adjoining insulation.

E. Closed Cell Elastomeric Insulation Pipe Hanger: Polyurethane insert with aluminum single piece construction with self-adhesive closure. Thickness to match pipe insulation.

F. Tie Wire: 0.048 inch stainless steel with twisted ends on maximum 12 inch centers.

G. Mineral Fiber Hydraulic-Setting Thermal Insulating and Finishing Cement: ASTM C449/C449M.

H. Insulating Cement: ASTM C195; hydraulic setting on mineral wool.

I. Adhesives: Compatible with insulation.

2.5 EQUIPMENT INSULATION

A. TYPE E-1: ASTM C552; glass fiber, rigid, noncombustible.
1. Thermal Conductivity: 0.29 at 75 degrees F.
2. Operating Temperature Range: 0 to 450 degrees F.
3. Density: 7.5 pound per cubic foot.
4. Jacket Temperature Limit: Minus 20 to 150 degrees F.

B. TYPE E-2: ASTM C612; glass fiber, rigid board, noncombustible with factory applied aluminum foil jacket.
1. Thermal Conductivity: 0.24 at 75 degrees F.
2. Operating Temperature Range: 0 to 450 degrees F.
3. Density: 3.0 pound per cubic foot.
4. Jacket Temperature Limit: minus 20 to 150 degrees F.

C. TYPE E-3: ASTM C612; semi-rigid, fibrous glass board noncombustible, end grain adhered to jacket.
1. Thermal Conductivity: 0.27 at 75 degrees F.
2. Operating Temperature Range: 0 to 650 degrees F.
3. Vapor Barrier Jacket: ASTM C1136, Type II, factory applied reinforced foil kraft with self-sealing adhesive joints.
4. Jacket Temperature Limit: minus 20 to 150 degrees F.

D. TYPE E-8: ASTM C534, Type II, flexible, closed cell elastomeric insulation, sheet.
   1. Thermal Conductivity: 0.27 at 75 degrees F .
   2. Operating Temperature Range: Range: Minus 70 to 220 degrees

2.6 EQUIPMENT INSULATION JACKETS

A. PVC Plastic Equipment Jacket:
   1. Product Description: ASTM D1785, sheet material, off-white color.
   2. Minimum Service Temperature: -40 degrees F.
   3. Maximum Service Temperature: 150 degrees F.
   4. Water Vapor Permeance: ASTM E96/E96M; 0.02 perms.
   5. Thickness: 10 mil.
   6. Connections: Pressure sensitive color matching vinyl tape.

B. Aluminum Equipment Jacket:
   1. ASTM B209 Thickness: 0.020 inch thick sheet.
   2. Finish: Smooth.
   3. Joining: Longitudinal slip joints and 2 inch laps.
   4. Fittings: 0.02 inch thick die shaped fitting covers with factory attached protective liner.
   5. Metal Jacket Bands: 3/8 inch wide; 0.02 inch thick aluminum.

C. Canvas Equipment Jacket: UL listed, 6 oz/sq yd, plain weave cotton fabric with fire retardant lagging adhesive compatible with insulation.

D. Vapor Retarder Jacket:
   1. ASTM C921, white Kraft paper with glass fiber yarn, bonded to aluminized film.
   2. Water Vapor Permeance: ASTM E96/E96M; 0.02 perms.

2.7 EQUIPMENT INSULATION ACCESSORIES

A. Vapor Retarder Lap Adhesive: Compatible with insulation.

B. Covering Adhesive Mastic: Compatible with insulation.

C. Tie Wire: 0.048 inch stainless steel with twisted ends on maximum 12 inch centers.

D. Mineral Fiber Hydraulic-Setting Thermal Insulating and Finishing Cement: ASTM C449/C449M.

E. Adhesives: Compatible with insulation.

2.8 DUCTWORK INSULATION

A. TYPE D-1: ASTM C1290, Type III, flexible glass fiber, commercial grade with factory applied reinforced aluminum foil jacket meeting ASTM C1136, Type II.
   1. Thermal Conductivity: 0.27 at 75 degrees F.
   2. Maximum Operating Temperature: 250 degrees F.

3. Density: 1.0 pound per cubic foot.

B. TYPE D-2: ASTM C612, Type IA or IB, rigid glass fiber, with factory applied all service facing meeting ASTM C1136, Type II.
   1. Thermal Conductivity: 0.23 at 75 degrees F.
   2. Density: 6.0 pound per cubic foot.

C. TYPE D-8: Inorganic blanket encapsulated with scrim reinforced foil meeting UL 1978.
   1. Thermal Conductivity: 0.42 at 500 degrees F.
   2. Weight: 1.4 pound per square foot.
   3. Surface Burning Characteristics: Maximum 0/0 flame spread/smoke developed index when tested in accordance with ASTM E84.

D. TYPE D-4: CLOSED CELL ELASTOMERIC LINER
   1. Insulation: ASTM C1534; flexible, polymeric foam sheet.
   2. 'R' Valve: Minimum 4.0.
   3. 'K' value (SI 'K' value): ASTM C518, 0.27 at 75 degrees F (0.039 at 24 degrees C).
   4. Maximum Service Temperature: 250 degrees F (121 degrees C).
   5. Maximum Velocity on Coated Air Side: 6,000 ft/min (20.3 m/sec).
   6. Thickness: 1 inch (25 mm)
   7. Noise Reducing Coefficient: NRC shall not exceed 0.3.
   8. Adhesive: Waterproof, fire retardant type.
   9.

E. TYPE D-6: ASTM C534, Type II, flexible, closed cell elastomeric insulation, sheet.
   1. Thermal Conductivity: 0.27 at 75 degrees F.
   2. Service Temperature Range: Range: Minus 58 to 180 degrees F.

2.9 DUCTWORK INSULATION JACKETS

A. Aluminum Duct Jacket:
   1. ASTM B209.
   2. Thickness: 0.020 inch thick sheet.
   3. Finish: Smooth.
   4. Joining: Longitudinal slip joints and 2 inch laps.
   5. Fittings: 0.016 inch thick die shaped fitting covers with factory attached protective liner.
   6. Metal Jacket Bands: 3/8 inch wide; 0.015 inch thick aluminum.

B. Vapor Retarder Jacket:
   1. Kraft paper with glass fiber yarn and bonded to aluminized film 0.0032 inch vinyl.
   2. Water Vapor Permeance: ASTM E96/E96M; 0.02 perms.
   3. Secure with pressure sensitive tape.

C. Canvas Duct Jacket: UL listed, 6 oz/sq yd, plain weave cotton fabric with fire retardant lagging adhesive compatible with insulation.

D. Outdoor Duct Jacket: Asphalt impregnated and coated sheet, 50 lb/square.

2.10 DUCTWORK INSULATION ACCESSORIES

A. Vapor Retarder Tape:
1. Kraft paper reinforced with glass fiber yarn and bonded to aluminized film, with pressure sensitive rubber based adhesive.

B. Vapor Retarder Lap Adhesive: Compatible with insulation.

C. Adhesive: Waterproof, ASTM E162 fire-retardant type.

D. Liner Fasteners: Galvanized steel, self-adhesive pad with head.

E. Tie Wire: 0.048 inch stainless steel with twisted ends on maximum 12 inch centers.

F. Lagging Adhesive: Fire retardant type with maximum 25/450 flame spread/smoke developed index when tested in accordance with ASTM E84.

G. Impale Anchors: Galvanized steel, 12 gage self-adhesive pad.

H. Adhesives: Compatible with insulation.

I. Membrane Adhesives: As recommended by membrane manufacturer.

PART 3 EXECUTION

3.1 EXAMINATION

A. Section 01 30 00 - Administrative Requirements: Coordination and project conditions.

B. Verify piping, equipment and ductwork has been tested before applying insulation materials.

C. Verify surfaces are clean and dry, with foreign material removed.

3.2 INSTALLATION - PIPING SYSTEMS

A. Piping Exposed to View in Finished Spaces Provide with PVC Plastic pipe jacketing for additional protection. Locate insulation and cover seams in least visible locations.

B. Continue insulation through penetrations of building assemblies or portions of assemblies having fire resistance rating of one hour or less. Provide intumescent firestopping when continuing insulation through assembly. Finish at supports, protrusions, and interruptions. Refer to Section 07 for penetrations of assemblies with fire resistance rating greater than one hour.

C. Piping Systems Conveying Fluids Below Ambient Temperature:
1. Insulate entire system including fittings, valves, unions, flanges, strainers, flexible connections, pump bodies, and expansion joints.
2. Furnish factory-applied or field-applied vapor retarder jackets. Secure factory-applied jackets with pressure sensitive adhesive self-sealing longitudinal laps and butt strips. Secure field-applied jackets with outward clinch expanding staples and seal staple penetrations with vapor retarder mastic.
3. Insulate fittings, joints, and valves with molded insulation of like material and thickness as adjacent pipe. Finish with glass cloth and vapor retarder adhesive or PVC fitting covers.

D. Glass Fiber Board Insulation:
1. Apply insulation close to equipment by grooving, scoring, and beveling insulation. Fasten insulation to equipment with studs, pins, clips, adhesive, wires, or bands.
2. Fill joints, cracks, seams, and depressions with bedding compound to form smooth surface. On cold equipment, use vapor retarder cement.
3. Cover wire mesh or bands with cement to a thickness to remove surface irregularities.

E. Hot Piping Systems:
1. Furnish factory-applied or field-applied standard jackets. Secure with outward clinch expanding staples or pressure sensitive adhesive system on standard factory-applied jacket and butt strips or both.
2. Insulate fittings, joints, and valves with insulation of like material and thickness as adjoining pipe. Finish with glass cloth and adhesive or PVC fitting covers.
3. Insulate flanges and unions at equipment.

F. Inserts and Shields:
1. Piping 1-1/2 inches Diameter and Smaller: Install galvanized steel shield between pipe hanger and insulation.
2. Piping 2 inches Diameter and Larger: Install insert between support shield and piping and under finish jacket.
    a. Insert Configuration: Minimum 6 inches long, of thickness and contour matching adjoining insulation; may be factory fabricated.
    b. Insert Material: Compression resistant insulating material suitable for planned temperature range and service.
3. Piping Supported by Roller Type Pipe Hangers: Install galvanized steel shield between roller and inserts.

G. Insulation Terminating Points:
   1. Coil Branch Piping 1 inch and Smaller: Terminate hot water piping at union upstream of the coil control valve.
   2. Chilled Water Coil Branch Piping: Insulate chilled water piping and associated components up to coil connection.
   3. Condensate Piping: Insulate entire piping system and components to prevent condensation.

H. Closed Cell Elastomeric Insulation:
   1. Push insulation on to piping.
   2. Miter joints at elbows.
   3. Seal seams and butt joints with manufacturer's recommended adhesive.
   4. When application requires multiple layers, apply with joints staggered.
   5. Insulate fittings and valves with insulation of like material and thickness as adjacent pipe.

I. Pipe Exposed in Mechanical Equipment Rooms and similar spaces or Finished Spaces less than 10 feet above finished floor: Finish with PVC jacket and fitting covers.

J. Piping Exterior to Building: Provide vapor retarder jacket. Insulate fittings, joints, and valves with insulation of like material and thickness as adjoining pipe, and finish with glass mesh reinforced vapor retarder cement. Cover with aluminum jacket with seams located at 3 or 9 o'clock position on side of horizontal piping with overlap facing down to shed water or on bottom side of horizontal piping.

K. Buried Piping: Insulate only where insulation manufacturer recommends insulation product may be installed in trench, tunnel or direct buried. Install factory fabricated assembly with inner all-purpose service jacket with self-sealing lap, and asphalt impregnated open mesh glass fabric, with 1 mil thick aluminum foil sandwiched between three layers of bituminous compound; outer surface faced with polyester film.

L. Heat Traced Piping Interior to Building: Insulate fittings, joints, and valves with insulation of like material, thickness, and finish as adjoining pipe. Size large enough to enclose pipe and heat tracer.

M. Heat Traced Piping Exterior to Building: Insulate fittings, joints, and valves with insulation of like material, thickness, and finish as adjoining pipe. Size insulation large enough to enclose pipe and heat tracer. Cover with aluminum jacket with seams located at 3 or 9 o'clock position on side of horizontal piping with overlap facing down to shed water.

N. Prepare pipe insulation for finish painting. Refer to Section 09 90 00.

3.3 INSTALLATION - EQUIPMENT

A. Factory Insulated Equipment: Do not insulate.

B. Exposed Equipment: Locate insulation and cover seams in least visible locations.

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

D. Equipment Containing Fluids Below Ambient Temperature:
1. Insulate entire equipment surfaces.
2. Apply insulation close to equipment by grooving, scoring, and beveling insulation. Fasten insulation to equipment with studs, pins, clips, adhesive, wires, or bands.
3. Furnish factory-applied or field-applied vapor retarder jackets. Secure factory-applied jackets with pressure sensitive adhesive self-sealing longitudinal laps and butt strips. Secure field-applied jackets with outward clinch expanding staples and seal staple penetrations with vapor retarder mastic.
4. Finish insulation at supports, protrusions, and interruptions.

E. Equipment Containing Fluids 140 degrees F Or Less:
1. Do not insulate flanges and unions, but bevel and seal ends of insulation.
2. Install insulation with factory-applied or field applied jackets, with or without vapor barrier. Finish with glass cloth and adhesive.
3. Finish insulation at supports, protrusions, and interruptions.

F. Equipment Containing Fluids Over 140 degrees F:
1. Insulate flanges and unions with removable sections and jackets.
2. Install insulation with factory-applied or field applied jackets, with or without vapor barrier. Finish with glass cloth and adhesive.
3. Finish insulation at supports, protrusions, and interruptions.

G. Equipment in Mechanical Equipment Rooms or Finished Spaces: Finish with canvas jacket sized for finish painting.

H. Equipment Located Exterior to Building: Install vapor barrier jacket or finish with glass mesh reinforced vapor barrier cement. Cover with aluminum jacket with seams located on bottom side of horizontal equipment.

I. Cover glass fiber, cellular glass, cellular foam insulation with metal mesh and finish with heavy coat of insulating cement.

J. Nameplates and ASME Stamps: Bevel and seal insulation around; do not cover with insulation.

K. Equipment Requiring Access for Maintenance, Repair, or Cleaning: Install insulation for easy removal and replacement without damage.

3.4 INSTALLATION - DUCTWORK SYSTEMS

A. Duct dimensions indicated on Drawings are finished inside dimensions.

B. Insulated ductwork conveying air below ambient temperature:
1. Provide insulation with vapor retarder jackets.
2. Finish with tape and vapor retarder jacket.
3. Continue insulation through walls, sleeves, hangers, and other duct penetrations.
4. Insulate entire system including fittings, joints, flanges, fire dampers, flexible connections, and expansion joints.

C. Insulated ductwork conveying air above ambient temperature:
1. Provide with or without standard vapor retarder jacket.
2. Insulate fittings and joints. Where service access is required, bevel and seal ends of insulation.

D. Ductwork Exposed in Mechanical Equipment Rooms or Finished Spaces below 10 feet above finished floor: Finish with canvas jacket sized for finish painting.

E. External Glass Fiber Duct Insulation:
1. Secure insulation with vapor retarder with wires and seal jacket joints with vapor retarder adhesive or tape to match jacket.
2. Secure insulation without vapor retarder with staples, tape, or wires.
3. Install without sag on underside of ductwork. Use adhesive or mechanical fasteners where necessary to prevent sagging. Lift ductwork off trapeze hangers and insert spacers.
4. Seal vapor retarder penetrations by mechanical fasteners with vapor retarder adhesive.
5. Stop and point insulation around access doors and damper operators to allow operation without disturbing wrapping.

F. External Elastomeric Duct Insulation:
1. Adhere to clean oil-free surfaces with full coverage of adhesive.
2. Seal seams and butt joints with manufacturer’s recommended adhesive.
3. When application requires multiple layers, apply with joints staggered.
4. Insulate standing metal duct seams with insulation of like material and thickness as adjacent duct surface. Apply adhesive at joints with flat duct surfaces.
5. Lift ductwork off trapeze hangers and insert spacers.

G. Duct and Plenum Liner:
1. Adhere insulation with adhesive for 90 percent coverage.
2. Secure insulation with mechanical liner fasteners. Comply with SMACNA Standards for spacing.
3. Seal and smooth joints. Seal and coat transverse joints.

4. Seal liner surface penetrations with adhesive.
5. Cut insulation for tight overlapped corner joints. Support top pieces of liner at edges with side pieces.

H. Kitchen Exhaust Ductwork:
1. Cover duct by wrapping with insulation using overlap method and butt joint with collar method.
2. Overlap seams of each method by 3 inches.
3. Attach insulation using steel banding or by welded pins and clips.
4. Install insulation without sag on underside of ductwork. Use additional fasteners to prevent sagging.

I. Ducts Exterior to Building:
1. Install insulation according to external duct insulation paragraph above.
2. Provide external insulation with vapor retarder jacket. Cover with outdoor jacket finished with caulked aluminum jacket with seams located on bottom side of horizontal duct section.
3. Finish with aluminum duct jacket.
4. Calk seams at flanges and joints. Located major longitudinal seams on bottom side of horizontal duct sections.

J. Prepare duct insulation for finish painting. Refer to Section 09 90 00.

3.5 SCHEDULES

A. Heating Services Piping Insulation Schedule:

PIPING SYSTEM	INSULATION TYPE	PIPE SIZE	INSULATION THICKNESS inches
Heating Water Supply and Return	P-1	1.5 inches and smaller 2 inches and larger	1.5 2.0

B. Ductwork Insulation Schedule:

DUCTWORK SYSTEM	INSULATION TYPE	INSULATION THICKNESS inches
Combustion Air	D-2	2.0
Outside Air Intake	D-2	2.0
Equipment Casings	D-2	2.0
Exhaust Ducts Within 10 feet of Exterior Openings	D-1 & D-2	1.5

END OF SECTION 23 0700

SECTION 23 0993 - SEQUENCE OF OPERATIONS FOR HVAC CONTROLS

PART 1 GENERAL

1.1 SUMMARY

A. Related Sections:
1. Section 23 0400 – General Conditions for Mechanical Trades
2. Section 23 5234 – Hot Water Condensing Boilers
3. Division 26 – Electrical

1.2 SUBMITTALS

A. Section 01 3300 - Submittal Procedures: Submittal procedures.

B. Shop Drawings: Indicate mechanical system controlled and control system components.
1. Label with settings, adjustable range of control and limits. Submit written description of control sequence.
2. Submit flow diagrams for each control system, graphically depicting control logic.
3. Submit draft copies of graphic displays indicating mechanical system components, control system components, and controlled function status and value.

1.3 CLOSEOUT SUBMITTALS

A. Section 01 7700 - Closeout Procedures.

B. Project Record Documents: Record actual locations of components and set points of controls, including changes to sequences made after submission of shop drawings.

PART 2 PRODUCTS

Not Used.

PART 3 EXECUTION

3.1 GENERAL

A. Provide all controls, low voltage control wiring, hardware points (analog in, analog out, binary in, binary out) and accessories as required to perform the control sequences indicated. Additionally, provide hardware points indicated regardless that such points may not be required to perform the control sequences indicated.

B. Installation and associated control wiring for Boiler Manufacturer provided devices including outside air and supply water temperature sensors shall be provided as part of the work of this division.

C. Unless otherwise indicated, setpoints and values listed in the sequence of controls shall be adjustable by the Owner thru the DDC (direct digital controls) or BMS (Building Management System) (BMS and DDC are used interchangeably and share same meaning) graphical interface; the Owner shall not be required to edit operating code in order to change any of the setpoints and values.

D. Heating shall only be enabled when the system is indexed to heating mode (shall occur when outside air temperature is below 65°F (adj)

E. Temperature Sensors
   1. General
      a. Where temperature ranges, reset temperatures, setback temperatures, setup temperatures, deadbands, override times, etc. are indicated, those values shall be adjustable.
   2. Mechanical Room
      a. Unless otherwise indicated, temperature sensors shall be the Stainless Steel dead front type sensors. Initial setpoints for dead front sensors shall be as follows:
      b. Occupied/Unoccupied
         1) The space temperature setpoint shall be at 80°F

3.2 CONTROL DEVICES

A. All devices and sensors shall be adjustable. BMS shall display setpoints and actual conditions/status of all control devices.

3.3 BOILER (B-1, B-2) SEQUENCE OF OPERATION

A. General

1. Boiler firing control shall be by the manufacturer's boiler control system (BCS). The BCS shall start dedicated primary pump and enable the manufactures system. Firing control, boiler safeties, etc. shall be used by the Manufactures control system. All setpoint shall be adjustable.
2. BCS control to be interfaced with existing Johnson Controls Metasys BMS currently in use by the city network. Contact JCI for assistance (860) 571-3300
3. Boilers to be BACnet over IP
4. Boilers shall be enabled and disabled by the BMS
5. Boiler firing rate shall be controlled by the BCS
6. Boilers shall be equipped to be shut down in the event of an emergency. At each entrance to the boiler room, as shown on drawing M-100 a wall mounted emergency shutdown switch shall be installed that if activated will immediately shut down the boilers.

B. Hot water temperature operation temperatures:
   1. The boilers shall modulate to maintain temperature in accordance with the following schedule:

Outside Air Temperature Reset Schedule	
Outside Air Temperature	Hot Water Supply Temperature
< 20°F	180°F
20°F to 60°F	Linear Rise from min to max
>60°F	130°F

C. Boiler Control (By Boiler Manufacturer)
   1. The boiler manufacturer shall provide lead/lag control
   2. Boilers shall fire to maintain hot water supply temperature in the primary loop. When the minimum fire rate is reached by the boilers the lag boilers shall turn off one at a time and the lead boiler shall modulate to maintain the setpoint temperature.
   3. Lead/Lag position shall be rotated to equalize run time.
   4. Boiler Pump Control
      a. Upon call for heat, boiler pump shall start.
      b. When the call for heating terminates, the boiler pump shall be stopped.

D. Alarms
   1. The BCS shall generate and alarm output to the BMS when the Boiler Controller indicates trouble.
   2. Boiler Emergency Shutdown safety circuit

E. Monitoring
   1. Hot water supply temperature (Building Loop)
   2. Hot water return temperature (Building Loop)
   3. Boiler 1 supply temperature
   4. Boiler 2 supply temperature
   5. Boiler return temperature (Primary Loop)
   6. Boiler Emergency Shutdown safety circuit
   7. Protonode BACnet Integration (Up to 10 points)

3.4 BOILER ROOM VENTILATION CONTROL

   1. Provide DDC thermostat to open/close the existing motorized dampers & start/stop the existing exhaust fan to maintain boiler room temperature at 80°f (adjustable). Provide control wiring and spring return actuators.

END OF SECTION 23-0993

SECTION 23 0995 - VARIABLE FREQUENCY CONTROLLERS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Variable frequency controllers.

1.2 RELATED SECTIONS

A. Section 230400 – General Conditions for Mechanical Trades.

B. Section 230500 – Common Work Results for HVAC.

C. Section 232123 – HVAC Pumps.

D. Section 237413 – Outdoor Central Station Air Handling Units

E. Section 230993 – Sequence of Operations

F. Division 26 – Electrical

1.3 REFERENCES

A. NEMA ICS 3.1 - Safety Standards for Construction and Guide for Selection, Installation and Operation of Adjustable-Speed Drive Systems.

B. NEMA ICS 7 - Industrial Control and Systems: Adjustable Speed Drives.

C. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).

D. NETA ATS - Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems (International Electrical Testing Association).

E. NFPA 70 - National Electrical Code.

1.4 SUBMITTALS FOR REVIEW

A. Division 1 and Section 01 33 05 - Submittal Procedures: Procedures for submittals.

B. Product Data: Provide catalog sheets showing voltage, controller size, ratings and size of switching and overcurrent protective devices, short circuit ratings, dimensions, and enclosure details.

C. Shop Drawings: Indicate front and side views of enclosures with overall dimensions and weights shown; conduit entrance locations and requirements; clearance requirements; and nameplate legends.

1.5 SUBMITTALS FOR INFORMATION

A. Division 1 and Section 01 33 05 - Submittal Procedures: Submittals for information.

B. Test Reports: Indicate field test and inspection procedures and test results.

C. Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by testing agency specified under Regulatory Requirements. Include instructions for storage, handling, protection, examination, preparation, and installation of Product.

D. Manufacturer's Field Reports: Indicate start-up inspection findings.

1.6 SUBMITTALS FOR CLOSEOUT

A. Division 1 and Section 01 33 05 - Submittal Procedures: Procedures for submittals.

B. Section 01 73 00 - Execution and Section 017700 - Closeout Procedures

C. Operation Data: NEMA ICS 3.1. Include instructions for starting and operating controllers, and describe operating limits that may result in hazardous or unsafe conditions.

D. Maintenance Data: NEMA ICS 3.1. Include routine preventive maintenance schedule.

1.7 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing variable frequency controllers with minimum three years documented experience, and with service facilities within 100 miles of Project.

1.8 REGULATORY REQUIREMENTS

A. Conform to requirements of NFPA 70.

B. Products: Listed and classified by Underwriters Laboratories, Inc as suitable for the purpose specified and indicated.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Section 01 60 00 - Product Requirements: Product storage and handling requirements.

B. Accept controllers on site in original packing. Inspect for damage.

C. Store in a clean, dry space. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic.

D. Handle in accordance with manufacturer's written instructions. Lift only with lugs provided for the purpose. Handle carefully to avoid damage to components, enclosure, and finish.

1.10 MAINTENANCE SERVICE

A. Provide service and maintenance of controller for one year from Date of Substantial Completion.

1.11 WARRANTY

A. Section 01 73 00 - Execution and Section 017700 - Closeout Procedures: Product warranties and product bonds.

B. Furnish one year manufacturer warranty for VFD's. Warranty all material and workmanship under these Specifications and the Contract from the date of final acceptance by Owner.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. ABB Industrial Systems

B. Toshiba International Corporation

C. Square D

D. Substitutions: Refer to Section 23 04 00.

2.2 DESCRIPTION

A. Enclosed variable frequency controllers suitable for operating the indicated loads, in conformance with requirements of NEMA ICS 7.

B. Select unspecified features and options in accordance with NEMA ICS 3.1.

2.3 RATINGS

A. Rated Input Voltage: As scheduled on the drawings.

B. Motor Nameplate Voltage: As scheduled on the drawings.

C. Displacement Power Factor: Between 1.0 and 0.95, lagging, over entire range of operating speed and load.

D. Operating Ambient: 0 degrees C to 40 degrees C.

2.4 DESIGN

A. Employ microprocessor-based inverter logic isolated from power circuits.

B. Employ pulse-width-modulated inverter system.

C. Design for ability to operate controller with motor disconnected from output.

D. Design to attempt five automatic restarts following fault condition before locking out and requiring manual restart.

2.5 PRODUCT OPTIONS AND FEATURES

A. Display: Provide integral digital display to indicate output voltage, output frequency, and output current.

B. Status Indicators: Separate indicators for overcurrent, overvoltage, ground fault, over temperature, and input power ON.

C. Volts Per Hertz Adjustment: Plus or minus 10 percent.

D. Current Limit Adjustment: 60 - 110 percent of rated.

E. Acceleration Rate Adjustment: 0.5 - 30 seconds.

F. Deceleration Rate Adjustment: 1 - 30 seconds.

G. Furnish HAND-OFF-AUTOMATIC selector switch and manual speed control.

H. Input/Output Signals:

1. 4-20 mA input central signal.

2. 4-20 mA output feedback signal.

3. Contact closure for general alarm output.

4. Input contact for on/off control.

I. Control Power Source: Integral control transformer.

J. Door Interlocks: Furnish mechanical means to prevent opening of equipment with power connected, or to disconnect power if door is opened; include means for defeating interlock by qualified persons.

K. Safety Interlocks: Furnish terminals for remote contact to inhibit starting under both manual and automatic mode.

L. Control Interlocks: Furnish terminals for remote contact to allow starting in automatic mode.

M. Manual Bypass: Furnish contactor, motor running overload protection, and short circuit protection for full voltage, non-reversing operation of the motor. Include isolation switch to allow maintenance of inverter during bypass operation.

N. Emergency Stop: Accommodate the use of dynamic brakes for emergency stop function.

O. Disconnecting Means: Include integral fused disconnect switch on the line side of each controller.

2.6 FABRICATION

A. Wiring Terminations: Match conductor materials and sizes indicated.

B. Enclosure: NEMA 250, Type 1, suitable for equipment application in places restricted to persons employed on the premises.

C. Finish: Manufacturer's standard enamel.

2.7 SOURCE QUALITY CONTROL

A. Shop inspect and perform standard productions tests for each controller.

B. Allow witnessing of factory inspections and tests at manufacturer's test facility. Notify Owner at least 7 days before inspections and tests are scheduled.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that surface is suitable for controller installation.

B. Do not install controller until building environment can be maintained within the service conditions required by the manufacturer.

C. Verify that field measurements are as indicated on shop drawings.

3.2 INSTALLATION

A. Install per manufacturer’s instructions and in accordance with NEMA ICS 3.1.

B. Tighten accessible connections and mechanical fasteners after placing controller.

C. Provide fuses in fusible switches; refer to Division 26 for product requirements.

D. Select and install overload heater elements in motor controllers to match installed motor characteristics.

E. Provide engraved plastic nameplates; refer to Section 230553 for product requirements and location.

F. Neatly type label inside each motor controller door identifying motor served, nameplate horsepower, full load amperes, code letter, service factor, and voltage/phase rating. Place in clear plastic holder.

3.3 FIELD QUALITY CONTROL

A. Section 01 73 00 - Execution and Section 017700 - Closeout Procedures: Field inspecting, testing, adjusting, and balancing.

B. Inspect and test in accordance with NETA ATS, except Section 4.

C. Perform inspections and tests listed in NETA ATS, Section 7.16.2.

3.4 MANUFACTURER'S FIELD SERVICES

A. Manufacture’s representative shall be present during preparation and starting of systems.

3.5 ADJUSTING

A. Section 01 73 00 - Execution and Section 017700 - Closeout Procedures: Field inspecting, testing, adjusting, and balancing.

B. Make final adjustments to installed controller to assure proper operation of load system. Obtain performance requirements from installer of driven loads.

3.6 DEMONSTRATION AND INSTRUCTIONS

A. Section 01 73 00 - Execution and Section 017700 - Closeout Procedures: Field inspecting, testing, adjusting, and balancing.

B. Demonstrate operation of controllers in automatic and manual modes.

END OF SECTION 23 0995

SECTION 23 2113 – HYDRONIC PIPING

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
1. Hydronic Piping, Buried
2. Hydronic Piping, Above Ground - 2-1/2 Inches And Larger
3. Hydronic Piping, Above Ground - 2 Inches And Smaller
4. Equipment Drains And Overflows
5. Unions And Flanges

B. Related Sections:
1. Section 07 84 13 – Penetration Firestopping: Product requirements for firestopping for placement by this section.
2. Section 07 84 46 – Fire-Resistive Joint Systems: Product requirements for firestopping for placement by this section
3. Section 09 91 00 – Painting: Execution requirements for piping painting specified by this section.
4. Section 23 04 00 – General Conditions for Mechanical Trades
5. Section 23 21 13 - Pipes and Tubes for HVAC Piping and Equipment: Product and installation requirements for piping materials applying to various system types.
6. Section 23 05 16 - Expansion Fittings and Loops for HVAC Piping: Product and execution requirements for expansion compensation devices use in heating and cooling piping systems.
7. Section 23 05 23 - General-Duty Valves for HVAC Piping: Product requirements for valves for placement by this section.
8. Section 23 05 29 - Hangers and Supports for HVAC Piping and Equipment: Product requirements for pipe hangers and supports, sleeves, and firestopping for placement by this section.
9. Section 23 05 48 - Vibration and Seismic Controls for HVAC Piping and Equipment: Product requirements for Vibration Isolation for placement by this section.
10. Section 23 05 53 - Identification for HVAC Piping and Equipment: Product requirements for pipe identification for placement by this section.
11. Section 23 07 00 - HVAC Insulation: Product requirements for Piping Insulation for placement by this section.
12. Section 23 21 16 - Hydronic Piping Specialties: Product and execution requirements for piping specialties used in heating and cooling piping systems.
13. Section 23 21 23 - Hydronic Pumps: Product and execution requirements for pumps used in heating and cooling piping systems.
14. Section 23 25 00 - HVAC Water Treatment: Product and execution requirements for cleaning and chemical treatment of heating and cooling piping systems.

1.2 REFERENCES

A. American Society of Mechanical Engineers:
1. ASME B16.3 - Malleable Iron Threaded Fittings.
2. ASME B16.4 - Gray Iron Threaded Fittings.
3. ASME B16.18 - Cast Copper Alloy Solder Joint Pressure Fittings.
4. ASME B16.22 - Wrought Copper and Copper Alloy Solder Joint Pressure Fittings.
5. ASME B31.9 - Building Services Piping.
6. ASME Section IX - Boiler and Pressure Vessel Code - Welding and Brazing Qualifications.

B. ASTM International:
1. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
2. ASTM A234/A234M - Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service.
3. ASTM A395/A395M - Standard Specification for Ferritic Ductile Iron Pressure-Retaining Castings for Use at Elevated Temperatures.
4. ASTM A536 - Standard Specification for Ductile Iron Castings.
5. ASTM B32 - Standard Specification for Solder Metal.
6. ASTM B75 – Standard Specification for Seamless Copper Tube.
7. ASTM B88 - Standard Specification for Seamless Copper Water Tube.
8. ASTM F708 - Standard Practice for Design and Installation of Rigid Pipe Hangers.
9. ASTM F1476 - Standard Specification for Performance of Gasketed Mechanical Couplings for Use in Piping Applications.

C. American Welding Society:
1. AWS A5.8 - Specification for Filler Metals for Brazing and Braze Welding.
2. AWS D1.1 - Structural Welding Code - Steel.

D. American Water Works Association:
1. AWWA C110 - American National Standard for Ductile-Iron and Grey-Iron Fittings, 3 in. through 48 in. (75 mm through 1200 mm), for Water and Other Liquids.
2. AWWA C151 - American National Standard for Ductile-Iron Pipe, Centrifugally Cast, for Water.
3. AWWA C606 - American National Standard for Grooved and Shouldered Joints.

E. Manufacturers Standardization Society of the Valve and Fittings Industry:
1. MSS SP 58 - Pipe Hangers and Supports - Materials, Design and Manufacturer.
2. MSS SP 69 - Pipe Hangers and Supports - Selection and Application.
3. MSS SP 89 - Pipe Hangers and Supports - Fabrication and Installation Practices.

1.3 SYSTEM DESCRIPTION

A. Where more than one piping system material is specified, provide compatible system components and joints. Use non-conducting dielectric connections whenever jointing dissimilar metals in open systems.

B. Provide flanges, union, and couplings at locations requiring servicing. Use unions, flanges, and Grooved coupling couplings downstream of valves and at equipment or apparatus connections. Do not use direct welded or threaded connections to valves, equipment or other apparatus.

C. Provide pipe hangers and supports in accordance with ASME B31.1.

D. Use ball or butterfly valves for shut-off and to isolate equipment, part of systems, or vertical risers.

E. Use ball valves for throttling, bypass, or manual flow control services.

F. Use spring loaded check valves on discharge of hot water and chilled water pumps.

G. Use plug valves for throttling service. Use non-lubricated plug valves only when shut-off or isolating valves are also provided.

H. Use butterfly valves in heating water systems and in chilled systems interchangeably with gate and globe valves.

I. Use only butterfly valves in chilled water systems for throttling and isolation service.

J. Use grooved or lug end butterfly valves to isolate equipment.

K. Use 3/4 inch ball valves with cap for drains at main shut-off valves, low points of piping, bases of vertical risers, and at equipment.

L. Flexible Connectors or Grooved coupling Flexible Couplings: Use at or near pumps where piping configuration does not absorb vibration.

1.4 SUBMITTALS

A. Division 01 – General Requirements and 23 04 00 – General Conditions for Mechanical Trades.

B. Shop Drawings: Indicate schematic layout of piping system, including equipment, critical dimensions, and sizes.

1. Grooved joint couplings and fittings shall be shown on drawings and product submittals, and be specifically identified with the applicable Grooved coupling style or series number.

C. Product Data:
   1. Piping: Submit data on pipe materials, fittings, and accessories. Submit manufacturers catalog information.
   2. Valves: Submit manufacturers catalog information with valve data and ratings for each service.
   3. Hangers and Supports: Submit manufacturers catalog information including load capacity.

D. Design Data: Indicate pipe size. Indicate load carrying capacity of trapeze, multiple pipe, and riser support hangers.

E. Manufacturer's Installation Instructions: Submit hanging and support methods, joining procedures and isolation.

F. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

G. Welders' Certificate: Include welders' certification of compliance with ASME Section IX.

1.5 CLOSEOUT SUBMITTALS

A. Division 01- General Requirements and 23 04 00 – General Conditions for Mechanical Trades.

B. Project Record Documents: Record actual locations of valves, equipment and accessories.

C. Operation and Maintenance Data: Submit instructions for installation and changing components, spare parts lists, exploded assembly views.

1.6 QUALITY ASSURANCE

A. Perform Work in accordance with ASME B31.1 code for installation of piping systems and ASME Section IX for welding materials and procedures.

B. Perform Work in accordance with applicable authority for welding hanger and support attachments to building structure.

C. To assure uniformity and compatibility of piping components in grooved piping systems, all grooved products utilized shall be supplied by a single manufacturer. Grooving tools shall be supplied by the same manufacturer as the grooved components.

1.7 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience.

B. Fabricator or Installer: Company specializing in performing Work of this section with minimum three years documented experience.

1.8 PRE-INSTALLATION MEETINGS

A. Division 01 – General Requirements.

B. Convene minimum one week prior to commencing work of this section.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Division 01- General Requirements.

B. Accept valves on site in shipping containers with labeling in place. Inspect for damage.

C. Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.

D. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the Work, and isolating parts of completed system.

1.10 ENVIRONMENTAL REQUIREMENTS

A. Division 01- General Requirements.

B. Do not install underground piping when bedding is wet or frozen.

1.11 FIELD MEASUREMENTS

A. Verify field measurements prior to fabrication.

1.12 COORDINATION

A. Division 01 - General Requirements.

1.13 WARRANTY

A. Division 01- General Requirements.

B. Section 01 40 00 - Quality Requirements, Section 01 73 00 - Execution and Section 017700 Closeout Procedures.

C. Warranty all material and workmanship under these Specifications and the Contract from the date of final acceptance by Owner.

1.14 EXTRA MATERIALS

A. Division 01- General Requirements.

PART 2 PRODUCTS

2.1 HYDRONIC PIPING, ABOVE GROUND - 2-1/2 INCHES AND LARGER

A. Steel Pipe: ASTM A53/A53M, Schedule 40, black, rolled grooved ends.
1. Fittings: ASTM A536 ductile iron, or ASTM A53 forged steel or fabricated from carbon steel pipe, grooved ends designed to accept Grooved coupling standard or AGS "W" series couplings.
2. Joints: Grooved mechanical couplings meeting ASTM F1476.
a. Housing Clamps: STM A536 ductile iron, enamel coated, compatible with steel piping sizes, rigid or flexible type.
1) Rigid Type: 2-1/2 inch through 12 inch: "Installation ready" rigid coupling with angle pattern bolt pads designed for direct 'stab' installation onto grooved end pipe without prior disassembly of the coupling, no torque requirement and Grade "EHP" EPDM gasket.
2) Flexible Type: 2-1/2 inch through 24 inch: Use in locations where vibration attenuation and stress relief are required. Flexible couplings may be used in lieu of flexible connectors for vibration isolation at equipment connections. Three (3) couplings, for each connector, shall be placed in close proximity to the source of vibration.
b. Grade "E" EPDM Gasket: Elastomer composition for operating temperature range from -30 degrees F to 230 degrees F.
c. Grade "EHP" EPDM Gasket: Elastomer composition for operating temperature range from -30 degrees F to 250 degrees F
d. Accessories: Steel bolts, nuts, and washers.

2.2 HYDRONIC PIPING, ABOVE GROUND - 2 INCHES AND SMALLER

A. Copper Tubing: ASTM B88, Type L drawn.
1. Fittings:
a. ASME B16.18, cast brass, or ASME B16.22, solder wrought copper.
b. Permanent push-to-connect fittings shall be ASME B16.22 wrought copper alloy or ASME B16.18 cast copper alloy with push-to-connect ends designed for direct insertion of copper tube. Push-to-connect ends shall be complete with EPDM engineered seal and 301 stainless steel internal components. EPDM engineered seal shall be suitable for water operating temperatures up to +180°F.
2. Joints: Solder, lead free, ASTM B32, 95-5 tin-antimony, or tin and silver, with melting range 430 to 535 degrees F.
3. Press Fittings: IAPMO PS 117, ANSI LC1002, NSF61-G, EPDM sealing element and leak detection feature

2.3 EQUIPMENT DRAINS AND OVERFLOWS

A. Steel Pipe: ASTM A53/A53M Schedule 40, galvanized, cut or rolled grooved ends.
   1. Fittings: ASTM A536 ductile iron, or ASTM A53/A53M forged carbon steel or fabricated from carbons steel pipe grooved ends designed to accept Grooved coupling or AGS "W" series couplings.
   2. Joints: Grooved mechanical couplings meeting ASTM F1476 by Tyco Grinnell or Victaulic.
      a. Housing Clamps: ASTM A536 ductile iron, enamel coated compatible with steel piping sizes, rigid or flexible type.
         1) Rigid Type: 2 inch through 8 inch: "Installation ready" rigid coupling with angle pattern bolt pads designed for direct 'stab' installation onto grooved end pipe without prior disassembly of the coupling and Grade "EHP" EPDM gasket.
         2) Flexible Type: 2 inch through 12 inch: Use in locations where vibration attenuation and stress relief are required.
      b. Grade "EHP" EPDM Gasket: Elastomer composition for operating temperature range from -20 degrees F to 220 degrees F.
      c. Accessories: Steel bolts, nuts, and washers.

B. Copper Tubing: ASTM B88, Type K drawn.
   1. Fittings:
      a. ASME B16.18, cast brass, or ASME B16.22 solder wrought copper.
   2. Joints: Solder, lead free, ASTM B32, 95-5 tin-antimony, or tin and silver, with melting range 430 to 535 degrees F. For 2" and larger, Victaulic CTS System may be used
   3. Press Fittings: IAPMO PS 117, ANSI LC1002, NSF61-G, EPDM sealing element and leak detection feature

2.4 UNIONS AND FLANGES

A. Unions for Pipe 2 inches and Smaller:
   1. Ferrous Piping: Class 150, malleable iron, threaded.
   2. Copper Piping: Class 150, bronze unions with soldered.
   3. Dielectric Connections:
      a. Union with galvanized or plated steel threaded end, copper solder end, water impervious isolation barrier.
      b. Waterway fitting with zinc electroplated steel or ductile iron body, male thread, grooved, or plain end, water impervious isolation barrier.

B. Flanges for Pipe 2-1/2 inches and Larger:
   1. Ferrous Piping:
      a. Class 150, forged steel, slip-on flanges.
      b. Grooved joint flange adapter, flat face, for direct connection to ANSI Class 125 and 150 flanges. For direct connection to ANSI Class 300 flanges

2. Copper Piping:
   a. Class 150, slip-on bronze flanges.
   b. Grooved joint flange adapter, flat face, for direct connection to ANSI Class 125 and 150 flanges.
3. Gaskets: 1/16 inch thick preformed neoprene gaskets.

PART 3 EXECUTION

3.1 EXAMINATION

A. Division 01- General Requirements.

B. Verify excavations are to required grade, dry, and not over-excavated.

3.2 PREPARATION

A. Ream pipe and tube ends. Remove burrs.

B. Remove scale and dirt on inside and outside before assembly.

C. Prepare piping connections to equipment with flanges or unions.

D. Keep open ends of pipe free from scale and dirt. Protect open ends with temporary plugs or caps.

E. After completion, fill, clean, and treat systems. Refer to Section 23 25 00.

3.3 INSTALLATION - INSERTS

A. Provide inserts for placement in concrete forms.

B. Provide inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.

C. Provide hooked rod to concrete reinforcement section for inserts carrying pipe 4 inches and larger.

D. Where concrete slabs form finished ceiling, locate inserts flush with slab surface.

E. Where inserts are omitted, drill through concrete slab from below and provide through-bolt with recessed square steel plate and nut flush with top of slab.

3.4 INSTALLATION - ABOVE GROUND PIPING SYSTEMS

A. Install Work in accordance with manufacturer’s guidelines.

B. Route piping parallel to building structure and maintain gradient.

C. Install piping to conserve building space, and not interfere with use of space.

D. Group piping whenever practical at common elevations.

E. Sleeve pipe passing through partitions, walls and floors. Refer to Section 23 05 29.

F. Install firestopping at fire rated construction perimeters and openings containing penetrating sleeves and piping.

G. Install pipe identification in accordance with Section 23 05 53.

H. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.

I. Provide access where valves and fittings are not exposed.

J. Slope hydronic piping and arrange systems to drain at low points. Use eccentric reducers to maintain top of pipe aligned.

K. Where pipe support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc rich primer to welds.

L. Prepare unfinished pipe, fittings, supports, and accessories, ready for finish painting. Refer to Division 09 - Finishes.

M. Install valves with stems upright or horizontal, not inverted.

N. Insulate piping and equipment; refer to Section 23 07 00.

O. Grooved joint piping systems shall be installed in accordance with the manufacturer's guidelines and recommendations. The gasket style and elastomeric material (grade) shall be verified as suitable for the intended service as specified. Gaskets shall be supplied by the grooved coupling manufacturer. Grooved end shall be clean and free from indentations, projections and roll marks in the area from pipe end to groove for proper gasket sealing. A factory trained field representative shall provide on-site training to contractor's field personnel in the installation of grooved piping products. Factory trained representative shall periodically review the product installation. Contractor shall remove and replace any improperly installed products.

1. Install the AGS piping system in accordance with the latest installation instructions. Use grooving tools with AGS roll sets to groove the pipe. Follow guidelines for tool selection and operation. Coupling installation shall be complete when visual metal-to-metal contact is reached. AGS products shall not be installed with standard grooved end pipe or components. Installing AGS products in combination with standard grooved end products could result in joint separation and/or leakage.

3.5 FIELD QUALITY CONTROL

A. Division 01 - General Requirements.

B. Test heating water piping system and chilled water piping system in accordance with ASME B31.9.

END OF SECTION 23 2113

SECTION 23 2116 - HYDRONIC PIPING SPECIALTIES

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
1. Positive displacement meters.
2. Heat consumption meters.
3. Liquid flow meters.
4. Pressure gages.
5. Pressure gage taps.
6. Thermometers.
7. Thermometer supports.
8. Test plugs.
9. Flexible connectors.
10. Diaphragm-type expansion tanks.
11. Air vents.
12. Air separators.
13. Strainers.
14. Pump suction fittings.
15. Combination pump discharge valves.
16. Flow controls.
17. Relief valves.

B. Related Sections:
1. Section 23 04 00 – General Conditions for Mechanical Trades
2. Section 23 21 13 - Hydronic Piping: Execution requirements for piping connections to products specified by this section.
3. Section 23 21 23 - Hydronic Pumps: Execution requirements for piping connections to products specified by this section.

1.2 REFERENCES

A. American Society of Mechanical Engineers:
1. ASME B40.1 - Gauges - Pressure Indicating Dial Type - Elastic Element.
2. ASME Section VIII - Boiler and Pressure Vessel Code - Pressure Vessels.

B. ASTM International:
1. ASTM E1 - Standard Specification for ASTM Thermometers.
2. ASTM E77 - Standard Test Method for Inspection and Verification of Thermometers.

C. American Water Works Association:
   1. AWWA C700 - Cold-Water Meters - Displacement Type, Bronze Main Case.
   2. AWWA C701 - Cold-Water Meters - Turbine Type, for Customer Service.
   3. AWWA C702 - Cold-Water Meters - Compound Type.
   4. AWWA C706 - Direct-Reading, Remote-Registration Systems for Cold-Water Meters.
   5. AWWA M6 - Water Meters - Selection, Installation, Testing, and Maintenance.

D. Underwriters Laboratories Inc.:
   1. UL 393 - Indicating Pressure Gauges for Fire-Protection Service.
   2. UL 404 - Gauges, Indicating Pressure, for Compressed Gas Service.

1.3 PERFORMANCE REQUIREMENTS

A. Flexible Connectors: Provide at or near pumps or motorized equipment where piping configuration does not absorb vibration.

1.4 SUBMITTALS

A. Section 01 33 05 - Submittal Procedures: Submittal procedures.

B. Product Data: Submit for manufactured products and assemblies used in this Project.
   1. Manufacturer’s data and list indicating use, operating range, total range, accuracy, and location for manufactured components.
   2. Submit product description, model, dimensions, component sizes, rough-in requirements, service sizes, and finishes.
   3. Submit schedule indicating manufacturer, model number, size, location, rated capacity, load served, and features for each piping specialty.
   4. Submit electrical characteristics and connection requirements.

C. Manufacturer's Installation Instructions: Submit hanging and support methods, joining procedures, application, selection, and hookup configuration. Include pipe and accessory elevations.

D. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

1.5 CLOSEOUT SUBMITTALS

A. Section 01 73 00 - Execution and Section 017700 - Closeout Procedures: Closeout procedures.

B. Project Record Documents: Record actual locations of actual locations of components and instrumentation, flow controls and flow meters.

C. Operation and Maintenance Data: Submit instructions for calibrating instruments, installation instructions, assembly views, servicing requirements, lubrication instruction, and replacement parts list.

1.6 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience , and with service facilities within 100 miles of Project.

B. Installer: Company specializing in performing Work of this section with minimum three years documented experience approved by manufacturer.

1.7 PRE-INSTALLATION MEETINGS

A. Division 1- Administrative Requirements: Pre-installation meeting.

B. Convene minimum one week prior to commencing work of this section.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Division 1- Product Requirements: Product storage and handling requirements.

B. Accept piping specialties on site in shipping containers with labeling in place. Inspect for damage.

C. Provide temporary protective coating on cast iron and steel valves.

D. Protect systems from entry of foreign materials by temporary covers, caps and closures, completing sections of the work, and isolating parts of completed system until installation.

1.9 ENVIRONMENTAL REQUIREMENTS

A. Division 1- Product Requirements.

B. Do not install instruments when areas are under construction, except rough in, taps, supports and test plugs.

1.10 FIELD MEASUREMENTS

A. Verify field measurements before fabrication.

1.11 WARRANTY

A. Section 01 73 00 - Execution and Section 017700 - Closeout Procedures: Product warranties and product bonds.

B. Furnish five year manufacturer warranty for piping specialties.

C. Warranty shall include labor and materials for a minimum period of two (2) years unless otherwise specified. Warranty starts at date of Commissioning acceptance of a complete system and Owner approval

1.12 MAINTENANCE SERVICE

A. Section 01 73 00 - Execution and Section 017700 - Closeout Procedures: Maintenance service.

B. Furnish service and maintenance of fluid components for two years from Date of Substantial Completion.

C. Furnish monthly visit for one year starting from Date of Substantial Completion to make fluid analysis on site. Detail findings with maintenance personnel in writing of corrective actions needed including analysis and amounts of chemicals or water added.

1.13 MAINTENANCE MATERIALS

A. Section 01 73 00 - Execution and Section 017700 - Closeout Procedures: Spare parts and maintenance materials.

B. Furnish two bottles of red gage oil for static pressure gages.

1.14 EXTRA MATERIALS

A. Section 01 73 00 - Execution and Section 017700 - Closeout Procedures: Spare parts and maintenance products.

B. Furnish four pressure gages with pulsation damper and dial thermometers.

PART 2 PRODUCTS

2.1 PRESSURE GAGES

A. Manufacturers:
1. Trerice
2. Ernst
3. Davis
4. Substitutions: Division 01, Section 012300 Alternates, Section 012500 – Substitution Procedures – Substitution Request Form and Section 016000 - Product Requirements.

B. Gage: ASME B40.1, with bourdon tube, rotary brass movement, brass socket, front calibration adjustment, black scale on white background.

1. Case: Cast aluminum
2. Bourdon Tube: Brass.
3. Dial Size: 3-1/2 inch diameter.
4. Mid-Scale Accuracy: One percent.
5. Scale: As shown on drawings.

2.2 PRESSURE GAGE TAPS

A. Manufacturers:
1. Trerice
2. Ernst
3. Davis
4. Substitutions: Division 01, Section 012300 Alternates, Section 012500 – Substitution Procedures – Substitution Request Form and Section 016000 - Product Requirements

B. Ball Valve: Brass 1/4 inch NPT for 250 psi.

2.3 STEM TYPE THERMOMETERS

A. Manufacturers:
1. Trerice
2. Ernst
3. Davis
4. Substitutions: Division 01, Section 012300 Alternates, Section 012500 – Substitution Procedures – Substitution Request Form and Section 016000 - Product Requirements

B. Thermometer: ASTM E1, red appearing mercury, lens front tube, cast aluminum case with enamel finish.
1. Size: 9 inch scale.
2. Window: Clear glass.
3. Stem: Brass, 3/4 inch NPT, 3-1/2 inch long.
4. Accuracy: ASTM E77 2 percent.
5. Calibration: Degrees F.

2.4 THERMOMETER SUPPORTS

A. Socket: Brass separable sockets for thermometer stems with or without extensions, and with cap and chain.

B. Flange: 3 inch outside diameter reversible flange, designed to fasten to sheet metal air ducts, with brass perforated stem.

2.5 TEST PLUGS

A. Manufacturers:
1. Omega
2. Imac
3. Peterson
4. Substitutions: Division 01, Section 012300 Alternates, Section 012500 – Substitution Procedures – Substitution Request Form and Section 016000 - Product Requirements

B. 1/4 inch NPT or 1/2 inch NPT brass fitting and cap for receiving 1/8 inch outside diameter pressure or temperature probe with:
1. Neoprene core for temperatures up to 200 degrees F.
2. Nordel core for temperatures up to 350 degrees F.
3. Viton core for temperatures up to 400 degrees F.

2.6 FLEXIBLE CONNECTORS

A. Manufacturers:
1. Mason
2. Vibration Eliminator
3. Metra Flex Model
4. Substitutions: Division 01, Section 012300 Alternates, Section 012500 – Substitution Procedures – Substitution Request Form and Section 016000 - Product Requirements.

B. Corrugated stainless steel hose with single layer of stainless steel exterior braiding, minimum 9 inches long with copper tube ends; for maximum working pressure 300 psig.

2.7 DIAPHRAGM-TYPE EXPANSION TANKS

A. Manufacturers:
1. Armstrong
2. Taco
3. B+G
4. Amtrol
5. Substitutions: Division 01, Section 012300 Alternates, Section 012500 – Substitution Procedures – Substitution Request Form and Section 016000 - Product Requirements

B. Construction: Welded steel, tested and stamped in accordance with ASME Section VIII; supplied with National Board Form U-1, rated for working pressure of 125 psig, with flexible butyl diaphragm sealed into tank , and steel support stand.

C. Accessories: Pressure gage and air-charging fitting, tank drain; pre-charge to system fill pressure.

D. Automatic Cold Water Fill Assembly: Pressure reducing valve, double check back flow prevention device, test cocks, strainer, vacuum breaker, and by-pass valves.

2.8 AIR VENTS

A. Manufacturers:
1. Armstrong
2. B+G
3. Amtrol
4. Taco
5. Substitutions: Division 01, Section 012300 Alternates, Section 012500 – Substitution Procedures – Substitution Request Form and Section 016000 - Product Requirements

B. Manual Type: Short vertical sections of 2 inch diameter pipe to form air chamber, with 1/8 inch brass needle valve at top of chamber.

C. Float Type:
1. Brass or semi-steel body, copper, polypropylene, or solid non-metallic float, stainless steel valve and valve seat; suitable for system operating temperature and pressure; with isolating valve.

D. Washer Type:
1. Brass with hydroscopic fiber discs, vent ports, adjustable cap for manual shut-off, and integral spring loaded ball check valve.

2.9 AIR SEPARATORS

A. Manufacturers:
1. Armstrong
2. Spirotherm
3. B+G.
4. Taco
5. Substitutions: Division 01, Section 012300 Alternates, Section 012500 – Substitution Procedures – Substitution Request Form and Section 016000 - Product Requirements.

B. Dip Tube Fitting: For 125 psig operating pressure; to prevent free air collected in boiler from rising into system.

C. In-line Air Separators: Cast iron for sizes 1-1/2 inch and smaller, or steel for sizes 2 inch and larger; tested and stamped in accordance with ASME Section VIII; for 125 psig operating pressure.

D. Combination Air Separators/Strainers: Steel, tested and stamped in accordance with ASME Section VIII; for 125 psig operating pressure, with integral galvanized steel strainer, tangential inlet and outlet connections, and internal stainless steel air collector tube.

2.10 STRAINERS

A. Manufacturers:
1. Sarco
2. Armstrong
3. Yarway
4. Substitutions: Division 01, Section 012300 Alternates, Section 012500 – Substitution Procedures – Substitution Request Form and Section 016000 - Product Requirements.

B. Size 2 inch and Smaller:
1. Screwed brass or iron body for 175 psig working pressure, Y pattern with 1/32 inch stainless steel perforated screen.

C. Size 2-1/2 inch to 4 inch:
1. Flanged iron body for 175 psig working pressure, Y pattern with 3/64 inch stainless steel perforated screen.

D. Size 5 inch and Larger:
1. Flanged iron body for 175 psig working pressure, basket pattern with 1/8 inch stainless steel perforated screen.

2.11 PUMP SUCTION FITTINGS

A. Manufacturers:
1. B+G
2. Taco
3. Armstrong
4. Substitutions: Division 01, Section 012300 Alternates, Section 012500 – Substitution Procedures – Substitution Request Form and Section 016000 - Product Requirements.

B. Fitting: Angle pattern, cast-iron body. Threaded for 2 inch and smaller, flanged for 2-1/2 inch and larger. Rated for 175 psig working pressure, with inlet vanes, cylinder strainer with 3/16 inch diameter openings, disposable fine mesh strainer to fit over cylinder strainer, and permanent magnet located in flow stream and removable for cleaning.

C. Accessories: Adjustable foot support, blow-down tapping in bottom, gage tapping in side.

2.12 COMBINATION PUMP DISCHARGE VALVES

A. Manufacturers:
1. B+G
2. Taco
3. Armstrong
4. Substitutions: Division 01, Section 012300 Alternates, Section 012500 – Substitution Procedures – Substitution Request Form and Section 016000 - Product Requirements.

B. Valves: Straight or angle pattern, flanged cast-iron valve body with bolt-on bonnet for 175 psig operating pressure, non-slam check valve with spring-loaded bronze disc and seat, stainless steel stem, and calibrated adjustment permitting flow regulation.

2.13 AUTOMATIC FLOW CONTROLS (MANUAL BALNCING VALVES ARE NOT ACCEPTABLE)

A. Manufacturers:
1. Nexus
2. Griswold
3. Flow Design
4. Macon
5. FDI
6. Substitutions: Division 01, Section 012300 Alternates, Section 012500 – Substitution Procedures – Substitution Request Form and Section 016000 - Product Requirements

B. Construction: Brass or bronze body with union on inlet, and outlet, temperature and pressure test plug on inlet and outlet combination blow-down and back-flush drain.

C. Calibration: Control within 5 percent of design flow over entire operating pressure.

D. Control Mechanism: Stainless steel or nickel plated brass piston or regulator cup, operating against stainless steel helical or wave formed spring.

E. Accessories: In-line strainer on inlet and ball valve on outlet.

2.14 RELIEF VALVES

A. Manufacturers:
1. Watts
2. Tyco
3. Parker Hannifin
4. B+G

5. Substitutions: Division 01, Section 012300 Alternates, Section 012500 – Substitution Procedures – Substitution Request Form and Section 016000 - Product Requirements.

B. Bronze body, Teflon seat, stainless steel stem and springs, automatic, direct pressure actuated capacities ASME certified and labeled.

PART 3 EXECUTION

3.1 INSTALLATION - METERS

A. Install positive displacement meters in accordance with AWWA M6, with isolating valves on inlet and outlet.

3.2 INSTALLATION - THERMOMETERS AND GAGES

A. Install one pressure gage for each pump, locate taps before strainers and on suction and discharge of pump; pipe to gage.

B. Install gage taps in piping

C. Install pressure gages with pulsation dampers. Provide ball valve to isolate each gage. Extend nipples to allow clearance from insulation.

D. Install thermometers in piping systems in sockets in short couplings. Enlarge pipes smaller than 2-1/2 inches for installation of thermometer sockets. Allow clearance from insulation.

E. Install thermometer sockets adjacent to controls systems thermostat, transmitter, or sensor sockets as required.

F. Coil and conceal excess capillary on remote element instruments.

G. Provide instruments with scale ranges selected according to service with largest appropriate scale.

H. Install gages and thermometers in locations where they are easily read from normal operating level. Install vertical to 45 degrees off vertical.

I. Adjust gages and thermometers to final angle, clean windows and lenses, and calibrate to zero.

3.3 INSTALLATION - HYDRONIC PIPING SPECIALTIES

A. Locate test plugs adjacent to pressure gages and pressure gage taps as indicated on Drawings.

B. Where large air quantities accumulate, provide enlarged air collection standpipes.

C. Install manual air vents at system high points.

D. For automatic air vents in ceiling spaces or other concealed locations, install vent tubing to nearest drain.

E. Provide air separator on suction side of system circulation pump and connect to expansion tank.

F. Provide drain and hose connection with valve on strainer blow down connection.

G. Provide pump suction fitting on suction side of base mounted centrifugal pumps. Remove temporary strainers after cleaning systems.

H. Provide combination pump discharge valve on discharge side of base mounted centrifugal pumps.

I. Support pump fittings with floor mounted pipe and flange supports.

J. Provide radiator valves on water inlet for the following terminal heating unit types: radiation, unit heaters, and fan coil units.

K. Provide radiator-balancing valves on water outlet for the following terminal heating unit types: radiation, unit heaters, and fan coil units.

L. Provide relief valves on pressure tanks, low-pressure side of reducing valves, heat exchangers, and expansion tanks.

M. Select system relief valve capacity greater than make-up pressure reducing valve capacity. Select equipment relief valve capacity to exceed rating of connected equipment.

N. Pipe relief valve outlet to nearest floor drain.

O. Where one line vents several relief valves, make cross sectional area equal to sum of individual vent areas.

3.4 FIELD QUALITY CONTROL

A. Section 01 40 00 - Quality Requirements, Section 01 73 00 - Execution and Section 017700 Closeout Procedures: Field inspecting, testing, adjusting, and balancing.

3.5 CLEANING

A. Section 01 73 00 - Execution and Section 017700 - Closeout Procedures: Requirements for cleaning.

B. Clean and flush system before adding chemical solution.

3.6 PROTECTION OF INSTALLED CONSTRUCTION

A. Section 01 73 00 - Execution and Section 017700 - Closeout Procedures: Requirements for protecting installed construction.

B. Do not install hydronic pressure gauges until after systems are pressure tested.

3.7 SCHEDULES

A. Pressure Gages.
   1. Pumps.
      a. Location: Suction & discharge of all pumps, circulators.
      b. Scale range:0-75 PSIG
   2. Expansion tanks.
      a. Location: On tank.
      b. Scale range: 0-75 PSIG
   3. Pressure reducing valves.
      a. Location: Inlet & discharge.
      b. Scale range: 0-75 PSIG

B. Pressure Gage Tapping Location:
   1. Major coils - inlets and outlets.
   2. Chiller - inlets and outlets.
   3. Boiler - inlets and outlets.

C. Stem Type Thermometers:
   1. Boilers - inlets and outlets.
      a. Location: inlets and outlets.
      b. Scale range: 50-250 Degrees F.
   2. After major coils.
      a. Location: inlets and outlets.
      b. Scale range: 50-250 Degrees F.

END OF SECTION 23 2116

SECTION 23 2123 - HYDRONIC PUMPS

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
1. In-line circulators.
2. Vertical in-line pumps.

B. Related Sections:
1. Section 23 04 00 – General Conditions for Mechanical Trades
2. Section 23 05 13 - Common Motor Requirements for HVAC Equipment: Product requirements for motors for placement by this section.
3. Section 23 05 23 - General-Duty Valves for HVAC Piping: Product requirements for valves used in hydronic piping systems.
4. Section 23 05 48 - Vibration and Seismic Controls for HVAC Piping and Equipment: Product requirements for vibrations isolators installed with pumps.
5. Section 23 21 13 - Hydronic Piping: Execution requirements for connection to pumps specified by this section.
6. Section 23 21 16 - Hydronic Piping Specialties: Product and execution requirements for piping specialties installed in hydronic systems adjacent to pumps.
7. Section 26 05 03 - Equipment Wiring Connections: Execution requirements for electrical connections to pumps specified by this section.

1.2 REFERENCES

A. National Electrical Manufacturers Association:
1. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).

B. Underwriters Laboratories Inc.:
1. UL 778 - Motor Operated Water Pumps.

1.3 PERFORMANCE REQUIREMENTS

A. Provide pumps to operate at system fluid temperatures indicated on Drawings without vapor binding and cavitation, are non-overloading in parallel or individual operation, and operate within 25 percent of midpoint of published maximum efficiency curve.

1.4 SUBMITTALS

A. Section 01 33 05 - Submittal Procedures: Submittal procedures.

B. Product Data: Submit certified pump curves showing performance characteristics with pump and system operating point plotted. Include NPSH curve when applicable. Include electrical characteristics and connection requirements. Submit also, manufacturer model number, dimensions, service sizes, and finishes.

C. Manufacturer's Installation Instructions: Submit application, selection, and hookup configuration with pipe and accessory elevations. Submit hanging and support requirements and recommendations.

D. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

1.5 CLOSEOUT SUBMITTALS

A. Section 01 73 00 - Execution and Section 017700 - Closeout Procedures: Closeout procedures.

B. Operation and Maintenance Data: Submit installation instructions, servicing requirements, assembly views, lubrication instructions, and replacement parts list.

C. Maintain one copy of each document on site.

1.6 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years experience.

B. Installer: Company specializing in performing Work of this section with minimum three years experience.

1.7 PRE-INSTALLATION MEETINGS

A. Section 01 30 00 - Administrative Requirements: Pre-installation meeting.

B. Convene minimum one week prior to commencing work of this section.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Section 01 60 00 - Product Requirements: Product storage and handling requirements.

B. Protect systems from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed system.

1.9 FIELD MEASUREMENTS

A. Verify field measurements prior to fabrication.

1.10 WARRANTY

A. Section 01 73 00 - Execution and Section 017700 - Closeout Procedures: Product warranties and product bonds.

B. Provide 24 month warranty on all pumps.

C. Warranty starts at date of Commissioning acceptance of a complete system and Owner approval

1.11 EXTRA MATERIALS

A. Section 01 73 00 - Execution and Section 017700 - Closeout Procedures: Spare parts and maintenance products.

B. Provide two (2) mechanical seals for each pump.

PART 2 PRODUCTS

2.1 IN-LINE CIRCULATORS

A. Manufacturers:
1. Taco
2. Armstrong
3. Wilo
4. Grundfos
5. B&G
6. Substitutions: Division 01, Section 012300 Alternates, Section 012500 – Substitution Procedures – Substitution Request Form and Section 016000 - Product Requirements.

B. Type: Horizontal shaft, single stage, direct connected, with resiliently mounted motor for in-line mounting, oil lubricated, for 125 psig maximum working pressure.

C. Casing: Cast iron, with flanged pump connections.

D. Impeller: Stamped brass or cast bronze, keyed to shaft.

E. Bearings: Two, oil lubricated bronze sleeves.

F. Shaft: Alloy or stainless steel with copper or bronze sleeve, integral thrust collar.

G. Seal: Carbon rotating against stationary ceramic seat, 212 degrees F maximum continuous operating temperature.

H. Drive: Flexible coupling.

2.2 Close-coupled VERTICAL IN-LINE PUMPS

A. Manufacturers:
1. Taco KV4007 series
2. Armstrong 4380 series
3. Grundfos
4. B&G
5. Substitutions: Division 01, Section 012300 Alternates, Section 012500 – Substitution Procedures – Substitution Request Form and Section 016000 - Product Requirements.

B. Close-Coupled Vertical Inline Pumps with integrated VFD controlled by BMS.

C. Pumps shall be Taco Model KV or approved equal. The pumps shall be single stage end suction rear pull out design. The seal shall be serviceable without disturbing the piping connections. The capacities and characteristics shall be as called for in the plans/schedules.

D. Pump casing shall be constructed of ASTM A48 class 30 cast iron. The pump casing/volute shall be rated for 250 psi working pressure for all jobs. The pump flanges shall be matched to suit the working pressure of the piping components on the job, with either ANSI Class 125 flanges or ANSI class 250 flanges. The pump casing shall be drilled and tapped for gauge ports on both the suction and discharge connections and for a drain port at the bottom of the casing. The casing shall have an additional tapping on the discharge connection to allow for the installation of a seal flush line. The pump cover shall be drilled and tapped to accommodate a seal flush line which can be connected to the corresponding tapping on the discharge connection, or to an external source to facilitate cooling and flushing of the seal faces.

E. All casings shall be flanged. Threaded casings not allowed unless extra unions and fittings are provided with that pump to allow servicing.

F. The pump shall have a factory installed vent/flush line to insure removal of trapped air from the casing and mechanical seal cooling. The vent/flush line shall run from the seal chamber to the pump discharge.

G. The impeller shall be ASTM B584-836/875 bronze and hydraulically balanced. The impeller shall be dynamically balanced to ANSI Grade G6.3 and shall be fitted to the shaft with a key. The impeller shall be cast by the hydraulically efficient lost foam technique to ensure repeatability of high quality.

H. The pump shall incorporate a dry shaft design to prevent the circulating fluid from contacting the shaft. The pump shaft shall be AISI 1045 carbon steel with field replaceable bronze SAE 660 shaft sleeve. In order to improve serviceability and reduce the cost of ownership the shaft sleeve must be slip on (press on not allowable) and must be easily replaced in the field.

I. The pump shall be fitted with a single mechanical seal, with EPT elastomers and Carbon/Ceramic faces, rated up to 250ºF. This seal must be capable of being flushed externally via a tapping in the pump cover adjacent to the seal cavity. The entire pump line shall use no more than three different sizes of seals.

J. The pump shall be close coupled to a NEMA standard JM frame motor.

K. In order to both simplify and reduce the total cost of ownership, the manufacturer shall standardize on no more than three sizes of mechanical seals through out the entire range of the family of pumps. The manufacturer shall not use multiple part numbers for the same part.

PART 3 EXECUTION

3.1 INSTALLATION

A. All pumps shall be fitted with a discharge multi-purpose balancing valve or other means of providing system balance, isolation, and check feature for reverse flow. The valve shall be straight or angle pattern and shall be field convertible between the two. The valve shall be ductile iron and rated for 250 psi working pressure for all jobs. The valve flanges shall be matched to suit the working pressure of the piping components on the job; with either ANSI class125 psi flanges or ANSI class 250 flanges. The valve shall include the following components; non-slam check valve with spring-loaded bronze disc and seat, stainless steel stem, and calibrated adjustment permitting flow regulation. Valve shall be serviceable under full system pressure. The valve shall be a Taco model MPV Plus Two multi-purpose valve or equivalent.

B. All pump suctions to be fitted with a multifunction inlet suction diffuser fitting equal to that as manufactured by Taco, Inc. The suction guide body and cover plate shall be ductile iron and be rated for 250 psi for all jobs. The guide flanges shall be matched to suit the working pressure of the piping components on the job; with either ANSI class 125 flanges or ANSI class 250 flanges. The suction guide shall include the following components; full length S.S. straightening vanes, permanent S.S. strainer, disposable 16 mesh bronze start up strainer, blow down ports, and metering ports. For those pumps where an inlet guide fitting is not installed, there should be five pipe diameters of straight undisturbed flow going into the pump suction. The fitting shall be a Taco model SD inlet suction elbow or equivalent.

C. All pumps shall be fitted with one 4 ½” dial pressure gauge piped to the inlet and outlet pump flanges. The gauge is to be isolated from each flange via ¼” ball valve. This gauge is to be used to take the differential across the pump unless otherwise indicated.

D. Provide pumps to operate at specified system fluid temperatures without vapor binding and cavitation, are non-overloading in parallel or individual operation, and operate within 25 percent of midpoint of published maximum efficiency curve.

E. Install long radius reducing elbows or reducers between pump and piping. Support piping adjacent to pump so no weight is carried on pump casings. For close coupled or base mounted pumps, install supports under elbows on pump suction and discharge line sizes 4 inches and over.

F. Pipe connections to pumps shall be made in such a manner so as not to exert any stress on pump housings. If necessary to meet this requirement, provide additional pipe supports and flex connectors. Install pumps on vibration isolators. Refer to Section 23 05 48.

G. Install flexible connectors at or near pumps piping configuration does not absorb vibration. Refer to Section 23 21 16.

H. Provide line sized shut-off valve and pump suction fitting on pump suction, and line sized soft seat check valve, shut-off valve on pump discharge.

I. Decrease from line size with long radius reducing elbows or reducers. Support piping adjacent to pump so no weight is carried on pump casings. Provide supports under elbows on pump suction and discharge line sizes 4 inches and larger.

J. Provide air cock and drain connection on horizontal pump casings.

K. Provide drains for bases and seals.

L. Check, align, and certify alignment of base mounted pumps prior to start-up.

M. Install close coupled on concrete housekeeping base, with anchor bolts, set and level, and grout in place. Refer to Section 03 30 00.

N. Lubricate pumps before start-up.

O. Change start-up strainers to permanent strainer upon acceptance of the job. Provide a blowdown valve on each strainer and terminate with hose thread or extend blowdown line to nearest floor drain.

3.2 FIELD QUALITY CONTROL

A. Section 01 40 00 - Quality Requirements, Section 01 73 00 - Execution and Section 017700 Closeout Procedures: Field inspecting, testing, adjusting, and balancing.

B. Inspect for alignment of base mounted pumps.

END OF SECTION 23 2123

SECTION 23 5100 - BREECHINGS, CHIMNEYS, AND STACKS

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
1. Double wall metal stacks.

B. Related Sections:
1. Division 3 - Concrete Forming and Accessories: Execution requirements for inserts specified by this section.
2. Division 3 - Cast-In-Place Concrete: Concrete for stack foundations.
3. Section 23 04 00 – General Conditions for Mechanical Trades
4. Section 23 05 29 - Hangers and Supports for HVAC Piping and Equipment: Product requirements for hangers and supports for placement by this section.
5. Section 23 07 00 - HVAC Insulation: Execution requirements for insulation specified by this section.
6. Section 23 08 00-Commissioning of HVAC Systems
7. Section 23 52 34 – Hot Water Condensing: Boilers using breeching, chimneys, and stacks.
8. Division 26 - Equipment Wiring Connections: Execution requirements for electrical connections specified by this section.

1.2 REFERENCES

A. American National Standards Institute:
1. ANSI Z21.66 - Automatic Vent Damper Devices for Use with Gas-Fired Appliances.
2. ANSI Z21.67 - Mechanically Actuated Automatic Vent Damper Device.
3. ANSI Z21.68 - Thermatically Actuated Automatic Vent Damper Devices.
4. ANSI Z95.1 - Oil Burning Equipment, Installation.

B. ASTM International:
1. ASTM A240/A240M - Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications.
2. ASTM A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar.
3. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
4. A1011/A1011M-07 Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength
5. ASTM C401 - Standard Classification of Alumina and Alumina-Silicate Castable Refractories.

C. National Fire Protection Association:
   1. NFPA 31 - Standard for the Installation of Oil-Burning Equipment.
   2. NFPA 54 - National Fuel Gas Code.
   3. NFPA 82 - Standard on Incinerators and Waste and Linen Handling Systems and Equipment.
   4. NFPA 211 - Standard for Chimneys, Fireplaces, Vents, and Solid Fuel Burning Appliances.

D. Sheet Metal and Air Conditioning Contractors:
   1. SMACNA - Guide for Steel Stack Construction.
   2. SMACNA - HVAC Duct Construction Standard - Metal and Flexible.

E. Underwriters Laboratories Inc.:
   1. UL 103 - Factory-Built Chimneys for Residential Type and Building Heating Appliances.
   2. UL 127 - Factory-Built Fireplaces.
   3. UL 378 - Draft Equipment.
   4. UL 441 - Gas Vents.
   5. UL 641 - Type L Low-Temperature Venting Systems.
   6. UL 959 - Medium Heat Appliance Factory Built Chimneys.

1.3 DEFINITIONS

A. Breeching: Vent Connector.

B. Chimney: Primarily vertical shaft enclosing at least one vent for conducting flue gases outdoors.

C. Smoke Pipe: Round, single wall vent connector.

D. Vent: Portion of a venting system designed to convey flue gases directly outdoors from a vent connector or from an appliance when a vent connector is not used.

E. Vent Connector: Part of a venting system that conducts the flue gases from the flue collar of an appliance to a chimney or vent, and may include a draft control device.

1.4 DESIGN REQUIREMENTS

A. Design metal stacks for wind loading of 110 mph and seismic loads for Zone 2A.

1.5 SUBMITTALS

A. Section 01 33 05 - Submittal Procedures: Submittals procedures.

B. Shop Drawings: Indicate general construction, dimensions, weights, support and layout of breeching. Submit layout drawings indicating plan view and elevations.

C. Product Data: Submit data indicating factory built chimneys, including dimensional details of components and flue caps, dimensions and weights, electrical characteristics and connection requirements.

D. Manufacturer's Installation Instructions: Submit assembly, support details, and connection requirements.

E. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

1.6 QUALITY ASSURANCE

A. Perform Work in accordance with State of Connecticut standard.

B. Maintain one copy of each document on site.

C. Provide factory built vents and chimneys used for venting natural draft appliances complying with NFPA 211 and UL listed and labeled.

1.7 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience.

B. Installer: Company specializing in performing Work of this section with minimum three years documented experience approved by manufacturer.

C. Design stacks over 10 feet above roof under direct supervision of Professional Engineer experienced in design of this Work and licensed at Project location.

1.8 PRE-INSTALLATION MEETINGS

A. Division 1 - Administrative Requirements: Pre-installation meeting.

B. Convene minimum one week prior to commencing work of this section.

1.9 ENVIRONMENTAL REQUIREMENTS

A. Division 1 - Product Requirements.

B. Maintain water integrity of roof during and after installation of chimney or vent.

1.10 FIELD MEASUREMENTS

A. Verify field measurements prior to fabrication.

1.11 WARRANTY

A. Section 01 40 00 - Quality Requirements, Section 01 73 00 - Execution and Section 017700 Closeout Procedures: Product warranties and product bonds.

B. The factory-built modular vent system shall be warranted against functional failure for Twenty-Five (25) years.

C. Warranty all material and workmanship under these Specifications and the Contract from the date of final acceptance by Owner.

PART 2 PRODUCTS

2.1 DOUBLE WALL METAL STACKS

A. Manufacturers:
1. Jeremias Chimney Systems model DWGV
2. Metal Fab Corrugard with 430 stainless steel outer jacket
3. Metalbestos Heat Fab Model CI Plus with 1”
4. Substitutions: Division 01, Section 012300 Alternates, Section 012500 – Substitution Procedures – Substitution Request Form and Section 016000 - Product Requirements

B. All parts of the venting system shall be of one manufacturer and the entire system shall be listed by UL1738.

C. All exits of the flue system from building shall be protected with a wall or roof thimble assembly as required.

D. The double-wall, insulated vent system shall be constructed of stainless steel inner flue, 1” minimum annular air space insulation and stainless steel outer jacket. The materials and construction of modular sections and accessories shall be as specified by the terms of the product’s UL listing.
1. 0.020” minimum thickness 444, 316L, or AL29-4C stainless steel inner line for diameters up to 8” diameter.
2. 0.025” minimum thickness 444, 36L, or AL29-4C stainless steel inner line for diameters up to 20”” diameter.
3. Minimum 1 air gap insulation.
4. 0.025” minimum thickness 430 stainless steel outer jacket. Aluminized steel shall not be acceptable.

E. Inner flue shall have gasketed joints that do not require sealant. Outer band joints shall be secured and sealed by means of a locking band.

F. All exhaust venting shall be pitched a minimum of ¼” per foot back toward disposal points.

G. Vent system shall be designed to compensate for all temperature induced thermal expansion, installed to be gastight, and thus prevent leakage of combustion products into a building.

H. Venting system fittings and installation shall incorporate a 2 degree pitch for all horizontal or angled sections for any condensate or moisture elimination.

I. Vent system shall incorporate condensate drains when used on condensing equipment to prevent pooling or condensate. Drains shall be located at base of all vertical sections, where pipe cannot be pitched back to appliance, or in horizontal pipe runs of 20 feet and over.

J. Vent manufacturer shall provide appliance adapter specially approved for brand and model being vented. Adapter shall be either gasketed or sealed with high temp RTV type sealant to prevent exhaust gas r condensate leakage.

K. Detailed manufacturer's submittal drawings shall be provided for engineer's approval prior to installation of the vent system

L. Roof and wall penetration thimbles shall be factory insulated and UL listed in a manner not to require air ventilation for safe installation in the proximity of combustible materials.

M. Entire vent system from the appliance outlet to the termination point, including accessories shall be from only one manufacturer.

N. All exit points shall have a factory installed screen. Vertical shall be open top or rain cap, and horizontal shall be mitered cut.

O. If there is less than 25 feet of exhaust piping from appliance to termination point, incorporate a UL listed sound attenuator (muffler) to help reduce external ambient noise levels.

P. Vent Manufacturer shall provide ASHRAE flue sizing calculations, or certificate of vent equivalent feet, confirming the inner diameter is in complete compliance with appliance manufacturers installation instructions.

Q. Manufacturer shall provide certificate of code compliance for all required local and national codes for the installation with the scheduled appliances

PART 3 EXECUTION

3.1 PREPARATION

A. Install concrete inserts for support of breeching, chimneys, and stacks in coordination with formwork.

3.2 INSTALLATION

A. Install in accordance with NFPA SMACNA Guide for Steel Stack Construction.

B. Install breeching with minimum of joints. Align accurately at connections, with internal surfaces smooth.

C. Support breeching from building structure, rigidly with suitable ties, braces, hangers and anchors to hold to shape and prevent buckling. Support vertical breeching, chimneys, and stacks at 12 foot spacing, to adjacent structural surfaces, or at floor penetrations. Refer to SMACNA HVAC Duct Construction Standards - Metal and Flexible for equivalent duct support configuration and size.

D. Install stacks on concrete foundations. Refer to Division 3.

E. Pitch breeching with positive slope up from fuel-fired equipment to chimney or stack.

F. Coordinate installation of dampers.

G. Insulate breeching in accordance with Section 23 07 00.

H. Install vent dampers, locating close to draft hood collar, and secured to breeching.

I. Assemble and install stack sections in accordance with NFPA 82, industry practices, and in compliance with UL listing. Join sections with acid-resistant joint cement. Connect base section to foundation using anchor lugs.

J. Level and plumb chimney and stacks.

K. Clean breeching, chimneys, and stacks during installation, removing dust and debris.

L. Install slip joints allowing removal of appliances without removal or dismantling of breeching, breeching insulation, chimneys, or stacks.

M. Provide minimum length of breeching to connect appliance to chimney.

N. Extend vent above roof in accordance with applicable code.

O. Maximum Vent Horizontal Distance: 75 percent of vent vertical distance.

P. Where appliance requires draft hood or barometric control device, install manufacturer furnished listed devices in accordance with manufacturer's instructions and applicable code.

Q. Provide drain connection at bottom of stacks and pipe to nearest floor drain.

3.3 COMMISSIONING

A. Verify that equipment is installed and commissioned as per requirements of Section 230800 and manufacturer's written instructions.

B. Complete installation and functional tests according to Section 230800 and manufacturer's written instructions.

END OF SECTION 23 5100

SECTION 23 5234 - HOT WATER CONDENSING BOILERS

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
1. Hot Water Condensing Boilers.
2. Boiler controls.
3. Boiler trim.
4. Natural gas fired burner.

B. Related Sections:
1. Division 3 - Cast-In-Place Concrete: Execution requirements for concrete housekeeping pads specified by this section.
2. Section 23 04 00 – General Conditions for Mechanical Trades
3. Section 22 11 00 - Facility Water Distribution: Execution requirements for cold water piping connections to boilers specified in this section.
4. Section 23 05 13 - Common Motor Requirements for HVAC Equipment: Product requirements for electric motors for placement by this section.
5. Section 23 05 48 - Vibration and Seismic Controls for HVAC Piping and Equipment: Product requirements for Vibration Isolators for placement by this section.
6. Section 23 21 13 - Hydronic Piping: Execution requirements for hot water piping for piping connections to boilers specified in this section.
7. Section 23 51 00 - Breechings, Chimneys, and Stacks: Execution requirements for breeching, chimney, and stack connections to boilers specified in this section.
8. Division 26 - Equipment Wiring Connections: Execution requirements for electric connections to boilers specified in this section.

1.2 REFERENCES

A. American National Standards Institute:
1. ANSI Z21.13 - Gas-fired Low Pressure Steam and Hot Water Boilers.

B. American Society of Heating, Refrigerating and Air-Conditioning Engineers:
1. ASHRAE 90.1 - Energy Standard for Buildings Except Low-Rise Residential Buildings.

C. American Society of Mechanical Engineers:
1. ASME Section I - Boiler and Pressure Vessel Code - Power Boilers.
2. ASME Section IV - Boiler and Pressure Vessel Code - Heating Boilers.
3. ASME Section VIII - Boiler and Pressure Vessel Code - Pressure Vessels.

D. Hydronics Institute:
   1. H.I. Heating Boiler Standard - Testing and Rating Standard for Heating Boilers.

E. National Electrical Manufacturers Association:
   1. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).

F. National Fire Protection Association:
   1. NFPA 54 - National Fuel Gas Code.
   2. NFPA 58 - Liquefied Petroleum Gas Code.

1.3 SUBMITTALS

A. Section 01 33 05 - Submittal Procedures: Submittal procedures.

B. Product Data: Submit capacities and accessories included with boiler. Include general layout, dimensions, size and location of water, fuel, electric and vent connections, electrical characteristics, weight and mounting loads.

C. Test Reports: Indicate boilers meet or exceed specified performance and efficiency. Submit results of combustion test.

D. Manufacturer's Installation Instructions: Submit assembly, support details, connection requirements, and include start-up instructions.

E. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

F. Manufacturers Field Reports: Indicate condition of equipment after start-up including control settings and performance chart of control system.

1.4 CLOSEOUT SUBMITTALS

A. Section 01 73 00 - Execution and Section 017700 - Closeout Procedures: Closeout procedures.

B. Operation and Maintenance Data: Submit manufacturer's descriptive literature, operating instructions, cleaning procedures, replacement parts list, and maintenance and repair data.

1.5 QUALITY ASSURANCE

A. Conform to ASME Section IV for construction of boilers. Provide boilers registered with National Board of Boiler and Pressure Vessel Inspectors.

B. Boiler Performance Requirements: Conform to minimum efficiency prescribed by ASHRAE 90.1 when tested in accordance with H.I. Heating Boiler Standard.

C. Gas Train and Safety Controls: Conform to requirements of GEGAP.

D. Unit Certification: AGA, UL certified.

E. Conform to applicable code for internal wiring of factory wired equipment.

F. Products Requiring Electrical Connection: Listed and classified by Underwriters' Laboratories, Inc., as suitable for purpose specified and indicated.

G. Perform Work in accordance with State of Connecticut.

H. Maintain two copies of each document on site.

1.6 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience, and with service facilities within 100 miles of Project.

B. Installer: Company specializing in performing Work of this section with minimum three years documented experience approved by manufacturer.

1.7 PRE-INSTALLATION MEETINGS

A. Division 1 - Administrative Requirements: Pre-installation meeting.

B. Convene minimum one week prior to commencing work of this section.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Division 1 - Product Requirements: Product storage and handling requirements.

B. Accept boilers and accessories on site in factory shipping packaging. Inspect for damage.

C. Protect boilers from damage by leaving packing in place until installation.

1.9 FIELD MEASUREMENTS

A. Verify field measurements prior to fabrication.

1.10 WARRANTY

A. Section 01 73 00 - Execution and Section 017700 - Closeout Procedures: Product warranties and product bonds.

B. Boilers shall include manufacturer's standard form in which manufacturer agrees to repair or replace components of boilers that fail in materials or workmanship within specified warranty period.
   1. Warranty Period for Fire-Tube Condensing Boilers
      a. The pressure vessel/heat exchanger shall carry a 10-year from shipment, 7 year full, 3 year prorated, limited warranty against any failure due to condensate corrosion, thermal stress, mechanical defects or workmanship.
      b. Manufacturer labeled control panels are conditionally warranted against failure for (2) two years from shipment.
      c. All other components, with the exception of the igniter and flame detector, are conditionally guaranteed against any failure for 18 months from shipment

C. Warranty shall include labor and materials for a minimum period of two (2) years unless otherwise specified. Warranty starts at date of Commissioning acceptance of a complete system and Owner approval

1.11 MAINTENANCE SERVICE

A. Section 01 73 00 - Execution and Section 017700 - Closeout Procedures: Maintenance service.

B. Furnish service and maintenance of boilers for 18 months from Date of Substantial Completion.

C. Provide emergency call back service at all hours for this maintenance period.

D. Maintain locally, near Place of the Work, adequate stock of parts for replacement or emergency purposes. Have personnel available to ensure fulfillment of this maintenance service, without unreasonable loss of time.

E. Perform maintenance work using qualified personnel under supervision of boiler manufacturer.

1.12 MAINTENANCE MATERIALS

A. Section 01 73 00 - Execution and Section 017700 - Closeout Procedures: Spare parts and maintenance products.

B. Furnish wire brush and handle for fire tube boiler cleaning.

1.13 EXTRA MATERIALS

A. Section 01 73 00 - Execution and Section 017700 - Closeout Procedures: Spare parts and maintenance products.

B. Furnish one set of circulator pump seals.

PART 2 PRODUCTS

2.1 BUILDING HEATING HOT WATER CONDENSING BOILERS

A. Manufacturers:
1. Aerco Benchmark – purchased by Owner.

B. General: Boilers are purchased by Owner and turned over to Division 23 contractor. Contractor shall coordinate storage of boiler at their shipping and holding location. Contractor is responsible for installing combustion air intake, exhaust air flues, gas piping water piping, heating hot water piping, controls etc. to provide a fully operational system.

C. Controls:
1. Control System Components

The boiler control system shall be segregated into three components: “C-More” Control Panel, Power Box and Input/Output Connection Box. The entire system shall be Underwriters Laboratories recognized. At a minimum the following points shall be passed from the C-More panel to the building management system via the modbus connection:

a. Status
b. Outlet Temp
c. Firing Rate out
d. Run cycles low
e. Run hours low
f. Fire rate in
g. Fault log code

2. Combustion Safeguard/Flame Monitoring:

The combustion safeguard/flame monitoring system shall use spark ignition and a rectification-type flame sensor.

3. Control Annunciator

The controls shall annunciate boiler and sensor status and include extensive self-diagnostic capabilities that incorporate a minimum of eight separate status messages and 34 separate fault messages.

4. Control Features

The control panel shall incorporate three self-governing features designed to enhance operation in modes where it receives an external control signal by eliminating nuisance faults due to over-temperature, improper external signal or loss of external signal. These features include:

a. Setpoint High Limit
Setpoint high limit allows for a selectable maximum boiler outlet temperature and acts as temperature limiting governor. Setpoint limit is based on a PID function that automatically limits firing rate to maintain outlet temperature within a 0 to 10 degree selectable band from the desired maximum boiler outlet temperature.

b. Setpoint Low Limit
Setpoint low limit allows for a selectable minimum operating temperature.

c. Failsafe Mode
Failsafe mode allows the boiler to switch its mode to operate from an internal setpoint if its external control signal is lost, rather than shut off. This is a selectable mode, enabling the control can to shut off the unit upon loss of external signal, if so desired.

5. Enhanced External System Interface

The boiler control system shall incorporate the following additional features for enhanced external system interface:

a. System start temperature feature
b. Pump delay timer
c. Auxiliary start delay timer
d. Auxiliary temperature sensor
e. Analog output feature to enable simple monitoring of temperature setpoint, outlet temperature or fire rate
f. Remote interlock circuit
g. Delayed interlock circuit
h. Fault relay for remote fault alarm

6. System Controller

Provide manufacturers BMS-2 standard electronic control panel to provide a coordinated sequencing and control of all boilers in the system. Panel shall be solid state control and communicate with boilers through a daisy chain RS-485 control loop. Panel shall have selectable modes of operation and be Modbus fitted for communication to building controller, Modbus interface will be used to pass points from boiler to building management system. At a minimum the following points shall be passed from the BMS-2 panel to the building management system via the modbus connection:

a. # of boilers firing
b. Header water temperature

c. % rate of fire
d. OA temp
e. Fault log code

7. Each boiler shall contain an on-board sequencing technology (BST) and capability with a completely integrated system to control all operation and energy input of the multiple boiler heating plant. The control shall communicate through MODBUS with the Boilers via the RS-485 port.
8. The integral control system shall have the ability to vary the firing rate and energy input of each individual boiler throughout its full modulating range to maximize the condensing capability and thermal efficiency output of the entire heating plant. The system shall control the boiler outlet header temperature within +2ºF. The control logic shall be a PID type and use Ramp Up/Ramp Down control algorithm for accurate temperature control with excellent variable load response. The controls shall be interlocked with the Building Automation System for auxiliary equipment such as system pumps and combustion air inlet dampers based upon outdoor air temperature.
9. The BST shall have the following anti-cycling features:
   a. Manual designation of lead boiler and last boiler.
   b. Lead boiler rotation at user-specified time interval.
   c. Delay the firing/shutting down of boilers when header temperature within a predefined deadband
10. When set on Internal Setpoint Mode, temperature control setpoint on the BST shall be fully field adjustable from 50ºF to 190ºF in operation. When set on Indoor/Outdoor Reset Mode, the BST will operate on an adjustable inverse ratio in response to outdoor temperature to control the main header temperature. Reset ratio shall be fully field adjustable from 0.3 to 3.0 in operation. When set on 4ma to 20ma Temperature Control Mode, the BST will operate the plant to vary header temperature setpoint linearly as an externally applied 4-20 ma signal is supplied.
11. When set on MODBUS Temperature Control Mode, the BST will operate the plant to vary header temperature setpoint as an external communication utilizing the MODBUS protocol is supplied via the RS-232 port. The BST will automatically balance the sequence of operating time on each boiler by a first-on first-off mode and provide for setback and remote alarm contacts. Connection between individual boilers shall be twisted pair low voltage wiring, with the boilers ‘daisy-chained’ for ease of installation.

12. Building Automation System Interface – Boiler manufacturer shall supply an external electronic cross protocol gateway between the boilers control system and the Building Automation system. The Gateway shall convert Modbus information to the protocol of the Building Automation System. Gateway shall allow the monitoring of all master control system and individual boiler addressable registers. The gateway shall allow the input of a master setpoint for the entire boiler plant and boiler plant enable/disable if specified by the Building Control Specification. Gateway shall be supplied with all cabling, power supply, and preloaded register addresses.

D. Condensate Neutralizer
1. The Contractor shall supply and install fireside condensate neutralizing tubes for each condensate drain and flue pipe condensate drain.
2. The neutralizer tubes shall be sized to meet the boiler capacity.
3. The installing contractor shall supply all boiler and vent condensate drains with factory provided float traps, and unions before the neutralizing tubes.
4. All piping shall be PVC and supplied/installed by contractor. Plastic tubing is acceptable alternative when used with barbed fittings and hose clamps. All PVC joints shall be glued, and all barbed fittings shall be secured with hose clamps.
5. The boiler and flue condensate drains shall not be combined into one neutralizer. All piping shall be per manufacturer's piping diagrams and directions. All neutralizing tubes shall be secured to the floor or wall so as not to be exposed to damage or within a normal walkway. The contactor shall fill all "P-traps" and neutralizing tubes with tap water before the firing of any boiler.

E. Boiler room life safety panel
1. Furnish and install a boiler room hazard safety alarm and interlock panel complete with remote sensors as indicated. This panel shall provide a single interface point for single or multiple Emergency safety shut-down of the boilers and/or water heaters as required by local Codes and jurisdictions and shall provide early warning and shutdown in the event of life threatening natural gas or carbon monoxide leaks.
2. The panel shall be furnished by the boiler vendor for single source responsibility and coordination. All sensors and switches, including the break glass switches shall be furnished with the system.
3. Activation of either break glass switch or the methane gas detection system high level alarm shall interrupt the power to the boilers.
4. The panel shall incorporate the following safety and hazard prevention functions and shall include interlocks for all auxiliary equipment:
5. Break glass interlocks and power contactors to disengage power to boilers in the event of a manual safety shutdown initiated by closure of any break glass switch. A break glass switch shall be furnished for each egress door to the boiler room.
6. Methane monitoring to include two alarm setpoints. The first setpoint shall initiate a warning alarm. The second alarm point shall shut down the boilers through the power contactors. Sensors shall be furnished to cover the boilers and incoming gas piping as required.

7. Methane detection shall also provide a dedicated dry contact for shut-down command for other MER equipment.
8. Water detection system to alarm on a boiler room leak. The leak detection system will include a full perimeter sensor cable for the boiler room and shall be run in a continuous manner (pilot light indication required).
9. In the event of an alarm, an audible and visual signal shall be initiated as well as a contact closure for remote use. The audible alarm shall have a first out silencing button that shall allow the alarm to sound again if a new fault occurs prior to the first fault clearing. Each alarm function shall have a separate indicator light.
10. Manual reset of system alarms shall be required in order to restart equipment shut down due to break-glass or high-level methane detection.
11. The entire system shall be factory wired in a NEMA 12 enclosure with separate sections for high and low voltage.
12. The sensors and cables shall be installed after the boiler mechanical construction is complete and construction debris has been removed.

F. Venting:
1. The exhaust vent must be UL Listed for use with Category II, III and IV appliances and compatible with operating temperatures up to 230°F, condensing flue gas service. UL-listed vents of Polypropylene and Al 29-4C stainless steel must be used with boilers
2. Vent manufacturer shall provide engineering calculations for both exhaust venting and combustion air intake, with total pressure drop calculated at full fire for Engineers Approval.
3. Combustion-Air Intake: Boilers shall be capable of drawing combustion air from the outdoors via a metal duct connected between the boiler and the outdoors.
4. Common vent and common combustion air must be an available option for boiler installation. Consult manufacturer for common vent and combustion air sizing.
5. Follow guidelines specified in manufacturer’s venting guide including wall thickness ad pressure drop of pipe and fittings.

2.2 ELECTRICAL CHARACTERISTICS AND COMPONENTS

A. Electrical Characteristics: In accordance with Division 26 and per schedule:

PART 3 EXECUTION

3.1 INSTALLATION

A. Install boilers plumb and level, to plus or minus 1/16 inch over boiler base.

B. Maintain manufacturer's recommended clearances around and over boilers.

C. Install boiler on concrete housekeeping pad, minimum 12 inches high and 6 inches larger than boiler base on each side. Coordinate with Division 3.

D. Install boiler on vibration isolators in accordance with Section 23 05 48.

E. Connect hot water piping to supply and return boiler connections.

F. Install the following piping accessories. Refer to Section 23 21 13.
   1. On supply:
      a. Per Piping Details.
   2. On return:
      a. Per Piping Details.

G. Install discharge piping from relief valves and drain valves to nearest floor drain.

H. Install circulator and diaphragm expansion tank on boiler.

I. Install boiler trim and accessories furnished loose for field mounting.

J. Install electrical devices furnished loose for field mounting.

K. Install control wiring between boiler mounted control panel, BMS-2 control panel and field mounted control devices.

L. Connect flue to boiler outlet, full size of outlet.

M. All aspects of installation of boiler plant shall be in strict accordance with manufacturer’s instructions.

3.2 FIELD QUALITY CONTROL

A. Division 1 - Quality Requirements, Division 1 - Execution and Closeout Requirements: Field inspecting, testing, adjusting, and balancing.

B. Perform combustion test including boiler firing rate, over fire draft, gas flow rate, heat input, burner manifold gas pressure, percent carbon monoxide, percent oxygen, percent excess air, flue gas temperature at outlet, ambient temperature, net stack temperature, percent stack loss, percent combustion efficiency, and heat output. Perform test at minimum, mid-range, and high fire.

C. Arrange with local authorities having jurisdiction for inspection of all boilers, piping, and for certificate of operation.

3.3 MANUFACTURER’S FIELD SERVICES

A. Start-up boilers according to manufacturer's start-up instructions and in presence of boiler manufacturer's representative Test controls and demonstrate compliance with

requirements. Adjust burner for maximum burning efficiency. Replace damaged or malfunctioning controls and equipment.

3.4 ADJUSTING

A. All heating equipment shall be adjusted as per manufacturer’s requirements.

3.5 CLEANING

A. Flush and clean boilers upon completion of installation, in accordance with manufacturer's start-up instructions.

3.6 DEMONSTRATION

A. Section 01 73 00 - Execution and Section 017700 - Closeout Procedures and Section 01 79 00 - Demonstration and training.

B. Demonstrate operation and maintenance procedures.

C. Furnish services for manufacturer's technical representative for one 8 hour day to instruct Owner's personnel in operation and maintenance of boilers. Schedule training with Owner, provide at least 7 days notice to Architect/Engineer prior to training date.

END OF SECTION 23 5234

SECTION 26 0400 - GENERAL CONDITIONS FOR ELECTRICAL TRADES

PART 1 GENERAL

1.1 RELATED REQUIREMENTS

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

B. This section applies to certain sections of Division 23, "HVAC," and this section applies to all sections of Division 26, "Electrical" of this project specification unless specified otherwise in the individual sections.

C. The Drawings of other trades Architectural and Mechanical shall be examined for coordination and familiarity of work with other Contractors. Any duplication or omission of provisions in this project should be brought to the attention of the Owner's Representative prior to Bidding.

D. The drawings of equipment suppliers shall be examined for coordination and familiarity of work with Owner's equipment suppliers.

1.2 DESCRIPTION

A. The General Conditions and Supplementary General Conditions are a part of this Division and are to be considered a part of this Contract.

B. Where items of the General Conditions and Supplementary General Conditions are repeated in other Sections of the Specifications, it is merely intended to qualify or to call particular attention to them. It is not intended that any other parts of the General Conditions and Supplementary General Conditions shall be assumed to be omitted if not repeated therein. This Section applies equally and specifically to all Contractors supplying labor and/or equipment and/or materials as required under each Section of this Division. Where conflicts exist between the drawings and the specifications or between this section of the specifications and other sections, the more stringent or higher cost option shall apply.

C. It is the intent of this Section of the Specifications to establish a standard of quality and performance characteristics for basic materials and installation methods used in building electrical systems.

1.3 INTENT

A. This contract is for all labor, materials and equipment required for installation. The system shall be complete and finished in all respects, tested and ready for operation. Work shall include calibration of equipment with factory settings. All materials, equipment and apparatus shall be new and of first class quality.

B. Any apparatus, appliance, material or work not shown on drawings but mentioned in the specifications, or vice versa, or any incidental accessories necessary to make the work complete and perfect in all respects and ready for operation as determined by good trade practice even if not particularly specified, shall be furnished, delivered and installed under their respective Divisions without any additional expense to the Owner.

C. Minor details not usually shown or specified but necessary for proper installation and operation shall be included in the work as though they were hereinafter shown or specified.

D. Work under each Section shall include giving written notice to the Owner and Engineer of any materials or apparatus believed inadequate or unsuitable; in violation of laws, ordinances, rules or regulations of authorities having jurisdiction; and any necessary items of work omitted. In the absence of such written notice, it is mutually agreed that work under each Section has included the cost of all required items for the accepted, satisfactory functioning of the entire system without extra compensation.

E. Location of all existing systems and equipment shown on floor plans is based on the best available information. The Contractor shall verify all dimensions and locations of existing systems and equipment in the field and adjust as necessary.

F. Certain items of existing equipment may be indicated for removal or relocation. Items noted for removal shall be disconnected and turned over to the Owner or disposed of by the Contractor if the Owner so requests. If instructed to dispose of items, the Contractor shall remove the items from the premises and dispose of them in a safe, legal and responsible manner and location. Questions regarding the suitability of the material or equipment shall be brought to the attention of the Owner and Engineer in writing.

G. Wherever a particular piece of equipment, device or material is specifically indicated on the Drawings by model number, type, series or other means, that specification shall take precedence over equipment or materials specified herein. For example: If a particular switch is specified on the Drawings, its specification takes precedence over switch specified herein.

1.4 DEFINITIONS

A. Word “Subcontractor” means specifically the subcontractor working under this Division. Other Contractors are specifically designated “Plumbing Subcontractor”, “General Contractor” and so on. Note: Take care to ascertain limits of responsibility for connecting equipment which requires connections by two or more trades.

B. Word “install” shall mean set in place complete with all mounting facilities and connections as necessary ready for normal use or service.

C. Words “furnish” or “supply” shall mean purchase, deliver to, and off-load at the job site, all ready to be installed including where appropriate all necessary interim storage and protection.

D. Word “provide” shall mean furnish (or supply) and install as necessary.

E. Word “finished” refers to all rooms and areas scheduled to be painted in Room Finish Schedule on the drawings. All rooms and areas not covered in Schedule, including underground tunnels and areas above ceilings shall be considered not finished, unless otherwise noted.

F. No Exceptions Taken – reviewed and determined to be in general conformance with contract documents.

G. Words “approved equal” mean any product which in the opinion of the Engineer is equal in quality, arrangement, appearance, and performance to the product specified.

H. Word “wiring” shall mean cable assembly, raceway, conductors, fittings and any other necessary accessories to make a complete wiring system. Word “product” shall mean any item of equipment, material, fixture, apparatus, appliance or accessory installed under this Division.

I. Substitutions: Requests for changes in products, materials, equipment, and methods of construction required by Contract Documents proposed by the Contractor after award of the Contract are considered requests for "substitutions."

J. Indicated: The term "indicated" refers to graphic representations, notes, or schedules on the Drawings, other paragraphs or schedules in the Specifications, and similar requirements in the Contract Documents. Where terms such as "shown," "noted," "scheduled," and "specified" are used, it is to help the reader locate the reference; no limitation on location is intended.

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

L. Approve: The term "approved," where used in conjunction with the Engineer's action on the Contractor's submittals, applications, and requests, is limited to the Engineer's duties and responsibilities as stated in General and Supplementary Conditions.

M. Regulation: The term "Regulations" includes laws, ordinances, statutes, and lawful orders issued by authorities having jurisdiction, as well as rules, conventions, and agreements within the construction industry that control performance of the Work.

N. Remove: The term “remove” means “to disconnect from its present position, remove from the premises and to dispose of in a legal manner.”

O. Standard Product Warranties are preprinted written warranties published by individual manufacturers for particular products and are specifically endorsed by the manufacturer to the Owner.

P. Special Warranties are written warranties required by or incorporated in the Contract Documents, either to extend time limits provided by standard warranties or to provide greater rights for the Owner.

1.5 DRAWINGS

A. Drawings are diagrammatic and indicate the general arrangement of systems and work included in the Contract. Consult the Architectural Drawings and Details for exact location of fixtures and equipment; where same are not definitely located, obtain this information from the Architect. (Do not scale the drawings)

B. Work under each Section shall closely follow Drawings in layout of work; check Drawings of other Divisions to verify spaces in which work will be installed. Maintain maximum headroom; where space conditions appear inadequate, Owner and Engineer shall be notified before proceeding with installations.

C. The Owner may, without extra charge, make reasonable modifications in the layout as needed to prevent conflict with work of other trades and/or for proper execution of the work.

D. Where variances occur between the Drawings and Specifications or within either of the Documents, the item or arrangement of better quality, higher rating, or higher value shall be included in the Contract price. The Owner and Engineer shall decide on the item and the manner in which the work shall be installed.

1.6 SURVEYS AND MEASUREMENTS

A. Before submitting his Bid, the Contractors shall visit the site and become thoroughly familiar with all existing conditions under which his work will be installed. This Contract includes all modifications of existing systems required for the installation of new equipment. This Contract includes all necessary offsets, transitions and modifications required to install all new equipment in existing spaces. All new and existing equipment and systems shall be fully operational under this Contract before the job is considered complete. The Contractors shall be held responsible for any assumptions he makes, any omissions or errors he makes as a result of his failure to become fully familiar with the existing conditions at the site and the Contract Documents.

B. The Contractor shall base all measurements, both horizontal and vertical, from established bench marks. All work shall agree with these established lines and levels. Verify all measurements at the site and check the correctness of same as related to the work.

C. Should the Contractor discover any discrepancies between actual measurements and those indicated which prevent following good practice or which interfere with the intent of the Drawings and Specifications, the Engineer will be notified and work will not proceed until instructions from the Engineer are received.

1.7 CODES AND STANDARDS

A. Reference Standard Compliance
1. Where equipment or materials are specified to conform to industry and technical society reference standards of the organizations such as American National Standards Institute (ANSI), American Society for Testing and Materials (ASTM), National Electrical Manufacturers Association (NEMA), and Underwriters Laboratories Inc. (UL), submit proof of such compliance. The label or listing by the specified organization will be acceptable evidence of compliance.
2. Independent Testing Organization Certificate: In lieu of the label or listing, indicated above submit a certificate from an independent testing organization, competent to perform testing, and approved by the engineer. The certificate shall state that the item has been tested in accordance with the specified organization's test methods and that the item complies with the specified organization's reference standard.

B. The Following Codes and Standards for the state and local jurisdiction where the project is located as listed below apply to all electrical work. Wherever Codes and/or Standards are mentioned in these Specifications, the latest applicable edition or revision shall be followed:

Connecticut State Building Code Including all Supplements
Connecticut State Fire Safety Code Including all Supplements
The International Building Code
The International Mechanical Code
NFPA 70, the National Electrical Code
NECA - 1 Standard for Good Workmanship in Electrical Construction
ASHRAE 90.1 and International Energy Conservation Code

C. The following Standards shall be used where referenced by the following abbreviations:

AIA	American Institute of Architects
ANSI	American National Standards Institute
ASME	American Society of Mechanical Engineers
ASTM	American Society of Testing and Materials
EPA	Environmental Protection Agency
FM	Factory Mutual
FSSC	Federal Specification
IEEE	Institute of Electrical and Electronics Engineers
NBS	National Bureau of Standards
NECA	National Electrical Contractors Association
NEMA	National Electrical Manufacturers Association
NFPA	National Fire Protection Association
NSC	National Safety Council
OSHA	Occupational Safety and Health Administration
UL	Underwriters' Laboratories

D. All materials furnished and all work installed shall comply with the rules and recommendations of the NFPA, the requirements of the local utility companies, the recommendations of the fire insurance rating organization having jurisdiction and the requirements of all Governmental departments having jurisdiction.

E. The Contractor shall include in the work, without extra cost to the Owner, any labor, materials, services, apparatus and Drawings in order to comply with all applicable laws, ordinances, rules and regulations, whether shown on Drawings and/or specified or not.

1.8 PERMITS AND FEES

A. The Contractor shall give all necessary notices, obtain all permits; and pay all Government and State sales taxes and fees where applicable, and other costs, including utility connections or extensions in connection with the work, file all necessary Drawings, prepare all documents and obtain all necessary approvals of all Governmental and State departments having jurisdiction, obtain all required certificates of inspection for his work, and deliver a copy to the Owner and Engineer before request for acceptance and final payment for the work.

1.9 EQUIPMENT EQUIVALENTS AND SUBSTITUTIONS

A. Certain manufacturers of material, apparatus or appliances are indicated in the drawings and specifications for this project. These items have been used as the basis of design, and as a convenience in fixing the minimum standard of workmanship, finish and design that is required. If the Contractors uses an “approved equal” alternative to the basis of design, and if the features of that alternative have an impact on other components of the Project, the Contractor shall include the necessary adjustments in those components, whether for architectural, mechanical, electrical, or any other elements, plus any adjustments for difference in performance.

B. Where one name only is used and is followed by the words “or approved equal”, the Contractor must use the item named or he is required to apply for a substitution. Where one name only is used, the Contractor must use that item named.

C. Where no specific make of material, apparatus or appliance is mentioned, any first-class product made by a reputable manufacturer may be submitted for Architect and Engineer review.

D. Where the Contractor proposes to use an item that is different from the basis of design in the Drawings and specifications, and that will require the redesign of the structure, partitions, foundations, piping, wiring or any other component of the mechanical, electrical, or architectural layout, the Contractor shall provide the necessary redesign of those components.

E. Where the Contractor proposes to deviate (provide an equivalent or request for substitution) from the basis of design scheduled equipment or materials as hereinafter specified or shown on the drawings, they are required to submit a requested for substitution in writing. The Contractor shall state in their request whether it is a substitution, equivalent or a non approved equivalent to that specified and the amount of credit or extra cost involved. A copy of said request shall be included in the Base Bid with manufacturer’s equipment cuts. The Base Bid shall be based on using the materials and equipment as specified with no exceptions.

F. If an alternative or substituted item results in a difference in quantity and arrangement of piping, ductwork, valves, pumps, insulation, wiring, conduit, and equipment from that specified or indicated on the Drawings, the Contractor shall furnish and install any such additional equipment required by the system, at no additional cost to the Owner including any costs added to other trades due to the equivalent change from the basis of design detailed in the drawings or included within the specifications.

G. Equipment, material or devices submitted for review as an "equivalent" shall meet the following requirements:
   1. The equivalent shall have the same construction features such as, but not limited to:
      a. Material thickness, gauge, weight, density, etc.
      b. Welded, riveted, bolted, etc., construction
      c. Finish, undercoating, corrosion protection
   2. The equivalent shall perform with the same or better operating efficiency.
   3. The equivalent shall be locally represented by the manufacturer for service, parts and technical information.
   4. The equivalent shall bear the same labels of performance certification as is applicable to the specified item, such as UL or NEMA labels.

H. Equipment, material or devices submitted for review as a "substitution" shall meet the following requirements:
   1. Substitution Request Submittal: Requests for substitution will be considered if received in writing 14 days before the bid date. Requests received later than 14 days before the bid date may be considered or rejected at the discretion of the Engineer/Owner. Once the Contractor submits a complete request for substitution as determined by the engineer, the engineer reserves the right to request the time necessary to evaluate the request for substitution and review it with the Owner.
   2. Submit three (3) copies of each request for substitution for consideration.
   3. Identify the product, or the fabrication or installation method to be replaced in each request. Include related Specification Section and Drawing numbers. Provide complete documentation showing compliance with the requirements for substitutions, and the following information, as appropriate:
      a. Product Data, including Drawings and descriptions of products, fabrication and installation procedures.
      b. Samples, where applicable or requested.

c. A detailed comparison of significant qualities of the proposed substitution with those of the Work specified. Significant qualities may include elements such as size, weight, durability, performance and visual effect.

d. Coordination information, including a list of changes or modifications needed to other parts of the Work and to construction performed by the Owner and separate Contractors that will become necessary to accommodate the proposed substitution.

e. A statement indicating the substitution's effect on the Contractor's Construction Schedule compared to the schedule without approval of the substitution. Indicate the effect of the proposed substitution on overall Contract Time.

f. Cost information, including a proposal of the net change, if any in the Contract Sum.

g. Certification by the Contractor that the substitution proposed is equal-to or better in every significant respect to that required by the Contract Documents, and that it will perform adequately in the application indicated. Include the Contractor's waiver of rights to additional payment or time that may subsequently become necessary because of the failure of the substitution to perform adequately.

h. Engineer's Action: Within one week of receipt of the request for substitution, the Engineer will notify the Contractor of acceptance or rejection of the proposed substitution. If a decision on use of a proposed substitute cannot be made or obtained within the time allocated, use the product specified by name. Acceptance of a product substitution will be in the form of an Addendum.

i. Other Conditions: The Contractor's substitution request will be received and considered by the Engineer when one or more of the following conditions are satisfied, as determined by the Engineer; otherwise requests will be returned without action except to record noncompliance with these requirements.

1) The request is directly related to an "or equal" clause or similar language in the Contract Documents.

2) The specified product or method of construction cannot be provided within the Contract Time. The request will not be considered if the product or method cannot be provided as a result of failure to pursue the Work promptly or coordinate activities properly.

3) A substantial advantage is offered the Owner, in terms of cost, time, energy conservation or other considerations of merit, after deducting offsetting responsibilities the Owner may be required to bear. Additional responsibilities for the Owner may include additional compensation to the Engineer for redesign and evaluation services, increased cost of other construction by the Owner or separate Contractors, and similar considerations.

1.10 SUBMITTAL PROCEDURES

A. Provide Submittals in accordance with the requirements of Division 1 and as indicated in the following.

B. Coordination: Coordinate preparation and processing of submittals with performance of construction activities. Transmit each submittal sufficiently in advance of performance of related construction activities to avoid delay.

1. Coordinate each submittal with fabrication, purchasing, testing, delivery, other submittals and related activities that require sequential activity.

2. Coordinate transmittal of different types of submittals for related elements of the Work so processing will not be delayed by the need to review submittals concurrently for coordination. The Engineer reserves the right to withhold action on a submittal requiring coordination with other submittals until related submittals are received.

C. Processing: Allow sufficient review time so that installation will not be delayed as a result of the time required to process submittals, including time for resubmittals.
   1. Allow two weeks for initial review. Allow additional time if processing must be delayed to permit coordination with subsequent submittals. The Engineer will promptly advise the Contractor when a submittal being processed must be delayed for coordination.
   2. If an intermediate submittal is necessary, process the same as the initial submittal.
   3. Allow two weeks for reprocessing each submittal.
   4. No extension of Contract Time will be authorized because of failure to transmit submittals to the Engineer sufficiently in advance of the Work to permit processing.

D. Submittal Preparation: Place a permanent label or title block on each submittal for identification. Indicate the name of the entity that prepared each submittal on the label or title block.
   1. Include the following information on the label for processing and recording action taken.
      a. Project name.
      b. Date.
      c. Name and address of Engineer.
      d. Name and address of Contractor.
      e. Name and address of subcontractor.
      f. Name and address of supplier.
      g. Name of manufacturer.
      h. Number and title of appropriate Specification Section.
      i. Drawing number and detail references, as appropriate.

E. Submittal Transmittal: Package each submittal appropriately for transmittal and handling. Transmit each submittal from Contractor to Engineer using a transmittal form. Submittals received from sources other than the Contractor will be returned without action. On the transmittal, record relevant information and requests for data. On the form, or separate sheet, record deviations from Contract Document requirements, including minor variations and limitations. Include Contractor's certification that information complies with Contract Document requirements.

F. Except for submittals for record, information or similar purposes, where action and return is required or requested, the Engineer will review each submittal, mark to indicate action taken, and return promptly. Compliance with specified characteristics is the Contractor's responsibility.

G. Action Stamp: The Engineer will stamp each submittal with a uniform, self-explanatory action stamp. The stamp will be appropriately marked, to indicate the action taken.

1.11 SHOP DRAWINGS

A. Submit newly prepared information, drawn to accurate scale. Highlight, encircle, or otherwise indicate deviations from the Contract Documents. Do not reproduce Contract Documents or copy standard information as the basis of Shop Drawings. Standard information prepared without specific reference to the Project is not considered Shop Drawings.

B. The Contractor shall submit for review detailed shop drawings of all equipment and material specified in each section and coordinated ductwork layouts. No material or equipment may be delivered to the job site or installed until the Contractor has received shop drawings for the particular material or equipment which have been properly reviewed. Shop drawings shall be submitted within 60 days after award of Contract before any material or equipment is purchased. The Contractor shall submit for review copies of all shop drawings to be incorporated in the Electrical Contract. Refer to the General Conditions and Supplementary General Conditions for the quantity of copies required for submission. Where quantities are not specified, provide seven (7) copies for review.

C. Provide shop drawings for all devices specified under equipment specifications for all systems including fire alarm, switchgear, clock, lighting, etc., or where called for elsewhere in the Specifications, or where scheduled on the drawings, or where called out on the drawings. Shop drawings shall include manufacturers' names, catalog numbers, cuts, diagrams, dimensions, identification of products and materials included, compliance with specified standards, notation of coordination requirements, notation of dimensions established by field measurement and other such descriptive data as may be required to identify and accept the equipment. A complete list in each category (example: all fixtures) of all shop drawings, catalog cuts, material lists, etc., shall be submitted to the Engineer at one time. No consideration will be given to a partial shop drawing submittal.

D. Submittals shall be marked with the trade involved, i.e., Electrical, HVAC, etc. when the submittal could involve more than one trade.

E. Where multiple quantities or types of equipment are being submitted, provide a cover sheet (with a list of contents) on the submittal identifying the equipment or material being submitted.

F. Failure to submit shop drawings in ample time for review shall not entitle the Contractor to an extension of Contract time. No claim for extension by reason of such default will be allowed, nor

shall the Contractor be entitled to purchase, furnish and/or install equipment which has not been reviewed by the Engineer.

G. The Contractor shall furnish all necessary templates, patterns, etc., for installation work and for the purpose of making adjoining work conform; furnish setting plans and shop details to other trades as required.

H. Acceptance rendered on shop drawings shall not be considered as a guarantee of measurements or building conditions. Where drawings are reviewed, review does not mean that drawings have been checked in detail; said approval does not in any way relieve the Contractor from his responsibility or necessity of furnishing material or performing work as required by the Contract Drawings and Specifications. Verify available space prior to submitting shop drawings.

I. Acceptance of shop drawings shall not apply to quantity nor relieve Contractor of his responsibility to comply with intent of Drawings and Specifications.

J. Acceptance of shop drawings is final and no further changes will be allowed without the written consent of the Engineer.

K. Acceptance of shop drawings does not relieve the Contractor from submitting, coordinating and implementing schedules, forms, worksheets and similar as required for owner/operator input and approval as specified herein and required for proper system operation.

L. Shop drawing submittal sheets which may show items that are not being furnished shall have those items crossed off to clearly indicate which items will be furnished.

M. Bidders shall not rely on any verbal clarification of the Drawings and/or Specifications. Any questions shall be referred to the Engineer in writing at least five (5) working days prior to bidding to allow for issuance of an Addendum.

N. Do not use Shop Drawings without an appropriate final stamp indicating action taken in connection with construction.

1.12 COORDINATION DRAWINGS

A. Prepare coordination drawings in accordance with Division 01 Section "PROJECT MANAGEMENT AND COORDINATION," to a scale of 1/4"=1'-0" or larger; detailing major elements, components, and systems of electrical equipment and materials in relationship with other systems, installations, and building components. Indicate locations where space is limited for installation and access and where sequencing and coordination of installations are of importance to the efficient flow of the Work, including (but not necessarily limited to) the following:
   1. Indicate the proposed locations of panelboards, conduits, cabinets, etc. Include the following:
   2. Clearances for installing and maintaining insulation.
   3. Clearances for servicing and maintaining equipment, including NEC requirements and space for equipment disassembly required for periodic maintenance.
   4. Equipment connections and support details.
   5. Exterior wall and foundation penetrations.
   6. Fire-rated wall penetrations.
   7. Sizes and locations of required concrete pads and bases.

B. Indicate scheduling, sequencing, movement, and positioning of large equipment into the building during construction.

C. Prepare floor plans, elevations, and details to indicate penetrations in floors, walls, and ceilings and their relationship to other penetrations and installations.

1.13 RESPONSIBILITIES, COOPERATION AND COORDINATION WITH OTHER TRADES

A. All work shall be carried out in conjunction with other trades and full cooperation shall be given in order that all work may proceed with a minimum of delay and interference. Particular emphasis is placed on timely installation of major apparatus and furnishing other Contractors, especially the Contractor or Construction Manager, with information as to openings, chases, sleeves, bases, inserts, equipment locations, panels, etc., required by other trades.

B. The Contractors are required to examine all of the Project Drawings and mutually arrange work so as to avoid interference with the work of other trades. In general, ductwork, heating, condenser, chilled water piping, sprinkler piping and drainage lines take precedence over water, gas and electrical conduits. The Engineer shall make final decisions regarding the arrangement of work which cannot be agreed upon by the Contractors.

C. Where the work of the Contractor will be installed in close proximity to or will interfere with work of other trades, the Contractors will cooperate in working out space conditions to make a satisfactory adjustment.

D. If the work under a Section is installed before coordinating with other Divisions or Sections or so as to cause interference with work of other Sections, the necessary changes to correct the condition shall be made by the Contractor causing the interference without extra charge to the Owner.

E. Where work is installed prior to preparation and approval of the Coordination Drawings or in conflict with the approved Coordination drawings and if so directed in other Sections, the Contractor indicated shall prepare composite working drawings and sections clearly showing how the work is to be installed in relation to the work of other trades, at no extra charge to the Owner.

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

G. Refer to the following contract documents and provide all inter-trade coordination and any additional hardware, software, building preparation, cabling, interfaces, etc. for completely operational systems.

H. Review all other contract documents sections, as required, to achieve complete inter-trade coordination.

I. The work shall be so performed that the progress of the entire building construction, including all other trades, shall not be delayed and not interfered with. Materials and apparatus shall be installed as fast as conditions of the building will permit.

1.14 WORKMANSHIP

A. Service Support: The equipment items shall be supported by service organizations which are reasonably convenient to the equipment installation in order to render satisfactory service to the equipment on a regular and emergency basis during the warranty period of the contract.

B. Modification of References: In each of the publications referred to herein, consider the advisory provisions to be mandatory, as though the word, "shall" had been substituted for "should" wherever it appears.

C. The Contractor shall furnish the services of an experienced superintendent who shall be constantly in charge of the installation of the work together with all skilled workmen, journeymen, electricians, helpers and laborers required to unload, transfer, erect, connect, adjust, start, operate and test each system.

D. Unless otherwise specifically indicated on the Drawings or Specifications, all equipment and materials shall be installed with the acceptance of the Engineer and in accordance with the recommendations of the manufacturer. This includes the performance of such tests as the manufacturer recommends.

E. All labor for installation of electrical systems shall be performed by experienced, skilled tradesmen under the supervision of a licensed journeyman foreman. All work shall be of a quality consistent with good trade practice and shall be installed in a neat, workmanlike manner. The Engineer reserves the right to reject any work which, in his opinion, has been installed in a substandard, dangerous or unserviceable manner. The Contractor shall replace said work in a satisfactory manner at no extra cost to the Owner.

1.15 SHUTDOWNS

A. When installation of a new system requires the temporary shutdown of an existing operating system, the connection of the new system shall be performed at such time as designated by the Owner.

B. The Engineer and the Owner shall be notified in writing of the estimated duration of the shutdown period at least ten (10) days in advance of the date the work is to be performed.

C. Work shall be arranged for continuous performance whenever possible. The Contractor shall provide all necessary labor, including overtime if required, to assure that existing operating services will be shut down only during the time actually required to make necessary connections.

1.16 TEMPORARY UTILITIES

A. General: Provide new materials and equipment; if acceptable to the Engineer, undamaged previously used materials in serviceable condition may be used. Provide materials suitable for the use intended.

B. Conditions of Use: Keep temporary services and facilities clean and neat in appearance. Operate in a safe and efficient manner. Take necessary fire prevention measures. Do not overload facilities, or permit them to interfere with progress. Do not allow hazardous dangerous or unsanitary conditions, or public nuisances to develop or persist on the site.

C. First Aid Supplies: Comply with governing regulations.

D. Fire Extinguishers: Provide hand-carried, portable UL-rated, class "A" fire extinguishers for temporary offices and similar spaces. In other locations provide hand-carried, portable, UL-rated, class "ABC" dry chemical extinguishers, or a combination of extinguishers of NFPA recommended classes for the exposures.

E. Provide temporary lighting in all areas, throughout construction activities.
   1. Use Charges: Cost or use charges for temporary facilities are not chargeable to the Owner or Engineer, and will not be accepted as a basis of claims for a Change Order.
   2. Temporary Electric Power Service: Provide weatherproof, grounded electric power service and distribution system of sufficient size, capacity, and power characteristics during construction period. Include meters, transformers, overload protected disconnects, automatic ground-fault interrupters, and main distribution switch gear.
      a. Except where overhead service must be used, install electric power service underground.
      b. Power Distribution System: Install wiring overhead, and rise vertically where least exposed to damage. Where permitted, wiring circuits not exceeding 125 Volts, AC 20 ampere rating, and lighting circuits may be nonmetallic sheathed cable where overhead and exposed for surveillance.
   3. Temporary Telephones: Provide temporary telephone service for all personnel engaged in construction activities, throughout the construction period.

F. Environmental Protection: Provide protection, operate temporary facilities and conduct construction in ways and by methods that comply with environmental regulations, and minimize the possibility that air, waterways and subsoil might be contaminated or polluted, or that other undesirable effects might result. Avoid use of tools and equipment which produce harmful noise. Restrict use of noise making tools and equipment to hours that will minimize complaints from persons or firms near the site.

G. Termination and Removal: Unless the Engineer requires that it be maintained longer, remove each temporary facility when the need has ended, or when replaced by authorized use of a permanent facility, or no later than Substantial Completion. Complete or, if necessary, restore permanent construction that may have been delayed because of interference with the temporary facility. Repair damaged Work, clean exposed surfaces and replace construction that cannot be satisfactorily repaired. Materials and facilities that constitute temporary facilities are property of the Contractor. The Owner reserves the right to take possession of Project identification signs.

1.17 PROJECT PHASING

A. Work under each Section shall include all necessary temporary connections, equipment, conduit, wiring, fire alarm equipment and testing, lighting and emergency lighting, fire stopping, connection of necessary mechanical equipment, labor, and material as necessary to accommodate the phasing of Construction as developed by the General Contractor or Construction Manager and approved by the Owner. All existing systems that pass-thru an area of the building or are required to be maintained in a phased fashion during construction shall remain operational during all phases of construction. No extra compensation shall be granted the Contractor for work required to maintain existing systems operational or to accommodate the construction phasing of the project.

1.18 PROTECTION OF MATERIALS AND EQUIPMENT

A. Work under each Section shall include protecting the work and material of all other Sections from damage by work or workmen and shall include making good all damage thus caused.

B. The Contractor shall be responsible for work and equipment until the facility has been accepted by the Owner. Protect work against theft, injury or damage and carefully store material and equipment received on site which is not immediately installed. Close open ends of work with temporary covers or plugs during construction to prevent entry of foreign material.

C. Work under each Section includes receiving, unloading, uncrating, storing, protecting, setting in place and completely connecting equipment supplied under each Section. Work under each Section shall also include exercising special care in handling and protecting equipment and fixtures, and shall include the cost of replacing any of the equipment and fixtures which are missing or damaged.

D. Equipment and material stored on the job site shall be protected from the weather, vehicles, dirt and/or damage by workmen or machinery. Insure that all electrical or absorbent equipment or material is protected from moisture during storage.

1.19 ADJUSTING AND TESTING

A. After all the equipment and accessories to be furnished are in place, they shall be put in final adjustment and subjected to such operating tests so as to assure the Engineer that they are in proper adjustment and in satisfactory, permanent operating condition.

B. Where requested by the Engineer or specified in the contract documents, a factory-trained service representative shall inspect the installation and assist in the initial startup and adjustment to the equipment. The period of these services shall be for such time as necessary to secure proper installation and adjustments. After the equipment is placed in permanent operation, the service representative shall supervise the initial operation of the equipment and instruct the personnel responsible for operation and maintenance of the equipment. The service representative shall notify the Contractor in writing that the equipment was installed according to manufacturer's recommendations and is operating as intended by the manufacturer. Factory start-up reports shall be included in the operation and maintenance manuals under the appropriate equipment section.

1.20 CLEANING

A. The Contractor shall thoroughly clean all equipment of all foreign substances, oils, dust, dirt, etc., inside and out before final acceptance by the Engineer.

B. If any part of a system should be stopped or damaged by any foreign matter after being placed in operation, the system shall be disconnected, cleaned and reconnected wherever necessary to locate and/or remove obstructions. Any work damaged in the course of removing obstructions shall be repaired or replaced when the system is reconnected at no additional cost to the Owner.

C. During the course of construction, all conduits shall be capped in an acceptable manner to insure adequate protection against the entrance of foreign matter.

D. Upon completion of all work under the Contract, the Contractor shall remove from the premises all rubbish, debris and excess materials left over from his work.

E. Complete the following cleaning operations before requesting inspection for Certification of Substantial Completion.
   1. Remove labels that are not permanent labels.
   2. Clean transparent materials, including mirrors and glass in doors and windows. Remove glazing compound and other substances that are noticeable vision-obscuring materials. Replace chipped or broken glass and other damaged transparent materials.
   3. Clean exposed exterior and interior hard-surfaced finishes to a dust-free condition, free of stains, films and similar foreign substances. Restore reflective surfaces to their original reflective condition. Leave concrete floors broom clean. Vacuum carpeted surfaces and panelboard interiors.
   4. Wipe surfaces of mechanical and electrical equipment. Remove excess lubrication and other substances. Clean light fixtures and lamps.

F. Comply with regulations of authorities having jurisdiction and safety standards for cleaning. Do not burn waste materials. Do not bury debris or excess materials on the Owner's property. Do not discharge volatile, harmful or dangerous materials into drainage systems. Remove and dispose of ALL waste materials, packaging material, skids etc. from the site and dispose of in a lawful manner in accordance with municipal, state and federal regulations.

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

1.21 OPERATING AND MAINTENANCE

A. Upon completion of all work and tests, the Contractor shall furnish the necessary skilled labor and helpers for operating his system and equipment for a period specified under each applicable Section of this Division. During this period, he shall fully instruct the Owner or the Owner’s representative in the operation, adjustment and maintenance of all equipment furnished. The Contractor shall give at least seven (7) day notice to the Owner and the Engineer in advance of this period.

B. The Contractor shall include the maintenance schedule for the principal items of equipment furnished under this Division.

C. The Contractor shall physically demonstrate procedures for all routine maintenance of all equipment furnished under each respective Section to assure accessibility to all devices.

D. An authorized manufacturer’s representative shall attest in writing that the equipment has been properly installed prior to startup of any major equipment. At a minimum, the following equipment will require this inspection: emergency generator, fire alarm system, nurse call system, paging systems, etc. These letters will be bound into the operating and maintenance books.

E. Refer to individual trade Sections for any other particular requirements related to operating instructions.

F. Demonstration shall be recorded on CD Rom with one (1) disc turned over to the Owner.

1.22 OPERATING AND MAINTENANCE MANUALS

A. Prepare operating and maintenance manuals in accordance with the requirements of Division 1 and as follows. The Contractor shall prepare six (6) copies of a complete maintenance and operating instructions manual, bound in booklet form. Organize operating and maintenance data into suitable sets of manageable size. Bind properly indexed data in individual heavy-duty, 3-ring, vinyl-covered binders, with pocket folders for folded sheet information. Mark appropriate identification on front and spine of each binder.

B. Manual shall include the following:
1. Description of function, normal operating characteristics and limitations, performance curves, engineering data and tests, and complete nomenclature and commercial numbers of replacement parts.
2. Manufacturer's printed operating procedures to include start-up, break-in, and routine and normal operating instructions; regulation, control, stopping, shutdown, and emergency instructions; and summer and winter operating instructions.
3. Maintenance procedures for routine preventative maintenance and troubleshooting; disassembly, repair, and reassembly; aligning and adjusting instructions.
4. Servicing instructions and lubrication charts and schedules.
5. Emergency instructions.
6. Spare parts list.
7. Copies of warranties.
8. Wiring diagrams.
9. Recommended "turn around" cycles.
10. Inspection procedures.
11. Shop Drawings and Product Data.
12. Equipment start-up reports.

C. Include in the manual, a tabulated equipment schedule for all equipment. Schedule shall include pertinent data such as: make, model number, serial number, voltage, normal operating current, belt size, filter quantities and sizes, bearing number, etc. Schedule shall include maintenance to be done and frequency.

D. Maintenance and instruction manuals shall be submitted to the Owner at the same time as the seven (7) day notice is given prior to the instruction period.

1.23 ACCEPTANCES

A. The equipment, materials, workmanship, design and arrangement of all work installed under the Electrical Sections shall be subject to the review of the Engineer.

B. Within 30 days after the awarding of a Contract, the Electrical Contractor shall submit to the Engineer, for review, a list of manufacturers of equipment proposed for the work under the Electrical Sections. The intent to use the exact makes specified does not relieve the Contractor of the responsibility of submitting such a list.

C. If extensive or unacceptable delivery time is expected on a particular item of equipment specified, the Contractor shall notify the Owner and Engineer, in writing, within 30 days of the awarding of the Contract. In such instances, deviations may be made pending acceptance by the Engineer or the Owner's representative.

D. Where any specific material, process or method of construction or manufactured article is specified by reference to the catalog number of a manufacturer, the Specifications are to be used as a guide and are not intended to take precedence over the basic duty and performance specified or noted on the Drawings. In all cases, the Electrical Contractor shall verify the duty specified with the specific characteristics of the equipment offered for review. Equipment characteristics are to be used as mandatory requirements where the Contractor proposes to use an acceptable equivalent.

E. If material or equipment is installed before it is reviewed and/or approved, the Contractor shall be liable for its removal and replacement at no extra charge to the Owner if, in the opinion of the Engineer, the material or equipment does not meet the intent of, or standard of quality implied by, the Drawings and Specifications.

F. Failure on the part of the Engineer to reject shop drawings or to reject work in progress shall not be interpreted as acceptance of work not in conformance with the Drawings and/or Specifications. Work not in conformance with the Drawings and/or Specifications shall be corrected whenever it is discovered.

1.24 RECORD DRAWINGS

A. General: Do not use record documents for construction purposes; protect from deterioration and loss in a secure, fire-resistive location; provide access to record documents for the Engineer's reference during normal working hours.

B. Record Drawings: Maintain a clean, undamaged set of blue or black line white-prints of Contract Drawings and Shop Drawings. Mark the set to show the actual installation where the installation varies substantially from the Work as originally shown. Mark whichever drawing is most capable of showing conditions fully and accurately; where Shop Drawings are used, record a cross-reference at the corresponding location on the Contract Drawings. Give particular attention to concealed elements that would be difficult to measure and record at a later date.
   1. Mark record sets with red erasable pencil; use other colors to distinguish between variations in separate categories of the Work.
   2. Mark new information that is important to the Owner, but was not shown on Contract Drawings or Shop Drawings.
   3. Note related Change Order numbers where applicable.
   4. Organize record drawing sheets into manageable sets, bind with durable paper cover sheets, and print suitable titles, dates and other identification on the cover of each set.
   5. Final record documents shall be prepared in the latest Revit version and digital media for all drawings and a clean set of reproducible paper copies shall be turned over to the Owner at the completion of the work.

1.25 WARRANTIES AND BONDS

A. The following general administrative and procedural requirements for warranties and bonds required by the Contract Documents, including manufacturers standard warranties on products and special warranties are to be included:
   1. General close-out requirements included in Section "Project Close-out."
   2. Specific requirements for warranties for the Work and products and installation that are specified to be warranted, are included in the individual Sections of Divisions 01 through 33.
   3. Certifications and other commitments and agreements for continuing services to Owner are specified elsewhere in the Contract Documents.

B. Disclaimers and Limitations: Manufacturer's disclaimers and limitations on product warranties do not relieve the Contractor of the warranty on the Work that incorporates the products, nor does it relieve suppliers, manufacturers, and subcontractors required to countersign special warranties with the Contractor.

C. Separate Prime Contracts: Each prime Contractor is responsible for warranties related to its own Contract.

1.26 WARRANTY REQUIREMENTS

A. Related Damages and Losses: When correcting warranted Work that has failed, remove and replace other Work that has been damaged as a result of such failure or that must be removed and replaced to provide access for correction of warranted Work.

B. Reinstatement of Warranty: When Work covered by a warranty has failed and been corrected by replacement or rebuilding, reinstate the warranty by written endorsement. The reinstated warranty shall be equal to the original warranty with an equitable adjustment for depreciation.

C. Replacement Cost: Upon determination that Work covered by a warranty has failed, replace or rebuild the Work to an acceptable condition complying with requirements of Contract Documents. The Contractor is responsible for the cost of replacing or rebuilding defective Work regardless of

whether the Owner has benefited from use of the Work through a portion of its anticipated useful service life.

D. Owner's Recourse: Written warranties made to the Owner are in addition to implied warranties, and shall not limit the duties, obligations, right and remedies otherwise available under the law, nor shall warranty periods be interpreted as limitations on time in which the Owner can enforce such other duties, obligations, rights, or remedies.

E. Rejection of Warranties: The Owner reserves the right to reject warranties and to limit selections to products with warranties not in conflict with requirements of the Contract Documents.

F. The Owner reserves the right to refuse to accept Work for the Project where a special warranty, certification, or similar commitment is required on such Work or part of the Work, until evidence is presented that entities required to countersign such commitments are willing to do so.

G. Submit written warranties to the Engineer prior to the date certified for Substantial Completion. If the Engineer's Certificate of Substantial Completion designates a commencement date for warranties other than the date of Substantial Completion for the Work, or a designated portion of the Work, submit written warranties upon request of the Engineer.

H. When a designated portion of the Work is completed and occupied or used by the Owner, by separate agreement with the Contractor during the construction period, submit properly executed warranties to the Engineer within fifteen days of completion of that designated portion of the Work.

I. When a special warranty is required to be executed by the Contractor, or the Contractor and a subcontractor, supplier or manufacturer, prepare a written document that contains appropriate terms and identification, ready for execution by the required parties. Submit a draft to the Owner through the Engineer for approval prior to final execution.
   1. Refer to individual Sections of Divisions 01 through 33 for specific content requirements, and particular requirements for submittal of special warranties.

J. Form of Submittal: At Final Completion compile two copies of each required warranty and bond properly executed by the Contractor, or by the Contractor, subcontractor, supplier, or manufacturer. Organize the warranty documents into an orderly sequence based on the table of contents of the Project Manual.

K. Bind warranties and bonds in heavy-duty, commercial quality, durable 3-ring vinyl covered loose-leaf binders, thickness as necessary to accommodate contents, and sized to receive 8-1/2" by 11" paper.
   1. Provide heavy paper dividers with celluloid covered tabs for each separate warranty. Mark the tab to identify the product or installation. Provide a typed description of the product or installation, including the name of the product, and the name, address and telephone number of the installer.
   2. Identify each binder on the front and the spine with the typed or printed title "WARRANTIES AND BONDS," the Project title or name, and the name of the Contractor.
   3. When operating and maintenance manuals are required for warranted construction, provide additional copies of each required warranty, as necessary, for inclusion in each required manual.

1.27 GUARANTEES

A. The Contractor shall guarantee all material and workmanship under these Specifications and the Contract for a period of one (1) year from the date of final acceptance by Owner. During this guarantee period, all defects developing through faulty equipment, materials or workmanship shall be corrected or replaced immediately by this Contractor without expense to the Owner. Such repairs or replacements shall be made to the Engineers satisfaction.

B. Contractor shall provide name, address, and phone number of all contractors and subcontractors and associated equipment they provided

1.28 PROJECT CLOSE-OUT

A. Contractor shall submit annual maintenance proposal to the Architect/Engineer for review and approval as part of the close out documents.

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

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

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

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

F. Inspection Procedures: On receipt of a request for inspection, the Engineer will either proceed with inspection or advise the Contractor of unfilled requirements. The Engineer will prepare the Certificate of Substantial Completion following inspection, or advise the Contractor of construction that must be completed or corrected before the certificate will be issued.
   1. The Engineer will repeat inspection when requested and assured that the Work has been substantially completed.
   2. Results of the completed inspection will form the basis of requirements for final acceptance.

END OF SECTION 26 0400

Electronic File Release Form

DELIVERY OF ELECTRONIC FILES FOR: _____
Project Name

In accepting and utilizing any drawings or other data on any form of electronic media generated and provided by the Design Professional, the Client covenants and agrees that all such drawings and data are instruments of service of the Design Professional, who shall be deemed the author of the drawings and data, and shall retain all common law, statutory law and other rights, including copyrights.

The Client further agrees not to use these drawings and data, in whole or in part, for any purpose or project other than the project which is the subject of this Agreement. The Client agrees to waive all claims against the Design Professional resulting in any way from any unauthorized changes or reuse of the drawings and data for any other project by anyone other than the Design Professional.

In addition, the Client agrees, to the fullest extent permitted by law, to indemnify and hold the Design Professional harmless from any damage, liability or cost, including reasonable attorneys' fees and costs of defense, arising from any changes made by anyone other than the Design Professional or from any reuse of the drawings and data without the prior written consent of the Design Professional.

Under no circumstances shall transfer of the drawings and other instruments of service on electronic media for use by the Client be deemed a sale by the Design Professional, and the Design Professional makes no warranties, either express or implied, of merchantability and fitness for any particular purpose.

_____ _____
Client's Signature Date

_____
Company - Title

_____ _____
Architects' Signature Date

_____
Firm - Title

_____ _____
Owner's Signature Date

_____
Company - Title

SECTION 26 0519 - BUILDING WIRE AND CABLE

PART 1 GENERAL

1.1 GENERAL PROVISIONS

A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections with DIVISION 1 - GENERAL REQUIREMENTS, which are hereby made a part of this Section of the Specifications.

B. Attention is directed Section 26 0400 – GENERAL CONDITIONS FOR ELECTRICAL TRADES, which is hereby made a part of this Section of the Specifications.

1.2 SUMMARY

A. Section includes building wire and cable; metal clad cable; and wiring connectors and connections.

B. Related Sections:
1. Section 26 0533 – Raceway and Boxes for Electrical Systems
2. Section 26 0553 – Electrical Identification: Product requirements for wire identification.

1.3 REFERENCES

A. International Electrical Testing Association:
1. NETA ATS - Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems.

B. National Fire Protection Association:
1. NFPA 70 - National Electrical Code.
2. NFPA 262 - Standard Method of Test for Flame Travel and Smoke of Wires and Cables for Use in Air-Handling Spaces.

1.4 SYSTEM DESCRIPTION

A. Product Requirements: Provide products as follows:
1. Solid conductor for feeders and branch circuits 10 AWG and smaller.
2. Stranded conductors for control circuits.
3. Conductor not smaller than 12 AWG for power and lighting circuits.
4. Conductor not smaller than 16 AWG for control circuits.
5. 10 AWG conductors for 20 ampere, 120 volt branch circuits longer than 150 feet.
6. 10 AWG conductors for 20 ampere, 277 volt branch circuits longer than 250 feet.

B. Wiring Methods: Refer to Section 26 0533 – Raceway and Boxes for Electrical Systems for raceway requirements. Provide the following wiring methods:
   1. Concealed Dry Interior Locations: Use only building wire, Type THHN/THWN insulation, in raceway or metal clad cable.
   2. Exposed Dry Interior Locations: Use only building wire, Type THHN/THWN insulation, in raceway.
   3. Above Accessible Ceilings: Use only building wire, Type THHN/THWN insulation, in raceway or metal clad cable.
   4. Wet or Damp Interior Locations: Use only building wire, Type THHN/THWN insulation, in raceway or metal clad cable with jacket.
   5. Exterior Locations: Use only building wire, Type XHHW insulation, in raceway.
   6. Underground Locations: Use only building wire, Type XHHW insulation in raceway.

1.5 SUBMITTALS

A. Division 01 - Submittal Procedures: Requirements for submittals.

B. Product Data: Submit for building wire and each cable assembly type.

C. Test Reports: Indicate procedures and values obtained.

1.6 CLOSEOUT SUBMITTALS

A. Division 01 - Execution and Closeout Procedures: Requirements for submittals.

B. Project Record Documents: Record actual locations of components and circuits.

1.7 QUALITY ASSURANCE

A. Provide wiring materials located in plenums with peak optical density not greater than 0.5, average optical density not greater than 0.15, and flame spread not greater than 5 feet (1.5 m) when tested in accordance with NFPA 262.

B. Perform Work in accordance with the current issue of the State of Connecticut Building and Fire Safety Code.

C. Maintain one copy of each document on site.

1.8 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years experience.

1.9 FIELD MEASUREMENTS

A. Verify field measurements are as indicated on Drawings.

1.10 COORDINATION

A. Division 01 - General Requirements: Requirements for coordination.

B. Where wire and cable destination is indicated and routing is not shown, determine routing and lengths required.

C. Wire and cable routing indicated is approximate unless dimensioned. Include wire and cable lengths within 10 ft of length shown.

PART 2 PRODUCTS

2.1 BUILDING WIRE

A. Manufacturers:
1. Southwire/Essex Group Inc.
2. General Cable Co..
3. Cerrowire.
4. Division 01 - Substitutions

B. Product Description: Single conductor insulated wire.

C. Conductor: All branch circuits shall be copper. All panelboard feeders shall be copper, unless otherwise noted on drawings.

D. Insulation: NFPA 70; Type THHN/THWN insulation for feeders and branch circuits, rated 75 degrees C.

2.2 METAL CLAD CABLE

A. Manufacturers:
1. AFC Cable Systems
2. Southwire/Essex Group Inc.
3. General Cable Co.
4. Division 01 - Substitutions

B. Conductor: All MC Cabling shall be copper.

C. Insulation Voltage Rating: 600 volts.

D. Insulation Temperature Rating: 90 degrees C.

E. Insulation Material: Thermoplastic.

F. Armor Material: Steel.

G. Jacket: Where required.

H. Provide separate ground conductor within cable do not use armor material for ground path.

PART 3 EXECUTION

3.1 EXAMINATION

A. Division 01 - General Requirements: Coordination and project conditions.

B. Verify interior of building has been protected from weather.

C. Verify mechanical work likely to damage wire and cable has been completed.

D. Verify raceway installation is complete and supported.

3.2 PREPARATION

A. Completely and thoroughly swab raceway before installing wire.

3.3 INSTALLATION

A. Route wire and cable to meet Project conditions.

B. Neatly train and lace wiring inside boxes, equipment, and panelboards.

C. Identify and color code wire and cable under provisions of Section 26 0553 - Electrical Identification. Identify each conductor with its circuit number or other designation indicated.

D. Special Techniques - Building Wire in Raceway:
1. Pull conductors into raceway at same time.
2. Install building wire 4 AWG and larger with pulling equipment.

E. Special Techniques - Cable:
1. Protect exposed cable from damage.
2. Support cables above accessible ceiling, using spring metal clips or metal cable ties to support cables from structure or ceiling suspension system. Do not rest cable on ceiling panels.
3. Use suitable cable fittings and connectors.

F. Special Techniques - Wiring Connections:
   1. Clean conductor surfaces before installing lugs and connectors.
   2. Make splices, taps, and terminations to carry full ampacity of conductors with no perceptible temperature rise.
   3. Tape uninsulated conductors and connectors with electrical tape to 150 percent of insulation rating of conductor.
   4. Install split bolt connectors for copper conductor splices and taps, 6 AWG and larger.
   5. Install solderless pressure connectors with insulating covers for copper conductor splices and taps, 8 AWG and smaller.
   6. Install insulated spring wire connectors with plastic caps for copper conductor splices and taps, 10 AWG and smaller.

G. Install solid conductor for feeders and branch circuits 10 AWG and smaller.

H. Install stranded conductors for branch circuits 10 AWG and smaller. However, when stranded conductors are used in lieu of solid, then install crimp on fork terminals for device terminations. Do not place bare stranded conductors directly under screws.

3.4 WIRE COLOR

A. General:
   1. For wire sizes 10 AWG and smaller, install wire colors in accordance with the following:
      a. Black, red, and blue for circuits at 120/208 volts single or three phase.
      b. Orange, brown, and yellow for circuits at 277/480 volts single or three phase.
   2. For wire sizes 8 AWG and larger, identify wire with colored tape at terminals, splices and boxes. Colors are as follows:
      a. Black, red, and blue for circuits at 120/208 volts single or three phase.
      b. Orange, brown, and yellow for circuits at 277/480 volts single or three phase.

B. Neutral Conductors: White. When two or more neutrals are located in one conduit, individually identify each with proper circuit number.

C. Branch Circuit Conductors: Install three or four wire home runs with each phase uniquely color coded.

D. Feeder Circuit Conductors: Uniquely color code each phase.

E. Ground Conductors:
   1. For 6 AWG and smaller: Green.
   2. For 4 AWG and larger: Identify with green tape at both ends and visible points including junction boxes.

3.5 FIELD QUALITY CONTROL

A. Division 01 - Execution and Closeout Procedures: Field inspecting, testing, adjusting, and balancing.

B. Inspect and test in accordance with NETA ATS, except Section 4.

C. Perform inspections and tests listed in NETA ATS, Section 7.3.1.

END OF SECTION 26 0519

SECTION 26 0526 - GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.1 GENERAL PROVISIONS

A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections with DIVISION 01 - GENERAL REQUIREMENTS, which are hereby made a part of this Section of the Specifications.

B. Attention is directed Section 26 0400 – GENERAL CONDITIONS FOR ELECTRICAL TRADES, which is hereby made a part of this Section of the Specifications.

1.2 SUMMARY

A. Section Includes:
1. Grounding and bonding requirements.
2. Conductors for grounding and bonding.
3. Connectors for grounding and bonding.

1.3 RELATED REQUIREMENTS

A. Division 01 – General Requirements

B. Division 03– Concrete.

C. Section 26 0400 – General Conditions for Electrical Trades

D. Section 26 0519 – Building Wire and Cable: Additional requirements for conductors for grounding and bonding, including conductor color coding.

E. Section 26 0553 - Identification for Electrical Systems: Identification products and requirements.

1.4 REFERENCES

A. IEEE 81 - IEEE Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Grounding System.

B. NECA 1 - Standard for Good Workmanship in Electrical Construction.

C. NETA ATS - Acceptance Testing Specifications for Electrical Power Equipment and Systems.

D. NFPA 70 - National Electrical Code.

E. UL 467 - Grounding and Bonding Equipment.

1.5 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
1. Verify exact locations of underground metal water service pipe entrances to building.
2. Coordinate the work with other trades to provide steel reinforcement complying with specified requirements for concrete-encased electrode.
3. Notify Architect of any conflicts with or deviations from the contract documents. Obtain direction before proceeding with work.

1.6 SUBMITTALS

A. See Division 01 – General Requirements.

B. Product Data: Provide manufacturer's standard catalog pages and data sheets for grounding and bonding system components.

C. Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.

D. Field quality control test reports.

1.7 QUALITY ASSURANCE

A. Conform to requirements of NFPA 70.

B. Maintain at the project site a copy of each referenced document that prescribes execution requirements.

C. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

D. Installer Qualifications for Signal Reference Grids: Company with minimum five years documented experience with high frequency grounding systems.

E. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Receive, inspect, handle, and store products in accordance with manufacturer's instructions.

1.9 CLOSEOUT SUBMITTALS

A. Division 01 - Execution and Closeout Procedures: Requirements for submittals.

B. Project Record Documents: Record actual locations of components and grounding electrodes.

1.10 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing Products specified in this section with minimum three years experience.

B. Installer: Company specializing in performing work of this section with minimum three years experience.

PART 2 PRODUCTS

2.1 GROUNDING AND BONDING REQUIREMENTS

A. Do not use products for applications other than as permitted by NFPA 70 and product listing.

B. Unless specifically indicated to be excluded, provide all required components, conductors, connectors, conduit, boxes, fittings, supports, accessories, etc. as necessary for a complete grounding and bonding system.

C. Where conductor size is not indicated, size to comply with NFPA 70 but not less than applicable minimum size requirements specified.

D. Grounding System Resistance:
1. Achieve specified grounding system resistance under normally dry conditions unless otherwise approved by Architect. Precipitation within the previous 48 hours does not constitute normally dry conditions.
2. Grounding Electrode System: Not greater than 5 ohms to ground, when tested according to IEEE 81 using "fall-of-potential" method.
3. Between Grounding Electrode System and Major Electrical Equipment Frames, System Neutral, and Derived Neutral Points: Not greater than 0.5 ohms, when tested using "point-to-point" methods.

E. Grounding Electrode System:
   1. Provide connection to required and supplemental grounding electrodes indicated to form grounding electrode system.
      a. Provide continuous grounding electrode conductors without splice or joint.
      b. Install grounding electrode conductors in raceway where exposed to physical damage. Bond grounding electrode conductor to metallic raceways at each end with bonding jumper.
   2. Metal Underground Water Pipe(s):
      a. Provide connection to underground metal domestic and fire protection (where present) water service pipe(s) that are in direct contact with earth for at least 10 feet at an accessible location not more than 5 feet from the point of entrance to the building.
      b. Provide bonding jumper(s) around insulating joints/pipes as required to make pipe electrically continuous.
      c. Provide bonding jumper around water meter of sufficient length to permit removal of meter without disconnecting jumper.
   3. Other Metal Piping:
      a. Provide connection to all metallic gas piping and miscellaneous metal piping of continuous lengths.
      b. Bond in accordance with NFPA 70.
      c. Size bonding conductor in accordance with NFPA 70.
   4. Metal In-Ground Support Structure:
      a. Provide connection to metal in-ground support structure that is in direct contact with earth in accordance with NFPA 70.
   5. Concrete-Encased Electrode:
      a. Provide connection to concrete-encased electrode consisting of not less than 20 feet of either steel reinforcing bars or bare copper conductor not smaller than 4 AWG embedded within concrete foundation or footing that is in direct contact with earth in accordance with NFPA 70.
   6. Ground Rod Electrode(s):
      a. Provide three electrodes in an equilateral triangle configuration unless otherwise indicated or required.
      b. Space electrodes not less than 22 feet from each other and any other ground electrode.
      c. Where location is not indicated, locate electrode(s) at least 5 feet outside building perimeter foundation as near as possible to electrical service entrance; where possible, locate in softscape (uncovered) area.
      d. Provide ground enhancement material around electrode where indicated.
      e. Provide ground access well for each electrode.
   7. Provide additional ground electrode(s) as required to achieve specified grounding electrode system resistance.

8. Ground Bar: Provide ground bar, separate from service equipment enclosure, for common connection point of grounding electrode system bonding jumpers as permitted in NFPA 70. Connect grounding electrode conductor provided for service-supplied system grounding to this ground bar.
   a. Ground Bar Size: 1/4 by 2 by 12 inches unless otherwise indicated or required.
   b. Where ground bar location is not indicated, locate in accessible location as near as possible to service disconnect enclosure.
   c. Ground Bar Mounting Height: 18 inches above finished floor unless otherwise indicated.
9. Ground Riser: Provide common grounding electrode conductor not less than 3/0 AWG for tap connections to multiple separately derived systems as permitted in NFPA 70.

F. Bonding and Equipment Grounding:
1. Provide bonding for equipment grounding conductors, equipment ground busses, metallic equipment enclosures, metallic raceways and boxes, device grounding terminals, and other normally non-current-carrying conductive materials enclosing electrical conductors/equipment or likely to become energized as indicated and in accordance with NFPA 70.
2. Provide insulated equipment grounding conductor in each feeder and branch circuit raceway. Do not use raceways as sole equipment grounding conductor.
3. Where circuit conductor sizes are increased for voltage drop, increase size of equipment grounding conductor proportionally in accordance with NFPA 70.
4. Unless otherwise indicated, connect wiring device grounding terminal to branch circuit equipment grounding conductor and to outlet box with bonding jumper.
5. Terminate branch circuit equipment grounding conductors on solidly bonded equipment ground bus only. Do not terminate on neutral (grounded) or isolated/insulated ground bus.
6. Provide bonding jumper across expansion or expansion/deflection fittings provided to accommodate conduit movement.
7. Provide bonding for interior metal piping systems in accordance with NFPA 70. This includes, but is not limited to:
   a. Metal water piping where not already effectively bonded to metal underground water pipe used as grounding electrode.
   b. Metal gas piping.
   c. Metal process piping.
8. Provide bonding for interior metal air ducts.
9. Provide bonding for metal building frame.
10. Provide bonding for metal siding not effectively bonded through attachment to metal building frame.
11. Provide bonding and equipment grounding for pools and fountains and associated equipment in accordance with NFPA 70.
12. Provide redundant grounding and bonding for patient care areas of health care facilities in accordance with NFPA 70 and NFPA 99.

2.2 GROUNDING AND BONDING COMPONENTS

A. General Requirements:
1. Provide products listed, classified, and labeled as suitable for the purpose intended.
2. Provide products listed and labeled as complying with UL 467 where applicable.

B. Conductors for Grounding and Bonding, in Addition to Requirements of Section 26 0526:
1. Use insulated copper conductors unless otherwise indicated.
a. Exceptions:
1) Use bare copper conductors where installed underground in direct contact with earth.
2) Use bare copper conductors where directly encased in concrete (not in raceway).
2. Factory Pre-fabricated Bonding Jumpers: Furnished with factory-installed ferrules; size braided cables to provide equivalent gage of specified conductors.

C. Connectors for Grounding and Bonding:
1. Description: Connectors appropriate for the application and suitable for the conductors and items to be connected; listed and labeled as complying with UL 467.
2. Unless otherwise indicated, use exothermic welded connections for underground, concealed and other inaccessible connections.
a. Exceptions:
1) Use mechanical connectors for connections to electrodes at ground access wells.
3. Unless otherwise indicated, use mechanical connectors, compression connectors, or exothermic welded connections for accessible connections.
a. Exceptions:
1) Use exothermic welded connections for connections to metal building frame.
4. Manufacturers - Mechanical and Compression Connectors:
a. Advanced Lightning Technology (ALT): www.altfab.com.
b. Burndy LLC: www.burndy.com.
c. Harger Lightning & Grounding: www.harger.com.
d. Thomas & Betts Corporation: www.tnb.com.
e. Substitutions: Division 01, Section 012300 Alternates, Section 012500 – Substitution Procedures – Substitution Request Form and Section 016000 - Product Requirements.
5. Manufacturers - Exothermic Welded Connections:
a. Burndy LLC: www.burndy.com.
b. Cadweld, a brand of Erico International Corporation: www.erico.com.

c. ThermOweld, a brand of Continental Industries, Inc: www.thermoweld.com.
d. Substitutions: Division 01, Section 012300 Alternates, Section 012500 – Substitution Procedures – Substitution Request Form and Section 016000 - Product Requirements.

D. Ground Bars:
1. Description: Copper rectangular ground bars with mounting brackets and insulators.
2. Size: As indicated.
3. Holes for Connections: As indicated or as required for connections to be made.
4. Manufacturers:
a. Advanced Lightning Technology (ALT): www.altfab.com.
b. Erico International Corporation: www.erico.com.
c. Harger Lightning & Grounding: www.harger.com.
d. ThermOweld, a brand of Continental Industries, Inc: www.thermoweld.com.
e. Substitutions: Division 01, Section 012300 Alternates, Section 012500 – Substitution Procedures – Substitution Request Form and Section 016000 - Product Requirements.

E. Ground Plate Electrodes:
1. Material: Copper.
2. Size: 24 by 24 by 1/4 inches, unless otherwise indicated.
3. Manufacturers:
a. Advanced Lightning Technology (ALT).
b. Erico International Corporation.
c. Harger Lightning & Grounding.
d. ThermOweld, subsidiary of Continental Industries: .
e. Substitutions: Division 01, Section 012300 Alternates, Section 012500 – Substitution Procedures – Substitution Request Form and Section 016000 - Product Requirements.

PART 3 EXECUTION

3.1 EXAMINATION

A. Division 01 - General Requirements

B. Verify that work likely to damage grounding and bonding system components has been completed.

C. Verify that field measurements are as shown on the drawings.

D. Verify that conditions are satisfactory for installation prior to starting work.

3.2 PREPARATION

A. Remove paint, rust, mill oils, surface contaminants at connection points.

3.3 INSTALLATION

A. Install products in accordance with manufacturer's instructions.

B. Perform work in accordance with NECA 1 (general workmanship).

C. Ground Plate Electrodes: Unless otherwise indicated, install ground plate electrodes at a depth of not less than 30 inches.

D. Make grounding and bonding connections using specified connectors.
1. Remove appropriate amount of conductor insulation for making connections without cutting, nicking or damaging conductors. Do not remove conductor strands to facilitate insertion into connector.
2. Remove nonconductive paint, enamel, or similar coating at threads, contact points, and contact surfaces.
3. Exothermic Welds: Make connections using molds and weld material suitable for the items to be connected in accordance with manufacturer's recommendations.
4. Mechanical Connectors: Secure connections according to manufacturer's recommended torque settings.
5. Compression Connectors: Secure connections using manufacturer's recommended tools and dies.

E. Install in accordance with IEEE 142.

F. Install grounding and bonding conductors concealed from view.

G. Equipment Grounding Conductor: Install separate, insulated conductor within each feeder and branch circuit raceway. Terminate each end on suitable lug, bus, or bushing.

H. Install continuous grounding using underground cold water system, driven rods and building steel as grounding electrode. Where water piping is not available, install artificial station ground by means of driven rods or buried electrodes.

I. Accomplish grounding of electrical system by using insulated grounding conductor installed with feeders and branch circuit conductors in conduits. Size grounding conductors in accordance with NEC. Install from grounding bus of serving panel to ground bus of served panel, grounding screw of receptacles, lighting fixture housing, light switch outlet boxes or metal enclosures of service equipment. Ground conduits by means of grounding bushings on terminations at panelboards with installed number 12 conductor to grounding bus.

J. Permanently attach equipment and grounding conductors prior to energizing equipment.

K. Common Ground Bonding with Lightning Protection System: Bond electric power system, grounding electrode system directly to lightning protection system earth connection at closest point to electric service grounding electrode. Use bonding conductor sized the same as system grounding conductor and install in conduit.

L. Identify grounding and bonding system components in accordance with Section 26 0553.

3.4 FIELD QUALITY CONTROL

A. Division 01 - Quality Requirements, Division 01 - Execution and Closeout Procedures.

B. Inspect and test in accordance with NETA ATS except Section 4.

C. Perform inspections and tests listed in NETA ATS, Section 7.13.

D. Perform ground electrode resistance tests under normally dry conditions. Precipitation within the previous 48 hours does not constitute normally dry conditions.

E. Investigate and correct deficiencies where measured ground resistances do not comply with specified requirements.

F. Submit detailed reports indicating inspection and testing results and corrective actions taken.

END OF SECTION 26 0526

SECTION 26 0529 - HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.1 GENERAL PROVISIONS

A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections with DIVISION 1 - GENERAL REQUIREMENTS, which are hereby made a part of this Section of the Specifications.

B. Attention is directed Section 26 0400 – GENERAL CONDITIONS FOR ELECTRICAL TRADES, which is hereby made a part of this Section of the Specifications.

1.2 SUMMARY

A. This section includes basic materials and methods for fastening and supporting electrical products and equipment. Products include the following:
1. Conduit supports.
2. Formed steel channel.
3. Spring steel clips.
4. Sleeves.
5. Mechanical sleeve seals.
6. Equipment Bases and Supports

B. Related sections:
1. Division 01– General Commissioning Requirements
2. Division 07 – Penetration Firestopping: Product requirements for firestopping for placement by this section.
3. Division 07 – Fire-Resistive Joint Systems: Product requirements for firestopping for placement by this section.

1.3 REFERENCES

A. ASTM International:
1. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.
2. ASTM E119 - Standard Test Methods for Fire Tests of Building Construction and Materials.
3. ASTM E814 - Standard Test Method for Fire Tests of Through-Penetration Fire Stops.
4. ASTM E1966 - Standard Test Method for Fire-Resistive Joint Systems.

B. FM Global:
1. FM - Approval Guide, A Guide to Equipment, Materials & Services Approved By Factory Mutual Research For Property Conservation.

C. National Fire Protection Association:
   1. NFPA 70 - National Electrical Code.

D. Underwriters Laboratories Inc.:
   1. UL 263 - Fire Tests of Building Construction and Materials.
   2. UL 723 - Tests for Surface Burning Characteristics of Building Materials.
   3. UL 1479 - Fire Tests of Through-Penetration Firestops.
   4. UL 2079 - Tests for Fire Resistance of Building Joint Systems.
   5. UL - Fire Resistance Directory.

1.4 DEFINITIONS

A. Firestopping (Through-Penetration Protection System): Sealing or stuffing material or assembly placed in spaces between and penetrations through building materials to arrest movement of fire, smoke, heat, and hot gases through fire rated construction.

1.5 SYSTEM DESCRIPTION

A. Firestopping Materials: ASTM E119, ASTM E814 to achieve fire ratings of adjacent construction in accordance with UL Design Numbers noted on the Architectural Drawings.

B. Surface Burning: ASTM E84 with maximum flame spread / smoke developed rating of 25/450.

C. Firestop interruptions to fire rated assemblies, materials, and components.

1.6 PERFORMANCE REQUIREMENTS

A. Firestopping: Conform to applicable code and UL requirements for fire resistance ratings and surface burning characteristics.

1.7 SUBMITTALS

A. Division 01 - Submittal Procedures: Requirements for submittals.

B. Shop Drawings: Indicate system layout with location and detail of trapeze hangers.

C. Product Data:
   1. Hangers and Supports: Submit manufacturers catalog data including load capacity.
   2. Firestopping: Submit data on product characteristics, performance and limitation criteria.

D. Firestopping Schedule: Submit schedule of opening locations and sizes, penetrating items, and required listed design numbers to seal openings to maintain fire resistance rating of adjacent assembly.

E. Design Data: Indicate load carrying capacity of trapeze hangers and hangers and supports.

F. Manufacturer's Installation Instructions:
   1. Hangers and Supports: Submit special procedures and assembly of components.
   2. Firestopping: Submit preparation and installation instructions.

G. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

H. Engineering Judgements: For conditions not covered by UL listed designs, submit judgements by licensed professional engineer suitable for presentation to authority having jurisdiction for acceptance as meeting code fire protection requirements.

1.8 QUALITY ASSURANCE

A. Division 01 - Quality Requirements, Division 01 - Execution and Closeout Procedures.

B. Perform Work in accordance with the latest adopted version of the State Building and Fire Safety Codes.

1.9 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing Products specified in this section with minimum three years experience.

B. Installer: Company specializing in performing work of this section with minimum three years experience, approved by manufacturer.

1.10 DELIVERY, STORAGE, AND HANDLING

A. Division 01 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.

B. Accept materials on site in original factory packaging, labeled with manufacturer's identification.

C. Protect from weather and construction traffic, dirt, water, chemical, and mechanical damage, by storing in original packaging.

PART 2 PRODUCTS

2.1 CONDUIT SUPPORTS

A. Manufacturers:
1. Allied Tube & Conduit Corp.
2. Electroline Manufacturing Company.
3. O-Z Gedney Co.
4. Thomas and Betts
5. Division 01 - Substitutions

B. Hanger Rods: Threaded high tensile strength galvanized carbon steel with free running threads.

C. Beam Clamps: Malleable Iron, with tapered hole in base and back to accept either bolt or hanger rod. Set screw: hardened steel.

D. Conduit clamps for trapeze hangers: Galvanized steel, notched to fit trapeze with single bolt to tighten.

E. Conduit clamps - general purpose: One hole malleable iron for surface mounted conduits.

F. Cable Ties: High strength nylon temperature rated to 185 degrees F. Self-locking.

2.2 FORMED STEEL CHANNEL

A. Manufacturers:
1. Allied Tube & Conduit Corp.
2. B-Line Systems.
3. Midland Ross Corporation, Electrical Products Division.
4. Unistrut Corp.
5. Division 01 - Substitutions

B. Product Description: Galvanized 12 gage thick steel. With holes 1-1/2 inches on center.

2.3 SPRING STEEL CLIPS

A. Manufacturers:
1. Allied Tube & Conduit Corp.
2. B-Line Systems
3. Midland Ross Corporation, Electrical Products Division.
4. Unistrut Corp.
5. Division 01 - Substitutions

B. Product Description: Mounting hole and screw closure.

2.4 SLEEVES

A. Sleeves for conduit, raceway, cable tray, busway, or cable through Non-fire Rated Beams, Walls, Footings, and Potentially Wet Floors: Steel pipe or 18 gage thick galvanized steel.

B. Sleeves for conduit, raceway, cable tray, busway, or cable through Fire Rated and Fire Resistive Floors and Walls, and Fire Proofing: Prefabricated fire rated sleeves including seals, UL listed.

C. Fire-stopping Insulation: Glass fiber type, non-combustible.

2.5 MECHANICAL SLEEVE SEALS

A. Manufacturers:
1. Thunderline Link-Seal, Inc.
2. NMP Corporation.
3. PSI Link-Seal.
4. Division 01 - Substitutions

B. Product Description: Modular mechanical type, consisting of interlocking synthetic rubber links shaped to continuously fill annular space between object and sleeve, connected with bolts and pressure plates causing rubber sealing elements to expand when tightened, providing watertight seal and electrical insulation.

PART 3 EXECUTION

3.1 EXAMINATION

A. Division 01 - General Requirements: Verification of existing conditions before starting work.

B. Verify openings are ready to receive sleeves.

C. Verify openings are ready to receive firestopping.

3.2 PREPARATION

A. Clean substrate surfaces of dirt, dust, grease, oil, loose material, or other matter affecting bond of firestopping material.

B. Remove incompatible materials affecting bond.

C. Install backing materials to arrest liquid material leakage.

D. Obtain permission from Architect/Engineer before using powder-actuated anchors.

E. Obtain permission from Architect/Engineer before drilling or cutting structural members.

3.3 INSTALLATION - HANGERS AND SUPPORTS

A. Anchors and Fasteners:
1. Concrete Structural Elements: Provide precast inserts, expansion anchors.
2. Steel Structural Elements: Provide beam clamps, spring steel clips, steel ramset fasteners.
3. Concrete Surfaces: Provide self-drilling anchors and expansion anchors.
4. Hollow Masonry, Plaster, and Gypsum Board Partitions: Provide toggle bolts and hollow wall fasteners.
5. Solid Masonry Walls: Provide expansion anchors and preset inserts.
6. Sheet Metal: Provide sheet metal screws.
7. Wood Elements: Provide wood screws.

B. Inserts:
1. Install inserts for placement in concrete forms.
2. Install inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.
3. Provide hooked rod to concrete reinforcement section for inserts carrying pipe over 4 inches.
4. Where concrete slabs form finished ceiling, locate inserts flush with slab surface.
5. Where inserts are omitted, drill through concrete slab from below and provide through-bolt with recessed square steel plate and nut above flush with top of recessed into and grouted flush with slab.

C. Install conduit and raceway support and spacing in accordance with NEC.

D. Do not fasten supports to pipes, ducts, mechanical equipment, or conduit.

E. Install multiple conduit runs on common hangers.

F. Supports:
1. Fabricate supports from structural steel or formed steel channel. Install hexagon head bolts to present neat appearance with adequate strength and rigidity. Install spring lock washers under nuts.
2. Install surface mounted cabinets and panelboards with minimum of four anchors.
3. In wet and damp locations install steel channel supports to stand cabinets and panelboards 1 inch off wall.
4. Support vertical conduit at every floor.

3.4 INSTALLATION - SLEEVES

A. Exterior watertight entries: Seal with adjustable interlocking rubber links.

B. Conduit penetrations not required to be watertight: Sleeve and fill with silicon foam.

C. Set sleeves in position in forms. Provide reinforcing around sleeves.

D. Size sleeves large enough to allow for movement due to expansion and contraction. Provide for continuous insulation wrapping.

E. Where conduit or raceway penetrates floor, ceiling, or wall, close off space between conduit or raceway and adjacent work with stuffing fire stopping insulation and caulk airtight. Provide close fitting metal collar or escutcheon covers at both sides of penetration.

3.5 FIELD QUALITY CONTROL

A. Division 01 - Quality Requirements, Division 01 - Execution and Closeout Procedures: Field inspecting, testing, adjusting, and balancing.

3.6 CLEANING

A. Division 01 - Execution and Closeout Procedures.

B. Division 01– Project Cleanliness

3.7 PROTECTION OF FINISHED WORK

A. Division 01 - Execution and Closeout Procedures: Requirements for protecting finished Work.

B. Protect adjacent surfaces from damage by material installation.

END OF SECTION 26 0529

SECTION 26 0533 RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.1 GENERAL PROVISIONS

A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections with DIVISION 1 - GENERAL REQUIREMENTS, which are hereby made a part of this Section of the Specifications.

B. Attention is directed Section 26 0400 – GENERAL CONDITIONS FOR ELECTRICAL TRADES, which is hereby made a part of this Section of the Specifications.

1.2 SUMMARY

A. Section includes conduit and tubing, wireways, pull and junction boxes.

B. Related Sections:
1. Section 26 0503 - Equipment Wiring Connections.
2. Section 26 0526 - Grounding and Bonding for Electrical Systems.
3. Section 26 0529 - Hangers and Supports for Electrical Systems.
4. Section 26 0553 – Electrical Identification.

1.3 REFERENCES

A. American National Standards Institute:
1. ANSI C80.1 - Rigid Steel Conduit, Zinc Coated.
2. ANSI C80.3 - Specification for Electrical Metallic Tubing, Zinc Coated.

B. National Electrical Manufacturers Association:
1. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).
2. NEMA FB 1 - Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit and Cable Assemblies.
3. NEMA OS 1 - Sheet Steel Outlet Boxes, Device Boxes, Covers, and Box Supports.
4. NEMA OS 2 - Nonmetallic Outlet Boxes, Device Boxes, Covers, and Box Supports.
5. NEMA RN 1 - Polyvinyl Chloride (PVC) Externally Coated Galvanized Rigid Steel Conduit and Intermediate Metal Conduit.
6. NEMA TC 2 - Electrical Polyvinyl Chloride (PVC) Tubing and Conduit.
7. NEMA TC 3 - PVC Fittings for Use with Rigid PVC Conduit and Tubing.

1.4 SYSTEM DESCRIPTION

A. Raceway and boxes located as indicated on Drawings, and at other locations required for splices, taps, wire pulling, equipment connections, and compliance with regulatory requirements. Raceway and boxes are shown in approximate locations unless dimensioned. Provide raceway to complete wiring system.

B. Wet and Damp Locations: Provide cast metal outlet, junction, and pull boxes. Provide flush mounting outlet box in finished areas. Provide building wire within rigid steel conduit.

C. Concealed Dry Locations: Provide sheet-metal boxes. Provide flush mounting outlet box in finished areas. Provide hinged enclosure for large pull boxes.
   1. HVAC/P/FP Equipment Circuits:
      a. Provide building wire within EMT conduit from panelboard to each HVAC/P/FP equipment being served.

D. Exposed Dry Locations: Provide sheet-metal boxes. Provide flush mounting outlet box in finished areas. Provide hinged enclosure for large pull boxes. Provide building wire within EMT conduit. MC Cable not acceptable.

1.5 DESIGN REQUIREMENTS

A. Minimum Raceway Size: 3/4 inch (19 mm) unless otherwise specified.

1.6 SUBMITTALS

A. Section 01 33 05 - Submittal Procedures: Submittal procedures.

B. Product Data: Submit for the following:
   1. Flexible metal conduit.
   2. Liquidtight flexible metal conduit.
   3. PVC conduit.
   4. Flexible nonmetallic conduit.
   5. Nonmetallic tubing.
   6. Raceway fittings.
   7. Conduit bodies.
   8. Wireway.
   9. Pull and junction boxes.

C. Manufacturer's Installation Instructions: Submit application conditions and limitations of use stipulated by Product testing agency specified under Regulatory Requirements. Include instructions for storage, handling, protection, examination, preparation, and installation of Product.

1.7 CLOSEOUT SUBMITTALS

A. Section 01 73 00 - Execution and Section 017700 - Closeout Procedures: Closeout procedures.

B. Project Record Documents:
1. Record actual routing of conduits larger than 2 inch (53 mm).
2. Record actual locations and mounting heights of outlet, pull, and junction boxes.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Section 01 6000 - Product Requirements: Product storage and handling requirements.

B. Protect conduit from corrosion and entrance of debris by storing above grade. Provide appropriate covering.

C. Protect PVC conduit from sunlight.

1.9 COORDINATION

A. Division 01 - General Requirements: Coordination and project conditions.

B. Coordinate installation of outlet boxes for equipment connected under Section 26 05 03 – Equipment Wiring Connections.

C. Coordinate mounting heights, orientation and locations of outlets mounted above counters, benches, and backsplashes.

D. Electrical contractor is responsible to fully coordinate with the site and concrete contractors and all other trades when routing conduit underslab. Routing of conduit underslab may be acceptable, provided spacing of conduits is adequate for proper backfilling of area surrounding conduits. Adequate spacing shall mean using factory made conduit spacers that allow for a minimum of 3-inches for backfilling with flowable fill or 3 times the pipe diameter for backfilling with a structural fill. Proposed conduit routing, installation and methods and backfilling procedures shall be submitted to the Engineer for review prior to installation.

PART 2 PRODUCTS

2.1 METAL CONDUIT

A. Manufacturers:
1. Allied Tube and Conduit.
2. Western Tube and Conduit.
3. Wheatland Tube Company.
4. Division 01 - Substitutions

B. Rigid Steel Conduit: ANSI C80.1.

C. Fittings and Conduit Bodies: NEMA FB 1; material to match conduit.

2.2 FLEXIBLE METAL CONDUIT

A. Manufacturers:
1. Allied Tube and Conduit
2. Western Tube and Conduit.
3. Wheatland Tube Company.
4. AFC Cable Company.
5. Division 01 - Substitutions

B. Fittings: NEMA FB 1.

2.3 LIQUIDTIGHT FLEXIBLE METAL CONDUIT

A. Manufacturers:
1. Carlon Electrical Products.
2. Anamet Electrical.
3. Allied Tube and Conduit.
4. Division 01 - Substitutions

B. Product Description: Interlocked steel construction with PVC jacket.

C. Fittings: NEMA FB 1.

2.4 ELECTRICAL METALLIC TUBING (EMT)

A. Manufacturers:
1. Allied Tube and Conduit.
2. Western Tube and Conduit.
3. Wheatland Tube Company.
4. Division 01 - Substitutions

B. Product Description: ANSI C80.3; galvanized tubing.

C. Fittings and Conduit Bodies: NEMA FB 1; steel type. Set screw fittings are acceptable in concealed dry locations. Compression fittings shall be used in all other locations.

2.5 NONMETALLIC CONDUIT

A. Manufacturers:
1. Carlon Electrical Products.
2. Thomas & Betts Corp.
3. Allied Tube and Conduit.
4. Division 01 - Substitutions

B. Product Description: NEMA TC 2; Schedule 40 or 80 PVC, as noted on drawings. Where not specifically indicated, provide Schedule 40.

C. Fittings and Conduit Bodies: NEMA TC 3.

2.6 NONMETALLIC TUBING

A. Manufacturers:
1. Carlon Electrical Products.
2. Thomas & Betts Corp.
3. Allied Tube and Conduit.
4. Division 01 - Substitutions

B. Product Description: NEMA TC 2.

C. Fittings and Conduit Bodies: NEMA TC 3.

2.7 WIREWAY

A. Manufacturers:
1. Carlon Electrical Products.
2. Thomas & Betts Corp.
3. Hoffman.
4. Legrand
5. Division 01 - Substitutions

B. Product Requirements. Knockouts: Manufacturer's standard.

C. Cover: Screw cover.

D. Finish: Rust inhibiting primer coating with gray enamel finish.

2.8 PULL AND JUNCTION BOXES

A. Manufacturers:
1. Carlon Electrical Products.
2. Hubbell Wiring Devices.
3. Thomas & Betts Corp.
4. Division 01 - Substitutions

B. Sheet Metal Boxes: NEMA OS 1, galvanized steel.

C. Surface Mounted Cast Metal Box: NEMA 250, flat-flanged, surface mounted junction box:
1. Material: Cast aluminum.
2. Cover: Furnish with ground flange, neoprene gasket, and stainless steel cover screws.

PART 3 EXECUTION

3.1 EXAMINATION

A. Division 01 - General Requirements: Coordination and project conditions.

B. Verify outlet locations and routing and termination locations of raceway prior to rough-in.

3.2 INSTALLATION

A. Ground and bond raceway and boxes in accordance with Section 26 0526 - Grounding and Bonding for Electrical Systems.

B. Fasten raceway and box supports to structure and finishes in accordance with Section 26 0529 - Hangers and Supports for Electrical Systems.

C. Identify raceway and boxes in accordance with Section 26 0553 - Electrical Identification.

D. Arrange raceway and boxes to maintain headroom and present neat appearance.

3.3 INSTALLATION - RACEWAY

A. Raceway routing is shown in approximate locations unless dimensioned. Route to complete wiring system.

B. Arrange raceway supports to prevent misalignment during wiring installation.

C. Support raceway using coated steel or malleable iron straps, lay-in adjustable hangers, clevis hangers, and split hangers.

D. Group related raceway; support using conduit rack. Construct rack using steel channel specified in Section 26 0529 - Hangers and Supports for Electrical Systems; provide space on each for 25 percent additional raceways.

E. Do not support raceway with wire or perforated pipe straps. Remove wire used for temporary supports

F. Do not attach raceway to ceiling support wires or other piping systems.

G. Route exposed raceway parallel and perpendicular to walls.

H. Route raceway installed above accessible ceilings parallel and perpendicular to walls.

I. Route conduit in and under slab from point-to-point.

J. Maintain clearance between raceway and piping for maintenance purposes.

K. Maintain 12 inch clearance between raceway and surfaces with temperatures exceeding 104 degrees F.

L. Cut conduit square using saw or pipe cutter; de-burr cut ends.

M. Bring conduit to shoulder of fittings; fasten securely.

N. Join nonmetallic conduit using cement as recommended by manufacturer. Wipe nonmetallic conduit dry and clean before joining. Apply full even coat of cement to entire area inserted in fitting. Allow joint to cure for minimum 20 minutes.

O. Install no more than equivalent of three 90 degree bends between boxes. Install conduit bodies to make sharp changes in direction, as around beams. Install factory elbows for bends in metal conduit larger than 2 inch size.

P. Avoid moisture traps; install junction box with drain fitting at low points in conduit system.

Q. Install fittings to accommodate expansion and deflection where raceway crosses seismic, control and expansion joints.

R. Install suitable pull string or cord in each empty raceway except sleeves and nipples.

S. Install suitable caps to protect installed conduit against entrance of dirt and moisture.

T. Close ends and unused openings in wireway.

3.4 INTERFACE WITH OTHER PRODUCTS

A. Install conduit to preserve fire resistance rating of partitions and other elements.

3.5 ADJUSTING

A. Division 01 - Execution and Closeout Procedures: Testing, adjusting, and balancing.

B. Adjust flush-mounting outlets to make front flush with finished wall material.

C. Install knockout closures in unused openings in boxes.

3.6 CLEANING

A. Division 01- Execution and Closeout Procedures.

B. Division 01 – Project Cleanliness

C. Clean interior of boxes to remove dust, debris, and other material.

D. Clean exposed surfaces and restore finish.

END OF SECTION 26 0533

SECTION 26 0553 – ELECTRICAL IDENTIFICATION

PART 1 GENERAL

1.1 GENERAL PROVISIONS

A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections with DIVISION 1 - GENERAL REQUIREMENTS, which are hereby made a part of this Section of the Specifications.

B. Attention is directed Section 26 0400 – GENERAL CONDITIONS FOR ELECTRICAL TRADES, which is hereby made a part of this Section of the Specifications.

1.2 SUMMARY

A. Section Includes:
1. Nameplates.
2. Labels.
3. Wire markers.
4. Conduit markers.
5. Stencils.
6. Warning Signs and Labels.
7. Device Identification.

B. Related Sections:
1. Division 09 – Painting: Execution requirements for piping painting specified by this section.

1.3 SUBMITTALS

A. Division 01 - Submittal Procedures.

B. Product Data:
1. Submit manufacturer’s catalog literature for each product required.
2. Submit electrical identification schedule including list of wording, symbols, letter size, color coding, tag number, location, and function.

C. Manufacturer's Installation Instructions: Indicate installation instructions, special procedures, and installation.

1.4 CLOSEOUT SUBMITTALS

A. Division 01 - Execution and Closeout Procedures: Requirements for submittals.

B. Project Record Documents: Record actual locations of tagged devices; include tag numbers.

1.5 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing Products specified in this section with minimum three years experience.

1.6 QUALITY ASSURANCE

A. Perform Work in accordance with State of Connecticut Public Work's standard.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Division 01- Product Requirements: Requirements for transporting, handling, storing, and protecting products.

B. Accept identification products on site in original containers. Inspect for damage.

C. Accept materials on site in original factory packaging, labeled with manufacturer's identification, including product density and thickness.

D. Protect insulation from weather and construction traffic, dirt, water, chemical, and mechanical damage, by storing in original wrapping.

1.8 ENVIRONMENTAL REQUIREMENTS

A. Division 01 - Product Requirements: Environmental conditions affecting products on site.

B. Install labels and nameplates only when ambient temperature and humidity conditions for adhesive are within range recommended by manufacturer.

1.9 EXTRA MATERIALS

A. Division 01 - Execution and Closeout Procedures: Requirements for extra materials.

B. Furnish two containers of spray-on adhesive.

PART 2 PRODUCTS

2.1 NAMEPLATES

A. Manufacturers:
1. Seton
2. Brady
3. Ideal Industries
4. Division 01 - Substitutions

B. Product Description: Laminated three-layer plastic with engraved black letters on white contrasting background color. White letters on Red background for emergency equipment

C. Letter Size:
   1. 1/8 inch high letters for identifying individual equipment and loads.
   2. 1/4 inch high letters for identifying grouped equipment and loads.

D. Minimum nameplate thickness: 1/8 inch.

2.2 EQUIPMENT LABELS

A. Manufacturers:
   1. Seton
   2. Brady
   3. Ideal Industries
   4. Division 01 - Substitutions

B. Product Description: Laminated three-layer plastic with engraved black letters on white contrasting background color. White letters on Red background for emergency equipment.

C. Labels: Embossed adhesive tape, with 3/16 inch white letters on black background.

2.3 WARNING LABELS AND SIGNS

A. Manufacturers:
   1. Seton.
   2. Brady.
   3. Ideal Industries
   4. Division 01 - Substitutions

B. Comply with NFPA 70 and OSHA 29 CFR 1910.145.

C. Self-Adhesive Warning Labels: Factory printed, multicolor, pressure sensitive adhesive labels, configured for display on front cover, door, or other access to equipment unless otherwise indicated. Use for interior applications.

D. Baked-enamel Warning Signs:
   1. Preprinted aluminum signs, punched or drilled for fasteners, with colors, legend and size required for application.
   2. ¼ inch grommets in corners for mounting.
   3. Use for exterior applications.

2.4 WIRE MARKERS

A. Manufacturers:
   1. Seton
   2. Brady
   3. Ideal Industries
   4. Division 01 - Substitutions

B. Legend:
1. Power and Lighting Circuits: Branch circuit or feeder number as indicated on Drawings.
2. Control Circuits: Control wire number as indicated on Drawings.

2.5 CONDUIT AND RACEWAY MARKERS

A. Manufacturers:
1. Seton
2. Brady
3. Ideal Industries
4. Division 01 - Substitutions

B. Color:
1. Medium Voltage System: Black lettering on white background.
2. 480 Volt System: Black lettering on white background.
3. 208 Volt System: Black lettering on white background.

C. Legend:
1. Medium Voltage System: HIGH VOLTAGE.
2. 480 Volt System: 480 VOLTS. HIGH VOLTAGE.
3. 208 Volt System: 208 VOLTS.
4. Emergency Power Systems: Emergency (with voltage following “Emergency”)

2.6 DEVICE IDENTIFICATION

A. Panelboards:
1. Labeling:
a. Indicate power supply origin (panelboard or transformer) of source feeding the panelboard.
b. Indicate Panelboard designation.

B. HVAC Equipment Disconnects:
1. Labeling:
a. Indicate equipment name.
b. Indicate source panel and circuit number.

2.7 STENCILS

A. Stencils: With clean cut symbols and letters of following size:
1. Up to 2 inches (50 mm) Outside Diameter of Raceway: 1/2 inch (13 mm) high letters.
2. 2-1/2 to 6 inches (64 to 150 mm) Outside Diameter of Raceway: 1 inch (25 mm) high letters.

2.8 WARNING LABELS AND SIGNS

A. Comply with NFPA 70 and OSHA 29 CFR 1910.145.

B. Self-Adhesive Warning Labels: Factory printed, multicolor, pressure sensitive adhesive labels, configured for display on front cover, door, or other access to equipment unless otherwise indicated. Use for interior applications.

C. Baked-enamel Warning Signs:
1. Preprinted aluminum signs, punched or drilled for fasteners, with colors, legend and size required for application.
2. ¼ inch grommets in corners for mounting.
3. Use for exterior applications.

2.9 LOCKOUT DEVICES

A. Lockout Hasps:
1. Manufacturers:
a. Seton
b. Brady
c. Ideal Industries
d. Division 01 - Substitutions

PART 3 EXECUTION

3.1 PREPARATION

A. Degrease and clean surfaces to receive adhesive for identification materials.

B. Prepare surfaces in accordance with Division 09 – Painting: Execution requirements for piping painting specified by this section.

3.2 INSTALLATION

A. Install identifying devices after completion of painting.

B. Nameplate Installation:
1. Install nameplate parallel to equipment lines.
2. Install nameplate for each electrical distribution and control equipment enclosure with corrosive-resistant mechanical fasteners, or adhesive.
3. Install nameplates for each control panel and major control components located outside panel with corrosive-resistant mechanical fasteners, or adhesive.
4. Secure nameplate to equipment front using rivets.
5. Secure nameplate to inside surface of door on recessed panelboard in finished locations.

6. Install nameplates for the following:
    a. Panelboards.
    b. Disconnects.
    c. Motor Starters.
    d. Control Panels.
    e. Other locations indicated on drawings.

C. Label Installation:
1. Install label parallel to equipment lines.
2. Install label for identification of individual control device stations.
3. Install labels for permanent adhesion and seal with clear lacquer.

D. Wire Marker Installation:
1. Install wire marker for each conductor at panelboard gutters, pull boxes, outlet and junction boxes, and each load connection.

E. Conduit Marker Installation:
1. Install conduit marker for each conduit longer than 6 feet.
2. Spacing: 20 feet on center.
3. Raceway Painting: Identify conduit using field painting.
    a. Paint colored band on raceway greater than 6 feet in length.
    b. 20 feet on center.
    c. Color:
        1) 480 Volt System: Blue.
        2) 208 Volt System: Yellow.

F. Stencil Installation:
1. Apply stencil painting in accordance with Division 09 – Painting and Finishing: Execution requirements for piping painting specified by this section.

END OF SECTION 26 0553

SECTION 26 2416 - PANELBOARDS

PART 1 GENERAL

1.1 GENERAL PROVISIONS

A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections with DIVISION 1 - GENERAL REQUIREMENTS, which are hereby made a part of this Section of the Specifications.

B. Attention is directed Section 26 0400 – GENERAL CONDITIONS FOR ELECTRICAL TRADES, which is hereby made a part of this Section of the Specifications.

1.2 SUMMARY

A. Section includes distribution and branch circuit panelboards, electronic grade branch circuit panelboards

B. Related Sections:
1. Division 01 Section “General Commissioning Requirements.”
2. Section 26 0526 - Grounding and Bonding for Electrical Systems.
3. Section 26 0553 – Electrical Identification.

1.3 REFERENCES

A. Institute of Electrical and Electronics Engineers:
1. IEEE C62.41 - Recommended Practice on Surge Voltages in Low-Voltage AC Power Circuits.

B. National Electrical Manufacturers Association:
1. NEMA AB 1 - Molded Case Circuit Breakers and Molded Case Switches.
2. NEMA ICS 2 - Industrial Control and Systems: Controllers, Contactors, and Overload Relays, Rated Not More Than 2000 Volts AC or 750 Volts DC.
3. NEMA ICS 5 - Industrial Control and Systems: Control Circuit and Pilot Devices.
4. NEMA KS 1 - Enclosed and Miscellaneous Distribution Equipment Switches (600 Volts Maximum).
5. NEMA PB 1 - Panelboards.
6. NEMA PB 1.1 - General Instructions for Proper Installation, Operation, and Maintenance of Panelboards Rated 600 Volts or Less.

C. International Electrical Testing Association:
1. NETA ATS - Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems.

D. National Fire Protection Association:
   1. NFPA 70 - National Electrical Code.

E. Underwriters Laboratories Inc.:
   1. UL 67 - Safety for Panelboards.
   2. UL 1283 - Electromagnetic Interference Filters.
   3. UL 1449 - Transient Voltage Surge Suppressors.

1.4 SUBMITTALS

A. Division 01 - Submittal Procedures: Requirements for submittals.

B. Shop Drawings: Indicate outline and support point dimensions, voltage, main bus ampacity, integrated short circuit ampere rating, circuit breaker and switch arrangement and sizes.

C. Product Data: Submit catalog data showing specified features of standard products.

1.5 CLOSEOUT SUBMITTALS

A. Division 01 - Execution and Closeout Procedures: Requirements for submittals.

B. Project Record Documents: Record actual locations of panelboards and record actual circuiting arrangements.

C. Operation and Maintenance Data: Submit spare parts listing; source and current prices of replacement parts and supplies; and recommended maintenance procedures and intervals.

1.6 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years of experience.

1.7 MAINTENANCE MATERIALS

A. Division 01 - Execution and Closeout Procedures: Requirements for maintenance products.

B. Furnish two of each panelboard key.

1.8 WARRANTY

A. Division 01 - Execution and Closeout Procedures: Closeout procedures.

B. Special Warranty: Submit a written warranty executed by the manufacturer, the Installer, and the Contractor, agreeing to repair or replace panelboards with branch metering that fail in materials or workmanship within the specified warranty period.
   1. Warranty Period: Warranty period shall be one year from the date of installation or 18 months from date of purchase.

PART 2 PRODUCTS

2.1 BRANCH CIRCUIT PANELBOARDS

A. Manufacturers:
   1. Square D.
   2. General Electric.
   3. Siemens.
   4. Eaton.
   5. Division 01 - Substitutions

B. Product Description: NEMA PB1, circuit breaker type, lighting and appliance branch circuit panelboard.

C. Panelboard Bus: Copper, current carrying components, ratings as indicated on Drawings. Furnish copper ground bus in each panelboard; furnish insulated ground bus as indicated on Drawings.

D. Minimum Integrated Short Circuit Rating: As indicated on drawings.

E. Molded Case Circuit Breakers: NEMA AB 1, bolt-on type thermal magnetic trip circuit breakers, with common trip handle for all poles, listed as Type SWD for lighting circuits, Type HACR for air conditioning equipment circuits, Class A ground fault interrupter circuit breakers as indicated on Drawings. Do not use tandem circuit breakers.
   1. Field-Changeable Ampere Rating Circuit Breaker: Circuit breakers with frame sizes 200 amperes and larger have changeable trip units.

F. Enclosure: NEMA PB 1, Type 1.

G. Cabinet Box: 6 inches deep, 20 inches wide.

H. Cabinet Front: Surface cabinet front with concealed hinge, metal directory frame, and flush lock keyed alike. Finish in manufacturer's standard gray enamel.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install panelboards in accordance with NEMA PB 1.1.

B. Install panelboards plumb.

C. Height: 6 feet to top of panelboard; install panelboards taller than 6 feet with bottom no more than 4 inches above floor.

D. Install filler plates for unused spaces in panelboards.

E. Provide typed circuit directory for each branch circuit panelboard. Revise directory to reflect circuiting changes to balance phase loads.

F. Install engraved plastic nameplates in accordance with Section 26 0553 – Electrical Identification.

G. Ground and bond panelboard enclosure according to Section 26 0526 – Grounding and Bonding for Electrical Systems. Connect equipment ground bars of panels in accordance with NFPA 70.

3.2 FIELD QUALITY CONTROL

A. Division 01 - Execution and Closeout Procedures: Field inspecting, testing, adjusting, and balancing.

B. Inspect and test in accordance with NETA ATS, except Section 4.

C. Perform circuit breaker inspections and tests listed in NETA ATS, Section 7.6.

D. Perform switch inspections and tests listed in NETA ATS, Section 7.5.

E. Above testing shall be witnessed by the CX agent, documented in writing, and furnished as a part of O&M manuals. Provide to CX agent prior to closeout.

3.3 ADJUSTING

A. Division 01 - Execution and Closeout Procedures: Requirements for starting and adjusting.

B. Measure steady state load currents at each panelboard feeder; rearrange circuits in panelboard to balance phase loads to within 20 percent of each other. Maintain proper phasing for multi-wire branch circuits.

END OF SECTION 26 2416

SECTION 26 2819 - ENCLOSED SWITCHES

PART 1 GENERAL

1.1 GENERAL PROVISIONS

A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections with DIVISION 1 - GENERAL REQUIREMENTS, which are hereby made a part of this Section of the Specifications.

B. Attention is directed Section 26 0400 – GENERAL CONDITIONS FOR ELECTRICAL TRADES, which is hereby made a part of this Section of the Specifications.

1.2 SUMMARY

A. Section includes nonfusible disconnect switches.

1.3 REFERENCES

A. National Electrical Manufacturers Association:
1. NEMA KS 1 - Enclosed and Miscellaneous Distribution Equipment Switches (600 Volts Maximum).

B. International Electrical Testing Association:
1. NETA ATS - Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems.

1.4 SUBMITTALS

A. Division 01 - Submittal Procedures: Submittal procedures.

B. Product Data: Submit switch ratings and enclosure dimensions.

1.5 CLOSEOUT SUBMITTALS

A. Division 01 - Execution and Closeout Procedures: Closeout procedures.

B. Project Record Documents: Record actual locations of enclosed switches and ratings of installed fuses.

1.6 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years experience.

PART 2 PRODUCTS

2.1 NONFUSIBLE SWITCH ASSEMBLIES

A. Manufacturers:
1. Square D.
2. General Electric.
3. Siemens.
4. Eaton.
5. Division 01 - Substitutions

B. Product Description: NEMA KS 1, enclosed load interrupter knife switch. Handle lockable in OFF position.

C. Enclosure: NEMA KS 1, to meet conditions. Fabricate enclosure from steel finished with manufacturer's standard gray
1. Interior Dry Locations: Type 1.

D. Furnish switches with entirely copper current carrying parts.

2.2 SWITCH RATINGS

A. Switch Rating: As indicated on drawings.

B. Switch Rating: Horsepower rated for AC or DC as indicated on Drawings.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install enclosed switches plumb. Provide supports in accordance with Section 26 0529 – Hangers and Supports for Electrical Systems.

B. Height: 5 feet to operating handle.

C. Install engraved plastic nameplates in accordance with Section 26 0553 – Electrical Identification.

D. Apply adhesive tag on inside door of each fused switch indicating NEMA fuse class and size installed.

E. For switches feeding mechanical equipment, install switch within sight of the equipment.

3.2 COORDINATION WITH OTHER TRADES

A. It is the responsibility of the electrical contractor to furnish and install a safety switch for each electrical connection to mechanical equipment in the project, unless otherwise noted in the drawings.

B. It is the responsibility of the electrical contractor to install all safety switches furnished under DIVISION 23 – MECHANICAL WORK. Items with loose switches furnished by other trades are notated in drawings.

C. Coordination between electrical and mechanical trades shall be anticipated.

3.3 FIELD QUALITY CONTROL

A. Division 01 - Execution and Closeout Procedures: Field inspecting, testing, adjusting, and balancing.

B. Inspect and test in accordance with NETA ATS, except Section 4.

C. Perform inspections and tests listed in NETA ATS, Section 7.5.

END OF SECTION 26 2819