ROANOKE COUNTY

Purchasing Division
5204 Bernard Drive, Suite 300-F, P.O. Box 29800
Roanoke, Virginia 24018-0798
TEL: (540) 772-2061 FAX: (540) 772-2074

April 27, 2023
ADDENDUM NO. 1 TO ALL BIDDERS:

Reference – IFB 2023-095
Description: William Byrd Middle School Boiler Replacement
Issue Date: April 17, 2023
Proposal Due: May 4, 2023

The above Project is hereby changed as addressed below:

1. Revised Bid Form: Please see Exhibit A to this Addendum for a revised bid form. This revised bid form hereby replaces the original bid form provided as Attachment A to IFB 2023-095. Bidders must complete and submit this revised copy of the bid form in order to be considered responsive.

2. Pre-Bid Conference Sign-In Log: Please see Exhibit B to this Addendum for a copy of the sign-in sheets from the pre-bid conference held on April 21, 2023.

3. Project Specifications: Please see Exhibit C to this Addendum for the Project Manual, provided by Ascent Engineering Group and dated April 26, 2023. Bids shall be submitted in accordance with the specifications provided in the Project Manual. Please reference Section 7.K of IFB 2023-095 in regards to deviations.

4. Revised Project Plans: Please see Exhibit D to this Addendum for an updated set of project plans, provided by Ascent Engineering Group and dated April 26, 2023. These updated plans shall hereby replace the original project plans provided as Attachment F to IFB 2023-095. In the event of any discrepancies, the updated plans dated April 26, 2023 shall prevail.

5. Questions Submitted by Prospective Bidders: Please see the following additional questions received, and the responses provided by the County/RCPS as we are able.

    a. Is a bid bond required? *The requirement for a bid bond has been waived by RCPS in this instance.*
    b. Can the requirement to deliver and install all items/work between May 27 and July 28, 2023 be waived? *Please reference Revised Bid Form provided as Exhibit A.*
    c. Can the liquidated damages clause be removed? *We will not remove this clause from the contract document. However, please be aware that the County/RCPS is aware of current restrictions on project schedules. Understanding will be given contingent upon Contractor's effective communication and transparency regarding the project timeframe.*
    d. Is there a preferred controls integrator? *This is addressed in the Project Specifications provided as Exhibit C to this Addendum.*

e. Is there a preferred roofing contractor for the boiler stack roof penetrations due to warranty? *There is a current warranty on the roof, via Firestone. Contractor will be responsible for completing roof penetrations without voiding the roof warranty. A copy of the warranty can be provided to the successful Bidder.*

6. Equipment Submittals: Per questions posed at the pre-bid conference, Bidders should provide submittals and/or equipment spec sheets as a part of their bid response, for review by RCPS.

7. Extension of Due Date: Due to the additional information offered within this Addendum, the due date is hereby extended to May 4, 2023. Sealed bids must be delivered to the Roanoke County Purchasing office no later than 2:00 PM on May 4, 2023.

Note: A signed acknowledgment of this addendum must be received at the location indicated on the original solicitation either prior to the proposal due date or attached to your proposal. Signature on this addendum does not substitute for your signature on the original proposal/bid document. The original proposal/bid document must be signed.

Thank you,

Kate Hoyt
Phone: (540) 283-8149
KHoyt@roanokecountyva.gov

_____	_____
Sign Name:	Print Name:
_____	_____
Name of Firm:	Date:

IFB # 2023-095

ATTACHMENT A: REVISED Bid Form/ Specifications

Exhibit A to Addendum 1

County of Roanoke
Purchasing Division
5204 Bernard Drive, SW, Suite 300-F
Roanoke, VA 24018-0798

The County reserves the right to add, delete, or adjust quantities as deemed necessary by the County.

Bids containing any conditions, omissions, unexplained erasures, alterations or items not called for in the bid, or irregularities of any kind, may be rejected by the County as being nonresponsive. No changes are to be made to the Bid Form. Any changes to a Bid Amount must be initialed by the person signing the Bid Form.

I/We hereby propose to furnish and provide replacement of boiler equipment at William Byrd Middle School, in accordance with the enclosed general terms, conditions and specifications contained in IFB No. 2023-095. The Bid Form must be completed in blue or black ink. Discrepancies in the multiplication of units of work and the unit prices will be resolved in favor of the correct multiplication of the unit prices. Discrepancies between the indicated sum of any column of figures and the correct sum thereof will be resolved in favor of the correct sum. My/Our prices are as follows:

PRICES QUOTED SHALL BE FOB DESTINATION. Freight charges shall be included in the bid price.

UNIT PRICING

Item	Description	Unit	Price
1	Receptacle: provide 120-volt, 20-Ampere (NEMA 5-20R) Receptacle and 50 linear ft of 2#12 & 2#12 GW and other materials as needed for a complete receptacle addition.	Per location	$
2	Data Drop: Provide Cat-6 data jack complete with testing and termination. Include 300 linear ft. of Cat-6 complete with outlet, coverplate, backbox, conduit concealed, labeling, testing and terminations.	Per location	$

BASE BID

Bidder shall complete the Work as specified in IFB 2023-095, for the following lump sum price:

$_____

Estimated Project Completion Time: _____ (# calendar days from NTP)
(preferred timeframe: May 27, 2023 to July 28, 2023)

Payment terms are: Net 30. If Bidder offers a cash discount for prompt payment, it will only be considered in determining the lowest responsible Bidder if the Bidder allows at least twenty (20)

days for the prompt payment after the goods or services are received or after the invoice is rendered, whichever is later.

To aid in the evaluation of bids, bidders must submit the original Bid Form and one copy of the Bid Form, Attachments, and detailed specification sheets, if applicable. If you fail to do so, your bid may be considered non-responsive and rejected.

Have you complied with this requirement? __Yes / __No.

Indicate whether your business _____ IS or _____ IS NOT located in Roanoke County. If it is, please include a copy of your Roanoke County business license with your bid.

I/We acknowledge the receipt of:

Addendum No._____ Dated_____.

Addendum No._____ Dated_____.

Addendum No._____ Dated_____.

Addendum No._____ Dated_____.

Exhibit B to Addendum 1

IFB #2023-095 WBMS Boiler Replacement
PRE-BID MEETING SIGN-IN LOG

April 21, 2023 10:00 AM

(PLEASE PRINT)

Name/Title BEN OBAUGH
Organization OBAUGH HVAC MECHANICAL
Email & Phone BOBAUGH@OBAUGHHVAC.COM

Name/Title MICAH WHITENACK ELEC. PRO. CORD.
Organization VARNEY, INC.
Email & Phone MWHITENACK@VARNEYINC.COM

Name/Title Jay Nash Estimator
Organization Weco, Inc.
Email & Phone JNash@WECOINC.NET 540-580-8851

Name/Title Kirby Shipman Project Manager
Organization G. J. Hopkins
Email & Phone kirby.shipman@gjhopkins.com 540-765-7553

Name/Title Chris Becker
Organization Hoffman Hydronics
Email & Phone chris.becker@hoffmanhydronics.com 5405411260

Name/Title Garrett Keith / Project MGR
Organization Comfort Systems USA
Email & Phone garrett.keith@comfortsystemsusa.com 540-632-3689

Name/Title Robert Marck / Service Sales
Organization Comfort Systems USA
Email & Phone Robert.Marck@ComfortSystemsUSA.com (540)632-6916

Name/Title Travis Quesenberry / Sales Engineer
Organization RWM Mechanical Sales
Email & Phone travis@RWHayes.net, 540-562-0500

IFB #2023-095 WBMS Boiler Replacement
PRE-BID MEETING SIGN-IN LOG

April 21, 2023 10:00 AM

(PLEASE PRINT)

Name/Title Curtis Adams Sales
Organization Hoffman Mechanical Solutions
Email & Phone Curtis.Adams@HOFFMECH.com 540-240-1375

Name/Title Terry Bateman Project Manager
Organization Southern Air
Email & Phone Terry.Bateman@Southern-air.com 434 841-6405

Name/Title Erick York Estimating
Organization Southern Air
Email & Phone Erick.York@Southern-air.com

Name/Title John Reeynolds ESTIMATING
Organization SOUTHERN AIR
Email & Phone John.Reeynolds@SOUTHERN-AIR.COM

Name/Title Brandon Tuck Estimating
Organization HTF Mechanical
Email & Phone btuck@htfmechanical.com 540 581-2867

Name/Title
Organization
Email & Phone

Name/Title
Organization
Email & Phone

Name/Title
Organization
Email & Phone

Project Manual

MEP Technical Specifications

Roanoke County Public Schools

5937 Cove Road

Roanoke, Virginia 24019

BOILER REPLACEMENTS

AT

WILLIAM BYRD MIDDLE SCHOOL

Vinton, VA 24179

April 26, 2023

COMMONWEALTH OF VIRGINIA
BOYD G. HEADLEY III
Lic. No. 21922
4/26/2023
PROFESSIONAL ENGINEER

COMMONWEALTH OF VIRGINIA
RANDALL ODELL SPENCER
Lic. No. 0402029321
4/26/2023
PROFESSIONAL ENGINEER

ASCENT
ENGINEERING GROUP

TABLE OF CONTENTS

SECTION 00002
PROJECT DIRECTORY

Project:	Boiler Replacements William Byrd Middle School
Owner:	Roanoke County Public Schools 5937 Cove Road Roanoke, Virginia 24019
Mechanical Engineer:	Ascent Engineering Group, Inc. Att: John D. Codington 5228 Valleypointe Parkway, Suite 4 Roanoke, Virginia 24019 Phone: (540) 265-4444 Fax: (540) 265-4445 jcodington@ascenteg.com

END OF SECTION

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SECTION 008500
DRAWINGS INDEX

SHEET TITLE

Cover Sheet

ME001 – MECHANICAL & ELECTRICAL CONTROLS, LEGENDS, DETAILS, SCHEDULES & NOTES

ME101 – MECHANICAL & ELECTRICAL DEMOLITION PLAN

ME201 – MECHANICAL & ELECTRICAL NEW WORK PLAN

P001 – PLUMBING LEGEND, SCHEDULES NOTES & DETAILS

P101 – PLUMBING FLOOR PLAN - DEMOLITION

P201 – PLUMBING FLOOR PLAN – DOMESTIC WATER AND GAS

END OF SECTION

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SECTION 220400
GENERAL REQUIREMENTS FOR PLUMBING

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. Section Includes: Every item of labor, materials, equipment and appurtenances for installing Plumbing Systems included in Division 22 of the Specifications.

B. Related Sections:

1. Section 03 30 00 – Cast–in Place Concrete
2. Section 22 05 13 – Common Motor Requirements for Plumbing Equipment
3. Section 22 05 23 – General-Duty Valves for Plumbing Piping
4. Section 22 05 29 – Hangers and Supports for Plumbing Piping and Equipment
5. Section 22 05 53 – Painting and Identification for Plumbing Piping and Equipment
6. Section 22 07 00 – Plumbing Insulation
7. Section 22 11 16 – Domestic Water Piping
8. Section 22 11 19 – Domestic Water Piping Specialties
9. Section 22 11 23 – Domestic Water Pumps
10. Section 22 16 13 – Facility Natural – Gas Piping
11. Section 22 34 00 – Fuel–Fired, Domestic – Water Heaters
12. Section 23 09 00 – Instrumentation and Control for HVAC
13. Section 23 50 00 – Central Heating Equipment
14. Division 26 – Electrical

1.03 DRAWINGS

A. The Plumbing Drawings are diagrammatic in nature and show the general arrangement of all piping, equipment and appurtenances and shall be followed as closely as actual building construction and the work of other trades will permit. Because of the small scale of the Plumbing Drawings, it is not feasible to indicate all offsets, fittings and accessories that may be required. The Contractor shall investigate the construction conditions affecting the work and provide fittings and accessories as required to meet actual conditions.

B. Where discrepancies in scope of work as to which Trade provides specific items, such as starters, disconnects, flow switches, electrical control components, etc. exist, such conflicts shall be reported to the Engineer. If such action is not taken, the Contractor, as applicable,

shall furnish such items as part of his work, for complete and operable systems and equipment, as determined by the Engineer.

1.04 REGULATIONS AND STANDARDS

A. The completed installation and all materials and equipment shall conform to local ordinances and codes, other regulations and standards listed herein or in related sections. These are intended as a minimum and shall be exceeded if required by the specifications or the Drawings. In the event of conflict between the codes, standards, or regulations, and information contained in the Contract Documents, the applicable code, standards, or regulation shall take precedence.

1.05 INSPECTION CERTIFICATES

A. The Contractor shall furnish three copies of certificates of final acceptance to the Engineer from all inspection authorities having jurisdiction.

1.06 SUBSTANTIAL COMPLETION INSPECTION

A. The Engineer will visit the site for the purpose of conducting a substantial completion inspection once the following items have been met by the Contractor:

1. All Plumbing systems shall be complete, operational and under automatic control.

2. Plumbing systems cleaning, balancing, and testing shall be complete and the final report shall be approved by the Engineer.

B. All discrepancies noted in the substantial completion report shall be corrected prior to the final inspection. The Contractor shall provide a detailed item-by-item description of all corrections made for each item on the substantial completion discrepancy list prior to scheduling final inspection by the Engineer. Additional visits required after the final inspection, for the reason that previously documented discrepancies had not been corrected at the time of the final inspection, will be made at the Contractor’s expense.

1.07 ASBESTOS

A. Asbestos Free Materials: The intention of these Drawings and specifications is that there are no asbestos-containing materials installed on this project. To the best of the Architects and Engineers knowledge, none of the material or equipment specified herein or shown on the Drawings contains asbestos. The Contractor shall make every effort to prevent any asbestos materials from being installed in or used on the construction of the project. At the completion of the project, the Contractor shall certify by letter that to the best of his knowledge, no asbestos-containing materials were used for or in the construction of this project.

B. Existing Materials:

1. Contractor shall review the Owners asbestos management plan to ensure suspected asbestos containing materials are under surveillance.

2. Discovery: If during the construction of this project, work involving friable asbestos is suspected, or encountered, all work in this area shall be discontinued and the Owner or the Owner’s representative, shall be notified immediately and the Owner with his own forces or by separate contract shall be responsible for complete investigation, removal, and disposition of the friable asbestos hazard in accordance with applicable laws and regulations. If the Contractor claims that delay or additional cost is involved because of such action by the Owner, he shall make such claim as provided elsewhere in the Contract Documents.

3. Removal: All work involving the removal of friable asbestos will be done under a separate contract.

1.08 MATERIALS AND WORKMANSHIP

A. Equipment and material used in the project shall be new and undamaged. The Plumbing installation shall fit into the space allotted and shall allow adequate and acceptable clearances for entry, servicing and maintenance. Similar types of equipment shall be the products of the same manufacturer unless specified otherwise. Work shall be performed by mechanics or tradesmen skilled in the trade involved.

B. All piping and equipment shall be installed in a neat and organized manner, parallel to other work and the nearest building elements, unless specifically shown otherwise on the Drawings.

C. Equipment and materials shall be suitable for use in the environment in which they are installed. Equipment exposed to outside conditions shall be adequately protected from the weather, manufactured from materials suitable for outdoor use, and designed specifically for use in outdoor environments.

1.09 SUBMITTALS

A. Submit shop drawings, product data and samples in accordance with Division 01 for all items as specified in related sections of these specifications. One (1) PDF format of the submittal shall be submitted. One (1) PDF format of the submittal will be returned to the Contractor. All submittal data shall be correctly identified to show project name, and the exact model, style or size of item being submitted. Improperly identified submittals will not be reviewed by the Engineer. Each item submitted for review shall bear the Subcontractor's stamp which states that they have reviewed the submission, that it is complete, and that in their opinion it meets the contract requirements. Contractor's stamp shall identify the specification section, paragraph and page number for which the submittal is being made. Shop drawings will be reviewed only for general compliance with the Contract Documents. Review will not include correctness of details, proper configuration, utility connections, dimensions, sizes, quantities, and the like. Any submission which has not been reviewed and stamped by the Plumbing Subcontractor will not be reviewed be the Engineer. No reviews prior to award of Contract will be considered or accepted. Re-submissions of shop drawings, product data and samples shall include the entire original submittal. **Partial submittals will not be reviewed by the Engineer.**

B. Submissions will be stamped by the Engineer in one of the following ways:

“No Exceptions Taken"	No exceptions are taken and subject to compliance\ with the Contract Documents.
"Make Corrections Noted"	Minor corrections are noted and a re-submittal is not required subject to compliance with the corrections and the Contract Documents.
"Correct and Resubmit "	The submitted material, method or system meets the intent of the specifications, yet has insufficient data to determine compliance with the Contract Documents. Re-submittal is required.
"Rejected"	The submitted material, method or system does not meet the intent of the specifications, or has insufficient data to determine compliance with the Contract Documents.

C. Submission Procedures:

1. If a submission is satisfactory to the Engineer, the Engineer will annotate the submission, "No Exceptions Taken" or "Make Corrections Noted" and transmit one (1) PDF format to the Contractor. If a resubmission is required, the Engineer will annotate the submission “Correct and Resubmit” or "Rejected" and transmit one (1) format to the Contractor for appropriate action.

2. The Contractor shall revise and resubmit submissions as required by the Engineer until submissions are acceptable to the Engineer.

3. Approval of a working and/or shop drawings by the Engineer will constitute acceptance of the subject matter for which the drawing was submitted and not for any other structure, material, equipment or appurtenances indicated as shown.

4. The Engineer's review of the Contractor's submissions shall in no way relieve the Contractor of any of his responsibilities under the Contract. An approval of a submission shall be interpreted to mean that the Engineer has no specific objections to the submitted material, subject to conformance with the Contract Documents.

5. Where as-built drawings, record drawings and specifications are available and when provided to the Contractor for use in performing the work, the Contractor shall verify the content of such drawings and specifications, the suitability of their use in performing the work and their accuracy for the purposes in which the Contractor intends to use any record or historical documents which may be obtained. In no case shall the Contractor assume that such documents reflect a true and accurate record of the construction. Acceptance of any such materials, records, and/or drawings shall in no way result in additional cost to the Owner should an error and/or omission in these documents result in additional costs to the Contractor.

6. On the first pages of all submittals, the Contractor shall provide a table showing all individual specification section paragraphs and drawings that apply to the equipment/component and a statement for each paragraph and drawing that the requirements have been met. The table shall be similar in format to the following, but shall include all relevant specification paragraphs and drawings:

Section 22 07 00 (example)	
1.2 A	Comply
1.2 B	Comply
1.3 A	Comply
1.3 B	Comply
1.3 C	Comply
1.4 A	Comply
1.4 A.1	Comply
1.4 A.2	Comply
Drawing M0.01	Comply

D. Equivalents: Manufacturers, trade names, and model numbers indicated herein and on Drawings shall be interpreted as establishing a standard of quality and shall not be construed as limiting competition. Unless definitely stated otherwise and upon complying with Division 1, the Contractor may use any article which, in his judgment is equal to that specified and is accepted by the Engineer. Manufacturers listed first in these specifications and on Drawings were used as a basis of design. It will be the responsibility of the Contractor to verify all connections, physical sizes, capacities, etc. of all other manufacturer's items, both named or proposed. If the equipment necessitates changes in rough-in, piping, wiring or other building systems from that indicated on the Drawings, the Contractor shall be responsible for all additional costs included and notify other trades. Where such changes are required, detail drawings indicating all required changes shall be submitted for review at the same time the manufacturers drawings are submitted for approval.

E. Shop drawings, diagrams, product data and such other data necessary to fully describe and substantiate compliance with these specifications shall be submitted for all equipment and materials where specifically required by specification and all items identified with an [S] behind the product title. Submittals not required by the Contract Documents will not be reviewed.

F. Shop Drawing manual(s) shall be submitted in accordance with Division 01 and shall include a complete product index, a copy of all approved shop drawings, and the name, address and telephone number of supplier or nearest representative. The manual(s) shall be presented to the Engineer for review and transmittal to the Owner before final payment is recommended.

G. Operation and Maintenance manual(s) shall be submitted in accordance with Division 01, this Section and shall include a complete product index in each volume, installation and maintenance data, parts lists, a copy of all approved shop drawings and the name, address and telephone number of supplier or nearest representative. All Plumbing devices, equipment and systems marked [O/M] in these specifications shall be included and all other such plumbing items that will require servicing before the duration of its useful life has been reached. Manual(s) shall be presented to the Engineer for review and transmittal to the Owner before final payment is recommended.

1.10 WARRANTY

A. The Contractor shall provide a warranty for a period of one year for all work provided under the Contract to include, but not necessarily limited to, all systems, equipment, materials, and

workmanship. This shall not be construed to limit any extended warranty periods of longer than one year for specific items or systems specified elsewhere in the Contract Documents.

B. The warranty period shall commence on the date of acceptance by the Owner and shall cover all parts and labor as required to fulfill the warranty at no cost to the Owner.

C. Comply with requirements for additional warranties specified in Division 01.

D. Information on all warranties shall be included in the O&M Manuals specified herein to be provided to the Owner.

E. In phased construction, warranties shall not begin until substantial completion of the FINAL phase. Contractor shall maintain all new equipment and systems until that time. Owner will maintain all existing equipment and systems. Where new systems are connected to existing, the Contractor and Owner shall determine coordination of maintenance responsibilities at the preconstruction meeting.

1.11 INTERRUPTION OF UTILITY SERVICES

A. It is necessary that close liaison be maintained with the Administrative Authorities in all matters affecting interruptions of any utility services serving the facility and existing buildings. Prior to interrupting any utility service, the Administrative Authorities shall be consulted and interruptions for connections made at a time (or times) suitable to the Administrative Authorities. Work shall be laid out and planned to limit the interruption times to a minimum.

1.12 COORDINATION OF WORK

A. General: The Contract Documents indicate the extent and general arrangement of the Plumbing systems. The Contractor shall be responsible for the coordination and proper relation of the Plumbing work to the building structure and to the work of other trades. No additional compensation or extension of completion time will be granted for extra work caused by the lack of coordination.

B. Cooperation: The Contractor shall provide dimensions and locations of all openings, shafts and similar items to the proper trades and install work as required so as not to interfere with, or delay, the building construction.

C. Locations of lines and equipment shall be determined from actual field measurements. The outlines of the building shown on the Plumbing Drawings are intended only as a guide to indicate relative locations of the Plumbing work. Refer to Architectural and Structural Drawings for building construction details. The Contractor shall determine the exact routing and location of his systems prior to fabrication or installation of any system component. Accurate measurements and coordination shall be completed to verify dimensions and characteristics for the installation of each system.

D. Unless necessitated by equipment access or otherwise indicated in the Contract Documents, all equipment, piping and conduit concealed above ceilings and in finished or utility spaces shall be routed as high as possible.

E. Offsets, transitions and changes of direction in all systems shall be made as required to maintain proper headroom and pitch of sloping lines whether or not indicated on the drawings. The Contractor shall provide manual air vents and drains as required for his work to affect these offsets, transitions and changes in direction, as applicable.

F. Cutting and Patching: Comply with requirements for cutting and patching specified in Division 01.

G. Roughing-In: Verify the locations of machines, door swings, block coursing, alignment of tile end and other similar features before roughing-in for Plumbing equipment components and/or controls.

H. Damage to Other Work: Each Contractor is responsible for damage to other work caused by his work or workmen. Repairing of damaged work shall be done by the Contractor who installed the work, and as directed by the Architect-Engineer; the cost of which shall be paid for by the Contractor responsible for the damage.

1.13 EQUIPMENT INSTALLATION

A. General: Equipment shall be installed in accordance with manufacturer's instructions to conform with the details and application indicated. Where manufacturer's recommendations or installation instructions require options or accessories not specified, they shall be included and installed by the Contractor.

B. Supports: Provide necessary supports for all equipment and appurtenances as required; this includes but is not limited to frames or supports for items such as storage tanks, water heaters, air compressors, plumbing fixtures, pumps, valves, and other similar items requiring supports. Floor mounted equipment in Equipment Rooms shall be set on 4-inch high concrete foundation pads unless shown otherwise. All pads shall be poured such that the top of the pad is level. Foundation drawings, bolt setting information and foundation bolts shall be furnished by the subcontractors furnishing the equipment for all equipment required to have concrete foundations. Concrete for foundations shall be provided by Plumbing Subcontractor unless indicated otherwise. Except where indicated all equipment shall be anchored to concrete pads.

C. Service Area: All equipment and appurtenances shall be located to permit adequate service clearance in accordance with manufacturer's recommendations and as otherwise required. Service clearance shall include but not be limited to service and removal of plumbing system, water heaters, pumps, motors, controls and other of equipment. All piping and other equipment shall be located outside of the service area or shall be flanged for easy removal to facilitate equipment service. All equipment shall be located with sufficient distance from building features, structural components, and the equipment of other trades. Service clearance in front of electrical panels shall be minimum as required by National Electric Code (NEC) where applicable.

D. Temporary Requirements: Openings in equipment shall be kept plugged at all times until connection is made to the system. The ends of all pipes and equipment openings shall be kept plugged or capped properly with approved devices. Approved devices are items such as specially molded plastic caps, pipe plugs, test plugs and sheet metal caps.

1.14 SLEEVES AND INSERTS

A. General: Sleeves and inserts shall be provided and correctly located in the structure, as require for the work.

B. Inserts shall be steel and proper size for loads encountered.

C. Sleeves shall be provided for all pipes passing through concrete or masonry walls, partitions, concrete beams or slabs installed during construction of the wall, partition, beam or slab. Sleeves through existing concrete walls and slabs may be omitted if wall or slab can be core drilled and properly sealed in a manner acceptable to the Engineer. Sleeves placed horizontally in walls or in any position in beams shall be standard weight ASTM A53 steel pipe of length equal to thickness of wall or beam. Those placed vertically in non-waterproof floors shall be 20 gauge galvanized sheet steel of length equal to thickness of slab, flared and nailed to the form, or fastened to reinforcing fabric and filled with sand during pouring to prevent deformation. Sleeves occurring in floors of rooms where hose bibs or floor drains occur, and in

pipe spaces, shall be standard weight steel pipe projecting 2" above the finished floor except in Equipment Rooms they shall project four (4) inches above floor. Sleeves in floors with waterproof membrane shall be provided with flanges or flashing rings and shall be clamped or flashed into membrane. All sleeves (and core drilled openings) shall be of sufficient diameter to clear bare or covered pipes by 1/4" all around except sleeves on lines subject to movement by expansion which shall clear the bare pipe or insulation on insulated pipe at least one inch all around. Pipes through exterior walls below grade and above footings shall be installed in sleeves having a minimum size of two larger pipe diameters and sealed watertight with flexible synthetic rubber seals. Sleeve shall have anchor and water stop plate. The entire assembly shall be tightened and adjusted and made watertight. Sleeves for pipes and conduit, penetrating fire (and smoke) rated partitions, walls and floors shall be sealed in accordance with the terms of U.L. Listed Through-Penetration Firestop Systems XHEZ as published in the U.L. Fire Resistance Directory. Penetrations shall exactly conform to details of the Firestop System indicated for the type of partition, wall and floor construction encountered. All penetrations through nonfireresistance rated floor assemblies and through the ceiling membrane of nonfireresistance rated roof assemblies shall be fireblocked with tightly packed mineral-wool insulation secured in place. All penetrations through equipment room walls and other areas of noise or heat generation shall be tightly sealed with mineral fiber rope. All penetrations through draftstop partitions shall be sealed to maintain the integrity of the partition. All firestopping and draftstopping of sleeves for Plumbing work shall be provided under Division 22.

1.15 ESCUTCHEONS

A. Where pipes pass through floors, walls or ceilings in finished rooms, they shall be fitted with chromium plated escutcheons of suitable pattern to effectively cover the rough opening. Where sleeves project above floors, special deep type escutcheons shall be provided.

1.16 ACCESS DOORS

A. Provide for all concealed valves, controls, dampers, junction boxes, equipment, or any item requiring access. Doors shall be of sufficient size and so located that the concealed items may be serviced or completely removed and replaced. Doors required for Plumbing work shall be furnished as a part of this Division to the General Contractor for installation. The Plumbing Sub-Contractor shall provide locations of all access doors such that service may be safely performed from a ladder, lift, or platform without the need for support from the ceiling system. Doors in acoustic tile ceilings shall be furnished in multiples of tile sizes. Doors are not required in exposed grid type ceilings where tiles are removable. Doors shall be metal access doors with cam lock, style to match ceiling or wall construction. Doors occurring in rated construction shall be fire rated U.L. labeled access doors correlated to preserve the integrity of the rated construction. Doors leading to concealed spaces shall be provided with means to open from the inside. Doors shall be prime finish steel except those in toilets, shower rooms, locker rooms, kitchens and other similar areas shall be stainless steel with brushed finish.

1.17 ELECTRICAL WIRING AND EQUIPMENT

A. Motors shall be provided in place as an integral part of the driven equipment, ready for electrical connections. Motors shall be in accordance with NEMA Standards and of design suitable for the starting and running characteristics of the driven equipment. Minimum efficiencies of motors shall be "nominal" efficiency as indicated in ASHRAE Standard 90.1-1989 as amended by 90.1c-1993 (ie: 1 HP, 82.5%; 5 HP, 87.5%; 10 HP, 89.5%; 20 HP, 91%; 50 HP, 93%) and shall meet or exceed those contained in NEMA MG1-1993, Table 10-12.

B. Motor starters and motor protective switches shall be provided under Division 26 except where specified to be furnished specifically with the driven equipment. Accessories such as auxiliary contacts, hand-off-automatic switches, start-stop switches, pilot lights, control power transformers and other similar items shall be provided in or on the controllers as required by the

control sequence indicated. Starting equipment, unless factory mounted on the equipment, shall be installed under Division 26.

C. Wiring, low voltage (100 volts or less) control wiring shall be provided as a part of Section 23 09 00 Instrumentation and Control for HVAC. Wiring material and installation shall be in strict accordance with Division 26 and manufacturer's recommendations to comply with the sequence of control indicated. Verify that wiring of all motors and controls required by equipment furnished is accomplished for the correct sequence of operation.

D. Wiring, line voltage (101 volts or higher) power or control wiring shall be furnished and installed under Division 26.

E. Disconnects shall be provided for each item of equipment under Division 26 unless specified otherwise in other sections.

F. Miscellaneous manual or automatic control and protective or signal devices required for the sequence of operation indicated for mechanical equipment shall be provided under the section of the specifications where the item of equipment is specified unless indicated otherwise.

1.18 PROTECTION FROM MOVING PARTS

A. Belts, pulleys, chains, gears, shafts, couplings and other rotating or moving parts located so that any person may come in close proximity thereto shall be fully enclosed or properly guarded.

1.19 RECORD OF UNDERGROUND LINES

A. On completion of the project, the Contractor shall prepare and submit to the Engineer a drawing in PDF format showing the location of any underground lines installed in locations different from those on the Architect-Engineer's Drawings. The location of cleanouts, and the distance from the building to outside sewers, mains, and manholes shall be dimensioned.

1.20 CHARTS AND DIAGRAMS

A. General: Material as listed below shall be provided by the Contractor and shall be mounted in separate hardwood frames where directed in the field or folded and stored in a plastic document folder and located in the control cabinets. All charts, diagrams and schemes shall be photographic positives prepared from original tracings. A copy of charts and diagrams shall be included with O/M manuals.

B. Automatic Temperature Control Diagrams identified as to name, sequence of operation, location and number of systems. Components of a control system shall be identified as to location, function, temperature setting and manufacturer's part number.

C. Electric Sequence Control Diagrams of entire Mechanical system.

D. Charts for identification of valves.

1.21 INSTRUCTION OF OWNER'S REPRESENTATIVE

A. Contractors shall instruct the representative of the Owner in the proper operation and maintenance of all elements of the Plumbing systems. Competent representatives of the Contractor shall spend such time as necessary to fully prepare the Owner to operate and maintain the Plumbing systems.

1.22 CONSTRUCTION STATUS REPORT

A. Each item of discrepancies noted on Construction Status Report prepared by the Engineer shall be answered in detail in writing by the Contractor before payment can be recommended.

1.23 GRAPHICS DATABASE

A. This project's Computer Aided Design & Drafting (CADD) drawing files may be obtained directly from the Engineer for use in preparing computer graphics specific to this project. Refer to Appendix A at the end of this Section for Letter of Indemnification.

PART 2 - PRODUCTS – Not Used

PART 3 - EXECUTION

3.01 PHASING OF WORK

A. Coordinate phasing requirements with Division 01.

3.02 DEMOLITION

A. Contractor shall visit site before bidding to determine extent of demolition.

B. Removal of Piping and Equipment: Remove all piping connections and equipment, plugging outlets, etc., such that are not required for present equipment and fixtures, or are not reused or needed for reconnecting new equipment and fixtures. Remove all equipment, fixtures, etc., indicated to be removed, or not reused or needed after the renovations are complete.

C. Where piping or other similar items passing through rated assemblies are removed; the assemblies shall be patched in accordance with UL so as to maintain the integrity of the assembly.

D. The Owner will select and retain such existing plumbing fixtures, equipment and materials which are indicated to be removed and not reused, as he desires. All other existing plumbing fixtures, equipment and materials indicated to be removed and not reused shall become the property of the Contractor, who shall promptly remove them from the premises. All existing equipment and fixtures indicated to be relocated shall be disconnected, removed, relocated and reconnected. All equipment and fixtures shall be protected from damage during demolition.

E. Miscellaneous: In all altered portions of the buildings, the Contractor shall remove or alter as necessary all existing Plumbing work that is not coordinated to operate with the new construction. Demolition shall not begin until the work schedule is approved by the owner. The work shall be scheduled to prevent any disruption to the normal operations of the building.

3.03 CONNECTIONS TO EQUIPMENT FURNISHED BY OTHERS

A. The Plumbing Contractor shall make proper connections to all equipment furnished by others where indicated on the drawings. Contractor shall make connections to fixtures and equipment and install water cutoffs or stops, and gas cocks at each piece of equipment. Comply with requirements for pipe and fittings specified under appropriate Division 22 sections herein.

B. The exact location of and roughing-in requirements of each piece of equipment shall be determined by the Contractor before roughing-in is done.

C. Check Valves: Provide check valves in hot and cold-water connections to fixtures where faucets or valves generally remain open during extended operation.

END OF SECTION 220400

APPENDIX A
LETTER OF INDEMNIFICATION

Project Name: William Byrd Middle School – Boiler Replacements

Project Location: Vinton, VA

The Contractor may obtain from Ascent Engineering Group a CD-ROM or electronic mail version of the projects Revit / CADD database. All seals, details, schematics, tables, controls, etc. will be deleted. All drawings will be provided in Autocad™ 2014 format.

Ascent Engineering Group reserves all rights to the original drawing files.

The Recipient agrees, to the fullest extent permitted by the law, to hold harmless and indemnify Ascent Engineering Group, as defined in the Bid Documents, from and against all claims, liabilities, losses, damages, and costs, including but not limited to attorney's fees, arising out of or in any way connected with the use, modification, misinterpretation, misuse, or reuse by the Recipient or others of the machine readable information and data provided by Ascent Engineering Group under this Agreement. The foregoing indemnification applies, without limitation, to any use of the project documentation on other projects, for additions to this project, or for completion of this project by others, excepting only such use as may be authorized, in writing, by Ascent Engineering Group.

The electronic drawing files are not part of the Contract Documents for the Project. The Recipient assumes all risks associated with the use of the transmitted files. Ascent Engineering Group will not be responsible for any differences in the information included in the transmitted files and the information shown on the Contract Documents. Modifications to the Contract Documents made before or during construction may or may not be included in the transmitted electronic drawing files.

The Recipient further agrees that the drawing files will only be used in graphics preparation for the above-referenced project.

Company Name of Recipient: _____

Recipient's Designated Representative: _____

Title: _____

Signature: _____

Address: _____

Return to: Ascent Engineering Group
5228 Valleypointe Parkway, Suite 4
Roanoke, VA 24019
AEG # 23070

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SECTION 220513
COMMON MOTOR REQUIREMENTS FOR PLUMBING EQUIPMENT

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. Section Includes: General requirements for single-phase and polyphase, general-purpose, horizontal, small and medium, squirrel-cage induction motors for use on ac power systems up to 600 V and installed at equipment manufacturer's factory or shipped separately by equipment manufacturer for field installation.

B. Related Sections:

1. Section 22 04 00 – General Requirements for Plumbing

2. Section 22 11 23 – Domestic Water Pumps

3. Section 22 34 00 – Fuel–Fired, Domestic – Water Heaters

4. Division 26 – Electrical

1.03 COORDINATION

A. Coordinate features of motors, installed units, and accessory devices to be compatible with the following:

1. Motor controllers.

2. Torque, speed, and horsepower requirements of the load.

3. Ratings and characteristics of supply circuit and required control sequence.

4. Ambient and environmental conditions of installation location.

PART 2 - PRODUCTS

2.01 GENERAL MOTOR REQUIREMENTS

A. Comply with requirements in this Section except when stricter requirements are specified in plumbing equipment schedules or Sections.

B. Comply with NEMA MG 1 unless otherwise indicated.

C. Comply with IEEE 841 for severe-duty motors.

2.02 MOTOR CHARACTERISTICS

A. Duty: Continuous duty at ambient temperature of 40 deg C and at altitude of 3300 feet above sea level.

B. Capacity and Torque Characteristics: Sufficient to start, accelerate, and operate connected loads at designated speeds, at installed altitude and environment, with indicated operating sequence, and without exceeding nameplate ratings or considering service factor.

2.03 SINGLE-PHASE MOTORS

A. Motors larger than 1/20 hp shall be one of the following, to suit starting torque and requirements of specific motor application:

1. Permanent-split capacitor.

2. Split phase.

3. Capacitor start, inductor run.

4. Capacitor start, capacitor run.

B. Multispeed Motors: Variable-torque, permanent-split-capacitor type.

C. Bearings: Prelubricated, antifriction ball bearings or sleeve bearings suitable for radial and thrust loading.

D. Motors 1/20 HP and Smaller: Shaded-pole type.

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

PART 3 - EXECUTION – Not Used

END OF SECTION

SECTION 220523
GENERAL-DUTY VALVES FOR PLUMBING PIPING

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. Section Includes:

1. Brass ball valves.
2. Bronze ball valves.
3. Iron ball valves.
4. Bronze swing check valves.
5. Iron swing check valves.
6. Iron gate valves.
7. Bronze globe valves.

B. Related Sections:

1. Section 03 30 00 – Cast– in Place Concrete
2. Section 22 04 00 – General Requirements for Plumbing
3. Section 22 05 29 – Hangers and Supports for Plumbing Piping and Equipment
4. Section 22 05 53 – Painting and Identification for Plumbing Piping and Equipment
5. Section 22 07 00 – Plumbing Insulation
6. Section 22 11 16 – Domestic Water Piping
7. Section 22 11 19 – Domestic Water Piping Specialties
8. Section 22 11 23 – Domestic Water Pumps
9. Section 22 16 13 – Facility Natural – Gas Piping
10. Section 22 34 00 – Fuel-Fired, Domestic – Water Heaters

1.03 DEFINITIONS

A. CWP: Cold working pressure.

B. EPDM: Ethylene propylene copolymer rubber.

C. NBR: Acrylonitrile-butadiene, Buna-N, or nitrile rubber.

D. NRS: Nonrising stem.

E. OS&Y: Outside screw and yoke.

F. RS: Rising stem.

G. SWP: Steam working pressure.

1.04 SUBMITTALS

A. Product Data: For each type of valve indicated [S]. Comply with requirements for submittals in Division 01 and Section 22 04 00 “General Requirements for Plumbing”.

1.05 QUALITY ASSURANCE

A. Source Limitations for Valves: Obtain each type of valve from single source from single manufacturer.

B. ASME Compliance:

1. ASME B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.

2. ASME B31.1 for power piping valves.

3. ASME B31.9 for building services piping valves.

C. NSF Compliance for valve materials that will be in contact with potable water:

1. NSF 61 "Drinking Water System Components - Health Effects".

2. NSF 372 "Drinking Water System Components - Lead Content".

1.06 DELIVERY, STORAGE, AND HANDLING

A. Prepare valves for shipping as follows:

1. Protect internal parts against rust and corrosion.

2. Protect threads, flange faces, grooves, and weld ends.

3. Set gate, and globe valves closed to prevent rattling.

4. Set ball and plug valves open to minimize exposure of functional surfaces.

5. Block check valves in either closed or open position.

B. Use the following precautions during storage:

1. Maintain valve end protection.

2. Store valves indoors and maintain at higher than ambient dew point temperature. If outdoor storage is necessary, store valves off the ground in watertight enclosures.

C. Use sling to handle large valves; rig sling to avoid damage to exposed parts. Do not use handwheels or stems as lifting or rigging points.

PART 2 - PRODUCTS

2.01 GENERAL REQUIREMENTS FOR VALVES

A. Refer to valve schedule articles for applications of valves.

B. Valve Pressure and Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.

C. Valve Sizes: Same as upstream piping unless otherwise indicated.

D. Valve Actuator Types:

1. Handwheel: For valves other than quarter-turn types.

2. Handlever: For quarter-turn valves.

E. Valves in Insulated Piping: With 2-inch stem extensions and the following features:

1. Gate Valves: With rising stem.

2. Ball Valves: With extended operating handle of non-thermal-conductive material, and protective sleeve that allows operation of valve without breaking the vapor seal or disturbing insulation.

F. Valve-End Connections:

1. Flanged: With flanges according to ASME B16.1 for iron valves.

2. Pressure-Seal: With pressure-seal-joint according to ASME B16.51.

3. Solder Joint: With sockets according to ASME B16.18.

4. Threaded: With threads according to ASME B1.20.1.

G. Valve Bypass and Drain Connections: MSS SP-45.

2.02 BRASS BALL VALVES[S]

A. Two-Piece, Full-Port, Brass Ball Valves with Stainless-Steel Trim:

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

a. Crane Co.; Crane Valve Group; Crane Valves.

b. Crane Co.; Crane Valve Group; Jenkins Valves.

c. Flow-Tek, Inc.; a subsidiary of Bray International, Inc.

d. Hammond Valve.

e. Jamesbury; a subsidiary of Metso Automation.

f. Kitz Corporation.

g. Marwin Valve; a division of Richards Industries.

h. Milwaukee Valve Company.

i. RuB Inc.

2. Description:

a. Standard: MSS SP-110.

b. SWP Rating: 150 psig.

c. CWP Rating: 600 psig.

d. Body Design: Two piece.

e. Body Material: Forged brass.

f. Ends: Threaded.

g. Seats: PTFE or TFE.

h. Stem: Stainless steel.

i. Ball: Stainless steel, vented.

j. Port: Full.

2.03 BRONZE BALL VALVES [S]

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

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

a. Conbraco Industries, Inc.; Apollo Valves.

b. Crane Co.; Crane Valve Group; Crane Valves.

c. Hammond Valve.

d. Lance Valves; a division of Advanced Thermal Systems, Inc.

e. Milwaukee Valve Company.

f. NIBCO INC.

g. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Description:

a. Standard: MSS SP-110.

b. SWP Rating: 150 psig.

c. CWP Rating: 600 psig.

d. Body Design: Two piece.

e. Body Material: Bronze.

f. Ends: Threaded.

g. Seats: PTFE or TFE.

h. Stem: Stainless steel.

i. Ball: Stainless steel, vented.

j. Port: Full.

k. Port: Regular.

2.04 IRON BALL VALVES [S]

A. Class 125, Iron Ball Valves:

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

a. American Valve, Inc.

b. Conbraco Industries, Inc.; Apollo Valves.

c. Kitz Corporation.

d. Sure Flow Equipment Inc.

e. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Description:

a. Standard: MSS SP-72.

b. CWP Rating: 200 psig.

c. Body Design: Split body.

d. Body Material: ASTM A 126, gray iron.

e. Ends: Flanged.

f. Seats: PTFE or TFE.

g. Stem: Stainless steel.

h. Ball: Stainless steel.

i. Port: Full.

2.05 BRONZE SWING CHECK VALVES [S]

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

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

a. American Valve, Inc.

b. Crane Co.; Crane Valve Group; Crane Valves.

c. Crane Co.; Crane Valve Group; Jenkins Valves.

d. Crane Co.; Crane Valve Group; Stockham Division.

e. Hammond Valve.

f. Kitz Corporation.

g. Milwaukee Valve Company.

h. NIBCO INC.

i. Powell Valves.

j. Red-White Valve Corporation.

k. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

l. Zy-Tech Global Industries, Inc.

2. Description:

a. Standard: MSS SP-80, Type 3.

b. CWP Rating: 200 psig.

c. Body Design: Horizontal flow.

d. Body Material: ASTM B 62, bronze.

e. Ends: Threaded.

f. Disc: Bronze.

2.06 IRON SWING CHECK VALVES [S]

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

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

    a. Crane Co.; Crane Valve Group; Crane Valves.

    b. Crane Co.; Crane Valve Group; Jenkins Valves.

    c. Crane Co.; Crane Valve Group; Stockham Division.

    d. Hammond Valve.

    e. Kitz Corporation.

    f. Legend Valve.

    g. Milwaukee Valve Company.

    h. NIBCO INC.

    i. Powell Valves.

    j. Red-White Valve Corporation.

    k. Sure Flow Equipment Inc.

    l. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

    m. Zy-Tech Global Industries, Inc.

2. Description:

    a. Standard: MSS SP-71, Type I.

    b. CWP Rating: 200 psig.

    c. Body Design: Clear or full waterway.

    d. Body Material: ASTM A 126, gray iron with bolted bonnet.

    e. Ends: Flanged.

    f. Trim: Bronze.

    g. Gasket: Asbestos free.

2.07 IRON GATE VALVES [S]

A. Class 125, NRS, Iron Gate Valves:

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

    a. Crane Co.; Crane Valve Group; Crane Valves.

b. Crane Co.; Crane Valve Group; Jenkins Valves.

c. Crane Co.; Crane Valve Group; Stockham Division.

d. Flo Fab Inc.

e. Hammond Valve.

f. Kitz Corporation.

g. Legend Valve.

h. Milwaukee Valve Company.

i. NIBCO INC.

j. Powell Valves.

k. Red-White Valve Corporation.

l. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

m. Zy-Tech Global Industries, Inc.

2. Description:

a. Standard: MSS SP-70, Type I.

b. CWP Rating: 200 psig.

c. Body Material: ASTM A 126, gray iron with bolted bonnet.

d. Ends: Flanged.

e. Trim: Bronze.

f. Disc: Solid wedge.

g. Packing and Gasket: Asbestos free.

2.08 BRONZE GLOBE VALVES [S]

A. Class 125, Bronze Globe Valves with Bronze Disc:

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

a. Crane Co.; Crane Valve Group; Crane Valves.

b. Crane Co.; Crane Valve Group; Stockham Division.

c. Hammond Valve.

d. Kitz Corporation.

e. Milwaukee Valve Company.

f. NIBCO INC.

g. Powell Valves.

h. Red-White Valve Corporation.

i. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

j. Zy-Tech Global Industries, Inc.

2. Description:

a. Standard: MSS SP-80, Type 1.

b. CWP Rating: 200 psig.

c. Body Material: ASTM B 62, bronze with integral seat and screw-in bonnet.

d. Ends: Threaded.

e. Stem and Disc: Bronze.

f. Packing: Asbestos free.

g. Handwheel: Malleable iron.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine valve interior for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks, used to prevent disc movement during shipping and handling.

B. Operate valves in positions from fully open to fully closed. Examine guides and seats made accessible by such operations.

C. Examine threads on valve and mating pipe for form and cleanliness.

D. Examine mating flange faces for conditions that might cause leakage. Check bolting for proper size, length, and material. Verify that gasket is of proper size, that its material composition is suitable for service, and that it is free from defects and damage.

E. Do not attempt to repair defective valves; replace with new valves.

3.02 VALVE INSTALLATION

A. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.

B. Locate valves for easy access and provide separate support where necessary.

C. Install valves in horizontal piping with stem at or above center of pipe.

D. Install valves in position to allow full stem movement.

E. Install check valves for proper direction of flow and as follows:

1. Swing Check Valves: In horizontal position with hinge pin level.

3.03 ADJUSTING

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

3.04 GENERAL REQUIREMENTS FOR VALVE APPLICATIONS

A. If valve applications are not indicated, use the following:

1. Shutoff Service: Ball or gate valves.

2. Throttling Service: Globe or ball valves.

B. If valves with specified SWP classes or CWP ratings are not available, the same types of valves with higher SWP classes or CWP ratings may be substituted.

C. Select valves, except wafer types, with the following end connections:

1. For Copper Tubing, NPS 3 and Smaller: Threaded ends except where solder-joint valve-end option is indicated in valve schedules below.

2. For Copper Tubing, NPS 4: Flanged ends except where threaded valve-end option is indicated in valve schedules below.

3. For Steel Piping, NPS 3 and Smaller: Threaded ends.

4. For Steel Piping, NPS 4: Flanged ends except where threaded valve-end option is indicated in valve schedules below.

3.05 DOMESTIC, HOT- AND COLD-WATER VALVE SCHEDULE

A. Pipe NPS 3 and Smaller:

1. Bronze and Brass Valves: May be provided with solder-joint or pressure-seal-joint ends instead of threaded ends.

2. Ball Valves: Two-piece, full-port, brass or bronze with brass, bronze or stainless-steel trim.

3. Bronze Swing Check Valves: Class 125, bronze disc.

4. Bronze Globe Valves: Class 125, bronze disc.

B. Pipe NPS 4 and Larger:

1. Iron Valves: Flanged ends.

2. Iron Ball Valves: Class 125.

3. Iron Swing Check Valves: Class 125, metal seats.

4. Iron Gate Valves: Class 125, NRS.

END OF SECTION

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SECTION 220529
HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. Section Includes:

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

B. Related Sections:

1. Section 05 50 00 – Metal Fabrications
2. Section 22 04 00 – General Requirements for Plumbing
3. Section 22 05 23 – General – Duty Valves for Plumbing Piping
4. Section 22 05 53 – Painting and Identification for Plumbing Piping and Equipment
5. Section 22 07 00 – Plumbing Insulation
6. Section 22 11 16 – Domestic Water Piping
7. Section 22 11 19 – Domestic Water Piping Specialties
8. Section 22 11 23 – Domestic Water Pumps
9. Section 22 16 13 – Facility Natural – Gas Piping

1.03 DEFINITIONS

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

1.04 PERFORMANCE REQUIREMENTS

A. Delegated Design: Design trapeze pipe hangers and equipment supports, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

B. Structural Performance: Hangers and supports for plumbing piping and equipment shall withstand the effects of gravity loads and stresses within limits and under conditions indicated according to SEI/ASCE 7 “Minimum Design Loads for Buildings and Other Structures.

1. Design supports for multiple pipes, including pipe stands, capable of supporting combined weight of supported systems, system contents, and test water.

2. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.

1.05 SUBMITTALS

A. Product Data: For each type of product indicated [S]. Comply with requirements in Division 01 and Section 22 04 00 “General Requirements for Plumbing”.

B. Shop Drawings: Show fabrication and installation details and include calculations for the following; include Product Data for components:

1. Trapeze pipe hangers.

2. Metal framing systems.

3. Equipment supports.

C. Delegated-Design Submittal: For trapeze hangers indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1. Detail fabrication and assembly of trapeze hangers.

2. Design Calculations: Calculate requirements for designing trapeze hangers.

D. Welding certificates.

1.06 QUALITY ASSURANCE

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

B. Pipe Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.

PART 2 - PRODUCTS

2.01 METAL PIPE HANGERS AND SUPPORTS

A. Carbon-Steel Pipe Hangers and Supports:

1. Description: MSS SP-58, Types 1 through 58, factory-fabricated components.

2. Galvanized Metallic Coatings: Pregalvanized or hot dipped.

3. Nonmetallic Coatings: Plastic coating, jacket, or liner.

4. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion to support bearing surface of piping.

5. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel.

B. Copper Pipe Hangers:

1. Description: MSS SP-58, Types 1 through 58, copper-coated-steel, factory-fabricated components.

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

2.02 TRAPEZE PIPE HANGERS

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

2.03 METAL FRAMING SYSTEMS

A. MFMA Manufacturer Metal Framing Systems:

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

a. Allied Tube & Conduit.

b. Cooper B-Line, Inc.

c. Flex-Strut Inc.

d. GS Metals Corp.

e. Thomas & Betts Corporation.

f. Unistrut Corporation; Tyco International, Ltd.

g. Wesanco, Inc.

2. Description: Shop- or field-fabricated pipe-support assembly for supporting multiple parallel pipes.

3. Standard: MFMA-4.

4. Channels: Continuous slotted steel channel with inturned lips.

5. Channel Nuts: Formed or stamped steel nuts or other devices designed to fit into channel slot and, when tightened, prevent slipping along channel.

6. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel.

7. Paint Coating: Alkyd.

B. Non-MFMA Manufacturer Metal Framing Systems:

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

    a. Anvil International; a subsidiary of Mueller Water Products Inc.

    b. Empire Industries, Inc.

    c. ERICO International Corporation.

    d. Haydon Corporation; H-Strut Division.

    e. NIBCO INC.

    f. PHD Manufacturing, Inc.

    g. PHS Industries, Inc.

2. Description: Shop- or field-fabricated pipe-support assembly made of steel channels, accessories, fittings, and other components for supporting multiple parallel pipes.

3. Standard: Comply with MFMA-4.

4. Channels: Continuous slotted steel channel with inturned lips.

5. Channel Nuts: Formed or stamped steel nuts or other devices designed to fit into channel slot and, when tightened, prevent slipping along channel.

6. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel.

7. Coating: Paint.

2.04 THERMAL-HANGER SHIELD INSERTS

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

1. Carpenter & Paterson, Inc.

2. Clement Support Services.

3. ERICO International Corporation.

4. National Pipe Hanger Corporation.

5. PHS Industries, Inc.

6. Pipe Shields, Inc.; a subsidiary of Piping Technology & Products, Inc.

7. Piping Technology & Products, Inc.

8. Rilco Manufacturing Co., Inc.

9. Value Engineered Products, Inc.

B. Insulation-Insert Material for Cold Piping: ASTM C 552, Type II cellular glass with 100-psig or ASTM C 591, Type VI, Grade 1 polyisocyanurate with 125-psig (862-kPa)] minimum compressive strength and vapor barrier.

C. Insulation-Insert Material for Hot Piping: Water-repellent treated, ASTM C 533, Type I calcium silicate with 100-psig minimum compressive strength.

D. For Trapeze or Clamped Systems: Insert and shield shall cover entire circumference of pipe.

E. For Clevis or Band Hangers: Insert and shield shall cover lower 180 degrees of pipe.

F. Insert Length: Extend 2 inches beyond sheet metal shield for piping operating below ambient air temperature.

2.05 FASTENER SYSTEMS

A. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

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

2.06 EQUIPMENT SUPPORTS

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

2.07 MISCELLANEOUS MATERIALS

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

B. Grout: ASTM C 1107, factory-mixed and -packaged, dry, hydraulic-cement, nonshrink and nonmetallic grout; suitable for interior and exterior applications.

1. Properties: Nonstaining, noncorrosive, and nongaseous.

2. Design Mix: 5000-psi, 28-day compressive strength.

PART 3 - EXECUTION

3.01 HANGER AND SUPPORT INSTALLATION

A. Metal Pipe-Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Install hangers, supports, clamps, and attachments as required to properly support piping from the building structure.

B. Metal Trapeze Pipe-Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Arrange for grouping of parallel runs of horizontal piping, and support together on field-fabricated trapeze pipe hangers.

1. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size or install intermediate supports for smaller diameter pipes as specified for individual pipe hangers.

2. Field fabricate from ASTM A 36, carbon-steel shapes selected for loads being supported. Weld steel according to AWS D1.1.

C. Metal Framing System Installation: Arrange for grouping of parallel runs of piping, and support together on field-assembled metal framing systems.

D. Thermal-Hanger Shield Installation: Install in pipe hanger or shield for insulated piping.

E. Fastener System Installation:

1. Install powder-actuated fasteners for use in lightweight concrete or concrete slabs less than 4 inches thick in concrete after concrete is placed and completely cured. Use operators that are licensed by powder-actuated tool manufacturer. Install fasteners according to powder-actuated tool manufacturer's operating manual.

2. Install mechanical-expansion anchors in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.

F. Install hangers and supports complete with necessary attachments, inserts, bolts, rods, nuts, washers, and other accessories.

G. Equipment Support Installation: Fabricate from welded-structural-steel shapes.

H. Install hangers and supports to allow controlled thermal and seismic movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.

I. Install lateral bracing with pipe hangers and supports to prevent swaying.

J. Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads, including valves, flanges, and strainers, NPS 2-1/2 and larger and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten inserts to forms and install reinforcing bars through openings at top of inserts.

K. Load Distribution: Install hangers and supports so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.

L. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and to not exceed maximum pipe deflections allowed by ASME B31.9 for building services piping.

M. Insulated Piping:

1. Attach clamps and spacers to piping.

a. Piping Operating above Ambient Air Temperature: Clamp may project through insulation.

b. Piping Operating below Ambient Air Temperature: Use thermal-hanger shield insert with clamp sized to match OD of insert.

c. Do not exceed pipe stress limits allowed by ASME B31.9 for building services piping.

2. Install MSS SP-58, Type 39, protection saddles if insulation without vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation.

a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.

3. Install MSS SP-58, Type 40, protective shields on cold piping with vapor barrier. Shields shall span an arc of 180 degrees.

a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.

4. Shield Dimensions for Pipe: Not less than the following:

a. NPS 1/4 to NPS 3-1/2: 12 inches long and 0.048 inch thick.

b. NPS 4: 12 inches long and 0.06 inch thick.

c. NPS 5 and NPS 6: 18 inches long and 0.06 inch thick.

d. NPS 8 to NPS 14: 24 inches long and 0.075 inch thick.

5. Insulated Pipes NPS 2 1/2 inches and Larger: Include reinforced calcium-silicate-insulation inserts of length at least as long as protective shield.

6. Thermal-Hanger Shields: Install with insulation same thickness as piping insulation.

3.02 EQUIPMENT SUPPORTS

A. Fabricate structural-steel stands to suspend equipment from structure overhead or to support equipment above floor.

B. Grouting: Place grout under supports for equipment and make bearing surface smooth.

C. Provide lateral bracing, to prevent swaying, for equipment supports.

3.03 METAL FABRICATIONS

A. Cut, drill, and fit miscellaneous metal fabrications for trapeze pipe hangers and equipment supports.

B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.

C. Field Welding: Comply with AWS D1.1 procedures for shielded, metal arc welding; appearance and quality of welds; and methods used in correcting welding work; and with the following:

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.

2. Obtain fusion without undercut or overlap.

3. Remove welding flux immediately.

4. Finish welds at exposed connections so no roughness shows after finishing and so contours of welded surfaces match adjacent contours.

3.04 ADJUSTING

A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.

B. Trim excess length of continuous-thread hanger and support rods to 1-1/2 inches.

3.05 PAINTING

A. Touchup: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.

1. Apply paint by brush or spray to provide a minimum dry film thickness of 2.0 mils.

B. Touchup: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal are specified in Division 09 painting Sections**.**

C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

3.06 HANGER AND SUPPORT SCHEDULE

A. Specific hanger and support requirements are in Sections specifying piping systems and equipment.

B. Comply with MSS SP-69 for pipe-hanger selections and applications that are not specified in piping system Sections.

C. Use hangers and supports with galvanized metallic coatings for piping and equipment that will not have field-applied finish.

D. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.

E. Use carbon-steel pipe hangers and supports, metal trapeze pipe hangers and metal framing systems and attachments for general service applications.

F. Use copper-plated pipe hangers and copper or stainless-steel attachments for copper piping and tubing.

G. Use thermal-hanger shield inserts for insulated piping and tubing.

H. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Adjustable, Steel Clevis Hangers (MSS Type 1): For suspension of noninsulated or insulated, stationary pipes NPS 1/2 to NPS 30.

2. Yoke-Type Pipe Clamps (MSS Type 2): For suspension of up to 1050 deg F, pipes NPS 4 to NPS 24, requiring up to 4 inches of insulation.

3. Carbon- or Alloy-Steel, Double-Bolt Pipe Clamps (MSS Type 3): For suspension of pipes NPS 3/4 to NPS 36, requiring clamp flexibility and up to 4 inches of insulation.

4. Steel Pipe Clamps (MSS Type 4): For suspension of cold and hot pipes NPS 1/2 to NPS 24 if little or no insulation is required.

5. Pipe Hangers (MSS Type 5): For suspension of pipes NPS 1/2 to NPS 4, to allow off-center closure for hanger installation before pipe erection.

6. Adjustable, Swivel Split- or Solid-Ring Hangers (MSS Type 6): For suspension of noninsulated, stationary pipes NPS 3/4 to NPS 8.

7. Adjustable, Steel Band Hangers (MSS Type 7): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.

8. Adjustable Band Hangers (MSS Type 9): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.

9. Adjustable, Swivel-Ring Band Hangers (MSS Type 10): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.

10. Split Pipe Ring with or without Turnbuckle Hangers (MSS Type 11): For suspension of noninsulated, stationary pipes NPS 3/8 to NPS 8.

11. Extension Hinged or Two-Bolt Split Pipe Clamps (MSS Type 12): For suspension of noninsulated, stationary pipes NPS 3/8 to NPS 3.

12. U-Bolts (MSS Type 24): For support of heavy pipes NPS 1/2 to NPS 30.

13. Clips (MSS Type 26): For support of insulated pipes not subject to expansion or contraction.

14. Pipe Saddle Supports (MSS Type 36): For support of pipes NPS 4 to NPS 36, with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate.

15. Pipe Stanchion Saddles (MSS Type 37): For support of pipes NPS 4 to NPS 36, with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate, and with U-bolt to retain pipe.

16. Adjustable Pipe Saddle Supports (MSS Type 38): For stanchion-type support for pipes NPS 2-1/2 to NPS 36 if vertical adjustment is required, with steel-pipe base stanchion support and cast-iron floor flange.

I. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers NPS 3/4 to NPS 24.

2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers NPS 3/4 to NPS 24 if longer ends are required for riser clamps.

J. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Steel Turnbuckles (MSS Type 13): For adjustment up to 6 inches for heavy loads.

2. Steel Clevises (MSS Type 14): For 120 to 450 deg F piping installations.

3. Swivel Turnbuckles (MSS Type 15): For use with MSS Type 11, split pipe rings.

4. Malleable-Iron Sockets (MSS Type 16): For attaching hanger rods to various types of building attachments.

5. Steel Weldless Eye Nuts (MSS Type 17): For 120 to 450 deg F piping installations.

K. Building Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Steel or Malleable Concrete Inserts (MSS Type 18): For upper attachment to suspend pipe hangers from concrete ceiling.

2. Top-Beam C-Clamps (MSS Type 19): For use under roof installations with bar-joist construction, to attach to top flange of structural shape.

3. Side-Beam or Channel Clamps (MSS Type 20): For attaching to bottom flange of beams, channels, or angles.

4. Center-Beam Clamps (MSS Type 21): For attaching to center of bottom flange of beams.

5. Welded Beam Attachments (MSS Type 22): For attaching to bottom of beams if loads are considerable and rod sizes are large.

6. C-Clamps (MSS Type 23): For structural shapes.

7. Top-Beam Clamps (MSS Type 25): For top of beams if hanger rod is required tangent to flange edge.

8. Side-Beam Clamps (MSS Type 27): For bottom of steel I-beams.

9. Steel-Beam Clamps with Eye Nuts (MSS Type 28): For attaching to bottom of steel I-beams for heavy loads.

10. Linked-Steel Clamps with Eye Nuts (MSS Type 29): For attaching to bottom of steel I-beams for heavy loads, with link extensions.

11. Malleable-Beam Clamps with Extension Pieces (MSS Type 30): For attaching to structural steel.

12. Welded-Steel Brackets: For support of pipes from below or for suspending from above by using clip and rod. Use one of the following for indicated loads:

    a. Light (MSS Type 31): 750 lb.

    b. Medium (MSS Type 32): 1500 lb.

    c. Heavy (MSS Type 33): 3000 lb.

13. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.

14. Plate Lugs (MSS Type 57): For attaching to steel beams if flexibility at beam is required.

15. Horizontal Travelers (MSS Type 58): For supporting piping systems subject to linear horizontal movement where headroom is limited.

L. Saddles and Shields: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Steel-Pipe-Covering Protection Saddles (MSS Type 39): To fill interior voids with insulation that matches adjoining insulation.

2. Protection Shields (MSS Type 40): Of length recommended in writing by manufacturer to prevent crushing insulation.

3. Thermal-Hanger Shield Inserts: For supporting insulated pipe.

M. Comply with MSS SP-69 for trapeze pipe-hanger selections and applications that are not specified in piping system Sections.

N. Comply with MFMA-103 for metal framing system selections and applications that are not specified in piping system Sections.

O. Use powder-actuated fasteners or mechanical-expansion anchors instead of building attachments where required in concrete construction.

END OF SECTION

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SECTION 220553
PAINTING AND IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. Section Includes:

1. Prepare and paint Division 22 equipment, accessories, piping and miscellaneous materials located in Equipment Rooms, Boiler Rooms and other utility areas housing Plumbing equipment and materials.

2. Identification of piping in exposed and accessible locations.

3. Marking and designation of equipment.

B. Not Included in Section:

1. Painting of piping or equipment exposed in finished areas other than those listed under “Section Includes” above.

C. Related Sections:

1. Section 22 04 00 – General Requirements for Plumbing

2. Section 22 05 23 – General – Duty Valves for Plumbing Piping

3. Section 22 05 29 – Hangers and Supports for Plumbing Piping and Equipment

4. Section 22 07 00 – Plumbing Insulation

5. Section 22 11 16 – Domestic Water Piping

6. Section 22 11 19 – Domestic Water Piping Specialties

7. Section 22 16 13 – Facility Natural – Gas Piping

8. Section 22 34 00 – Fuel-Fired, Domestic – Water Heaters

9. Division 26 – Electrical

1.03 SUBMITTALS

A. For each type of Product indicated [S]. Comply with requirements in Division 01 and Section 22 04 00 “General Requirements for Plumbing.

1.04 REFERENCED STANDARDS

A. General: The following standards or codes (latest edition) form a part of this specification to the extent indicated by the reference thereto.

B. American National Standards Institute (ANSI):

ANSI A13.1	Scheme for Identification of Piping Systems

C. American Society for Testing and Materials (ASTM):

ASTM E 84	Standard Test Method for Surface Burning Characteristics of Building Materials
ASTM C 411	Standard Test Method for Hot-Surface Performance of High-Temperature Thermal Insulation

D. National Fire Protection Association (NFPA):

Standard 255	Method of Test of Surface Burning Characteristics of Building Materials

E. Underwriters Laboratories, Inc. (UL)

Standard 723	Tests for Surface Burning Characteristics of Building Materials

F. California Department of Health Services

Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Except as otherwise specified, materials shall be the products of the following manufacturers:

1. Sherwin-Williams
2. Pratt and Lambert
3. Pittsburg Paints (PPG)
4. Benjamin Moore
5. Porter Paints
6. Seton Identification Products

2.02 MATERIALS

A. Deliver all paints and materials to the project site in their unopened original containers with all labels intact and legible at the time of use.

B. For adhesives and sealants applied within the building waterproofing envelope, comply with low emitting requirements in Division 01 section ”Indoor Air Quality Requirements.”

C. All coatings exposed to supply and return airstreams and where applied to exposed surfaces in a return air plenum, shall have a composite flame spread rating not exceeding 25, and a smoke developed rating not exceeding 50 as tested under procedure ASTM E-84-75, NFPA 255 and

UL 723. Coatings shall not flame, glow, smolder or smoke when tested in accordance with ASTM C411, latest edition.

D. Sherwin-Williams Industrial Maintenance Coatings System 4000 products are listed below to establish color and a standard of quality.

1. All Hangers and Supports: One coat Pro-Industrial Zero VOC Acrylic Gloss Black.

2. All major items of equipment and equipment supports including pumps, tanks and all other similar items shall be painted as follows:

a. Uninsulated hot surfaces on equipment, operating at or above 150°F, shall be painted with two coats of No. B59S8 Heat Resistant Aluminum.

b. Other unfinished equipment surfaces of aluminum, iron and steel shall be primed with one coat of Pro-Cryl Primer (1000g/L). Galvanized surfaces shall be chemically prepared and primed with one coat of Galvite B50W3 Primer. Field insulated surfaces shall be primed with No. B28W200 Wall Primer. Where equipment is furnished with factory finish coat, only touch up to match finish is required at any damaged areas. Finish all equipment with two coats of Pro–Industrial Zero VOC Acrylic Gloss, No. SW4063 Robotic Blue. Exterior of belt guards and other protective guards shall be finished with two coats of Pro–Industrial Zero VOC Acrylic Gloss, No. SW4084 safety yellow color. Interior of and all items covered by belt guards and other protective guards shall be finished with two coats of No. SW4083 safety orange color.

c. Nameplates and Testing Agency Labels on equipment or machinery shall not be painted.

3. Piping: Exposed in equipment rooms and where connections are made to equipment located in storage rooms and other utility type areas.

a. Priming:

(1) Insulation Canvas or Paper Jacket: One coat Pro-Cryl Primer (1000g/L).

(2) Insulation Aluminum Jacket: One coat Pro-Cryl Primer (1000g/L).

(3) Bare Iron or Steel or Copper: One coat Pro-Cryl Primer (1000g/L).

(4) Galvanized Steel: Pipes shall be chemically prepared and primed with one coat of Pro-Cryl B66-310 Primer.

(5) Asphalt Coated Pipe: One coat No. B28W200 Wall Primer.

b. Finish: All pipe lines and the supports or hangers therefore, shall be finished with Pro–Industrial Zero VOC Acrylic Gloss gray No. SW4028 Gypsum applied in sufficient number of coats to effectively cover the prime coat. Painting of pipe hangers is specified hereinbefore.

c. Exposed gas piping shall be primed and painted with two (2) coats of Series 54 Alkyd Gloss Enamel, No. SW4084 Safety Yellow Color, the full circumference of the pipe and painted stencil identification with flow arrows and pressure used.

d. Materials shall be as recommended by the manufacturer for the surface to be finished.

e. Unless otherwise specified, primer shall be by the same manufacturer as the finish coat.

f. Materials shall not be thinned or cut except as recommended by the coating manufacturer. Thinners shall be by the same manufacturer as the primer and finish coat.

E. Valve tags shall be neat circular brass with designations stamped thereon, attached with solid brass jack chain to each valve stem or handle.

F. Each item of equipment such as pumps, water heaters, tempering valves and equipment control devices such as motor starters, disconnect switches, etc. shall be properly marked with laminated engraved plastic nameplates fastened with sheet metal screws, bolts, rivets or permanent adhesive. Pressure sensitive tape is not acceptable.

G. All piping, insulated and un-insulated, shall be identified with Seton Ultra-Mark or equal wrap around piping system markers and arrow flow directional marker. Markers shall be pre-coiled, semi-rigid plastic or polyester with sealed color graphics. Markers shall be minimum 12 inches long with 1-¼ inch high letters, formed to cover entire circumference of the pipe. Markers shall be attached to piping using plastic tie wraps. Pipe identification shall use the same designations or abbreviations used on the drawings. Marker colors shall be in accordance with ANSI.

H. For field applications within the weatherproofing system, all paints, adhesives and sealants shall comply with the requirements of the California Health Services Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers.

PART 3 - EXECUTION

3.01 WORKMANSHIP

A. The work shall be accomplished by qualified mechanics skilled in the painting trade. Painting of equipment, piping, ductwork and other materials shall not commence until all testing is complete and systems are ready for operation. Materials shall be applied according to manufacturer's directions. All containers shall be securely closed when not in use. Flammable materials shall not be stored on premises. Flammable waste shall be disposed of daily in devices approved for such purposes. Materials shall be evenly spread, and smoothly flowed on without runs or sags. Each coat shall be thoroughly dry before application of succeeding coats.

3.02 PROTECTION OF WORK

A. The painters shall protect all adjacent surfaces with drop covers during the process of painting. Upon completion, paint spots, if any, shall be removed from all surfaces.

3.03 PREPARATION OF SURFACE

A. Surfaces to be painted shall be completely dry before applying paint. Metal surfaces shall be cleaned with mineral spirits before applying materials. Rust and scale shall be removed by wire brushing or sanding. Galvanized surfaces shall be chemically pretreated with crystalline (zinc phosphate) phosphate in strict accordance with the manufacturer's recommendations. Surfaces shall not be painted when the temperature is, or is likely to be, near the freezing point, or when they are exposed to hot sun.

3.04 IDENTIFICATION OF PIPES AND EQUIPMENT

A. Equipment: After all other painting is completed; each major item of equipment shall be properly identified with nameplates. Identification symbols and designations shall be the same as shown on the Contract Documents. Where equipment is installed above lay-in ceilings the plastic nameplate shall be adhered to the face of the T-bar support so that it can be identified from within the space.

B. Apply piping system markers after completion of required insulation and finishes on piping systems. Exposed gas piping shall be primed and painted with two (2) coats of Series 54 Alkyd Gloss Enamel, No. SW4084 Safety Yellow Color, the full circumference of the pipe and painted stencil identification with flow arrows and pressure used. For other piping, markers shall be applied in the following locations and where identified by the Engineer:

1. At each valve and at connection to equipment.

2. At every tee and branch connection.

3. At each riser including branch risers from mains.

4. At each side of a pipe passage through floors, walls and partitions.

5. Every 15 feet on straight runs of piping mains and branches.

6. Within 6 feet of elbows (each side).

7. At access doors or similar points that permit view of concealed piping.

8. Markers shall be provided on all piping above lay-in ceilings.

9. Provide arrow markers showing direction of flow incorporated into, or adjacent to, each piping system marker.

10. Apply all piping system markers where view is unobstructed, and legends can be read and easily identified.

11. Apply all tags and piping system markers in accordance with the supplier’s instructions.

END OF SECTION

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SECTION 220700
PLUMBING INSULATION

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. Section Includes:

1. Insulation Materials:

a. Calcium silicate.

b. Mineral fiber.

c. Polyolefin.

2. Insulating cements.

3. Adhesives.

4. Sealants.

5. Factory-applied jackets.

6. Tapes.

7. Securements.

8. Corner angles.

B. Related Sections:

1. Section 22 04 00 – General Requirements for Plumbing

2. Section 22 05 23 – General – Duty Valves for Plumbing Piping

3. Section 22 05 29 – Hangers and Supports for Plumbing Piping and Equipment

4. Section 22 05 53 – Painting and Identification for Plumbing Piping and Equipment

5. Section 22 11 16 – Domestic Water Piping

6. Section 22 11 19 – Domestic Water Piping Specialties

7. Section 22 11 23 – Domestic Water Pumps

8. Section 22 34 00 – Fuel–Fired, Domestic – Water Heaters

9. Division 26 – Electrical

1.03 DEFINITIONS

A. Runout: Last section of pipe from branch or main to fixtures or equipment.

1.04 SUBMITTALS

A. Product Data: For each type of product indicated [S]. Include thermal conductivity, thickness, and jackets (both factory and field applied, if any). Comply with requirements in Division 01 and Section 22 04 00 “General Requirements for Plumbing”.

B. Shop Drawings:

1. Detail application of protective shields, saddles, and inserts at hangers for each type of insulation and hanger.

2. Detail attachment and covering of heat tracing inside insulation.

3. Detail insulation application at pipe expansion joints for each type of insulation.

4. Detail insulation application at elbows, fittings, flanges, valves, and specialties for each type of insulation.

5. Detail removable insulation at piping specialties, equipment connections, and access panels.

6. Detail application at linkages of control devices.

7. Detail field application for each equipment type.

C. Qualification Data: For qualified Installer.

D. Material Test Reports: From a qualified testing agency acceptable to authorities having jurisdiction indicating, interpreting, and certifying test results for compliance of insulation materials, sealers, attachments, cements, and jackets, with requirements indicated. Include dates of tests and test methods employed.

E. Field quality-control reports.

1.05 QUALITY ASSURANCE

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

B. Fire-Test-Response Characteristics: Insulation and related materials shall have fire-test-response characteristics indicated, as determined by testing identical products per ASTM E 84, by a testing and inspecting agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing and inspecting agency.

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

2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.

1.06 DELIVERY, STORAGE, AND HANDLING

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

1.07 COORDINATION

A. Coordinate size and location of supports, hangers, and insulation shields specified in Section 22 05 29 “Hangers and Supports for Plumbing Piping and Equipment."

B. Coordinate clearance requirements with piping Installer for piping insulation application and equipment Installer for equipment insulation application. Before preparing piping Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.

C. Coordinate installation and testing of heat tracing.

1.08 SCHEDULING

A. Schedule insulation application after pressure testing systems and, where required, after installing and testing heat tracing. Insulation application may begin on segments that have satisfactory test results.

B. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.

PART 2 - PRODUCTS

2.01 INSULATION MATERIALS [S]

A. Comply with requirements in Part 3 schedule articles for where insulating materials shall be applied.

B. Products shall not contain asbestos, lead, mercury, or mercury compounds.

C. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871.

D. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.

E. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.

F. Calcium Silicate:

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

a. Industrial Insulation Group (The); Thermo-12 Gold.

2. Preformed Pipe Sections: Flat-, curved-, and grooved-block sections of noncombustible, inorganic, hydrous calcium silicate with a non-asbestos fibrous reinforcement. Comply with ASTM C 533, Type I.

3. Flat-, curved-, and grooved-block sections of noncombustible, inorganic, hydrous calcium silicate with a non-asbestos fibrous reinforcement. Comply with ASTM C 533, Type I.

4. Prefabricated Fitting Covers: Comply with ASTM C 450 and ASTM C 585 for dimensions used in preforming insulation to cover valves, elbows, tees, and flanges.

G. Mineral-Fiber, Preformed Pipe Insulation:

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

a. Fibrex Insulations Inc.; Coreplus 1200.

b. Johns Manville; Micro-Lok.

c. Knauf Insulation; 1000(Pipe Insulation.

d. Manson Insulation Inc.; Alley-K.

e. Owens Corning; Fiberglas Pipe Insulation.

2. Type I, 850 deg F Materials: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 547, Type I, Grade A, with factory-applied ASJ. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

H. Polyolefin: Unicellular, polyethylene thermal plastic insulation. Comply with ASTM C 534 or ASTM C 1427, Type I, Grade 1 for tubular materials and Type II, Grade 1 for sheet materials.

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

a. Armacell LLC; Tubolit.

b. Nomaco Inc.; IMCOLOCK, IMCOSHEET, NOMALOCK, and NOMAPLY.

c. RBX Corporation; Therma-cell.

2.02 ADHESIVES

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

2.03 SEALANTS

A. Joint Sealants: Provide sealants either manufactured or recommended by the insulation material manufacturer.

2.04 FACTORY-APPLIED JACKETS [S]

A. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:

1. ASJ: White, kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C 1136, Type I.

2.05 TAPES

A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136.

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

a. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0835.

b. Compac Corp.; 104 and 105.

c. Ideal Tape Co., Inc., an American Biltrite Company; 428 AWF ASJ.

d. Venture Tape; 1540 CW Plus, 1542 CW Plus, and 1542 CW Plus/SQ.

2. Width: 3 inches.

3. Thickness: 11.5 mils.

4. Adhesion: 90 ounces force/inch in width.

5. Elongation: 2 percent.

6. Tensile Strength: 40 lbf/inch in width.

7. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.

2.06 SECUREMENTS

A. Bands:

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

a. Childers Products; Bands.

b. PABCO Metals Corporation; Bands.

c. RPR Products, Inc.; Bands.

2. Stainless Steel: ASTM A 167 or ASTM A 240/A 240M, Type 304 or Type 316; 0.015 inch thick, 1/2 inch or 3/4 inch wide with wing or closed seal.

3. Springs: Twin spring set constructed of stainless steel with ends flat and slotted to accept metal bands. Spring size determined by manufacturer for application.

B. Staples: Outward-clinching insulation staples, nominal 3/4-inch- wide, stainless steel or Monel.

2.07 CORNER ANGLES

A. PVC Corner Angles: 30 mils thick, minimum 1 by 1 inch, PVC according to ASTM D 1784, Class 16354-C. White or color-coded to match adjacent surface.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine substrates and conditions for compliance with requirements for installation and other conditions affecting performance of insulation application.

1. Verify that systems and equipment to be insulated have been tested and are free of defects.

2. Verify that surfaces to be insulated are clean and dry.

3. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.

3.03 GENERAL INSTALLATION REQUIREMENTS

A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of equipment and piping including fittings, valves, and specialties.

B. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.

C. Install insulation with longitudinal seams at top and bottom of horizontal runs.

D. Install multiple layers of insulation with longitudinal and end seams staggered.

E. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.

F. Keep insulation materials dry during application and finishing.

G. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.

H. Install insulation with least number of joints practical.

I. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.

1. Install insulation continuously through hangers and around anchor attachments.

2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.

3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.

4. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.

J. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.

K. Install insulation with factory-applied jackets as follows:

1. Draw jacket tight and smooth.

2. Cover circumferential joints with 3-inch- wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches o.c.

3. Overlap jacket longitudinal seams at least 1-1/2 inches. Install insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 2 inches o.c.

a. For below ambient services, apply vapor-barrier mastic over staples.

4. Cover joints and seams with tape as recommended by insulation material manufacturer to maintain vapor seal.

5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to pipe flanges and fittings.

L. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.

M. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.

N. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.

O. For above ambient services, do not install insulation to the following:

1. Testing agency labels and stamps.

2. Nameplates and data plates.

3.04 PENETRATIONS

A. Insulation Installation at Roof Penetrations: Install insulation continuously through roof penetrations.

1. Seal penetrations with flashing sealant.

2. For applications requiring only indoor insulation, terminate insulation above roof surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.

3. Extend jacket of outdoor insulation outside roof flashing at least 2 inches below top of roof flashing.

4. Seal jacket to roof flashing with flashing sealant.

B. Insulation Installation at Aboveground Exterior Wall Penetrations: Install insulation continuously through wall penetrations.

1. For applications requiring only indoor insulation, terminate insulation inside wall surface and seal with joint sealant.

C. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.

D. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Install insulation continuously through penetrations of fire-rated walls and partitions.

1. Comply with requirements in Division 07 Section "Penetration Firestopping" for firestopping and fire-resistive joint sealers.

E. Insulation Installation at Floor Penetrations:

1. Pipe: Install insulation continuously through floor penetrations.

2. Seal penetrations through fire-rated assemblies. Comply with requirements in Division 07 Section "Penetration Firestopping."

3.05 GENERAL PIPE INSULATION INSTALLATION

A. Requirements in this article generally apply to all insulation materials except where more specific requirements are specified in various pipe insulation material installation articles.

B. Insulation Installation on Fittings, Valves, Strainers, Flanges, and Unions:

1. Install insulation over fittings, valves, strainers, flanges, unions, and other specialties with continuous thermal and vapor-retarder integrity, unless otherwise indicated.

2. Insulate pipe elbows using preformed fitting insulation or mitered fittings made from same material and density as adjacent pipe insulation. Each piece shall be butted tightly against adjoining piece and bonded with adhesive. Fill joints, seams, voids, and irregular surfaces with insulating cement finished to a smooth, hard, and uniform contour that is uniform with adjoining pipe insulation.

3. Insulate tee fittings with preformed fitting insulation or sectional pipe insulation of same material and thickness as used for adjacent pipe. Cut sectional pipe insulation to fit. Butt each section closely to the next and hold in place with tie wire. Bond pieces with adhesive.

4. Insulate valves using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. For valves, insulate up to and including the bonnets, valve stuffing-box studs, bolts, and nuts. Fill joints, seams, and irregular surfaces with insulating cement.

5. Insulate strainers using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Fill joints, seams, and irregular surfaces with insulating cement.

Insulate strainers so strainer basket flange or plug can be easily removed and replaced without damaging the insulation and jacket. Provide a removable reusable insulation cover. For below ambient services, provide a design that maintains vapor barrier.

6. Insulate flanges and unions using a section of oversized preformed pipe insulation. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker.

7. Cover segmented insulated surfaces with a layer of finishing cement and coat with a mastic. Install vapor-barrier mastic for below ambient services and a breather mastic for above ambient services. Reinforce the mastic with fabric-reinforcing mesh. Trowel the mastic to a smooth and well-shaped contour.

8. For services not specified to receive a field-applied jacket except for flexible elastomeric and polyolefin, install fitted PVC cover over elbows, tees, strainers, valves, flanges, and unions. Terminate ends with PVC end caps. Tape PVC covers to adjoining insulation facing using PVC tape.

9. Stencil or label the outside insulation jacket of each union with the word "UNION." Match size and color of pipe labels.

C. Insulate instrument connections for thermometers, pressure gages, pressure temperature taps, test connections, flow meters, sensors, switches, and transmitters on insulated pipes, vessels, and equipment. Shape insulation at these connections by tapering it to and around the connection with insulating cement and finish with finishing cement, mastic, and flashing sealant.

D. Install removable insulation covers at locations indicated. Installation shall conform to the following:

1. Make removable flange and union insulation from sectional pipe insulation of same thickness as that on adjoining pipe. Install same insulation jacket as adjoining pipe insulation.

2. When flange and union covers are made from sectional pipe insulation, extend insulation from flanges or union long at least two times the insulation thickness over adjacent pipe insulation on each side of flange or union. Secure flange cover in place with stainless-steel or aluminum bands. Select band material compatible with insulation and jacket.

3. Construct removable valve insulation covers in same manner as for flanges except divide the two-part section on the vertical center line of valve body.

4. When covers are made from block insulation, make two halves, each consisting of mitered blocks wired to stainless-steel fabric. Secure this wire frame, with its attached insulation, to flanges with tie wire. Extend insulation at least 2 inches over adjacent pipe insulation on each side of valve. Fill space between flange or union cover and pipe insulation with insulating cement. Finish cover assembly with insulating cement applied in two coats. After first coat is dry, apply and trowel second coat to a smooth finish.

5. Unless a PVC jacket is indicated in field-applied jacket schedules, finish exposed surfaces with a metal jacket.

3.06 CALCIUM SILICATE INSULATION INSTALLATION

A. Insulation Installation on Straight Pipes and Tubes:

1. Secure single-layer insulation with stainless-steel bands at 12-inch intervals and tighten bands without deforming insulation materials.

2. Install 2-layer insulation with joints tightly butted and staggered at least 3 inches. Secure inner layer with wire spaced at 12-inch intervals. Secure outer layer with stainless-steel bands at 12-inch intervals.

3. Apply a skim coat of mineral-fiber, hydraulic-setting cement to insulation surface. When cement is dry, apply flood coat of lagging adhesive and press on one layer of glass cloth or tape. Overlap edges at least 1 inch. Apply finish coat of lagging adhesive over glass cloth or tape. Thin finish coat to achieve smooth, uniform finish.

3.07 MINERAL-FIBER INSULATION INSTALLATION

A. Insulation Installation on Straight Pipes and Tubes:

1. Secure each layer of preformed pipe insulation to pipe with wire or bands and tighten bands without deforming insulation materials.

2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.

3. For insulation with factory-applied jackets on above ambient surfaces, secure laps with outward clinched staples at 6 inches o.c.

4. For insulation with factory-applied jackets on below ambient surfaces, do not staple longitudinal tabs but secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant.

B. Insulation Installation on Pipe Flanges:

1. Install preformed pipe insulation to outer diameter of pipe flange.

2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.

3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with mineral-fiber blanket insulation.

4. Install jacket material with manufacturer's recommended adhesive, overlap seams at least 1 inch, and seal joints with flashing sealant.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install preformed sections of same material as straight segments of pipe insulation when available.

2. When preformed insulation elbows and fittings are not available, install mitered sections of pipe insulation, to a thickness equal to adjoining pipe insulation. Secure insulation materials with wire or bands.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed sections of same material as straight segments of pipe insulation when available.

2. When preformed sections are not available, install mitered sections of pipe insulation to valve body.

3. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.

4. Install insulation to flanges as specified for flange insulation application.

3.08 POLYOLEFIN INSULATION INSTALLATION

A. Insulation Installation on Straight Pipes and Tubes:

1. Seal split-tube longitudinal seams and end joints with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

B. Insulation Installation on Pipe Flanges:

1. Install pipe insulation to outer diameter of pipe flange.

2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.

3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of polyolefin sheet insulation of same thickness as pipe insulation.

4. Secure insulation to flanges and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install mitered sections of polyolefin pipe insulation.

2. Secure insulation materials and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install cut sections of polyolefin pipe and sheet insulation to valve body.

2. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.

3. Install insulation to flanges as specified for flange insulation application.

4. Secure insulation to valves and specialties, and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

3.09 FINISHES

A. Equipment and Pipe Insulation with ASJ, Glass-Cloth, or Other Paintable Jacket Material: Paint jacket with paint system identified below and as specified in Section 22 05 53 “Painting and Identification for Plumbing Piping and Equipment”.

B. Do not field paint aluminum or stainless-steel jackets.

3.10 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Perform tests and inspections.

C. Tests and Inspections:

1. Inspect field-insulated equipment, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to one location(s) for each type of equipment defined in the "Equipment Insulation Schedule" Article. For large equipment, remove only a portion adequate to determine compliance.

2. Inspect pipe, fittings, strainers, and valves, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to three locations of straight pipe, three locations of fittings, two locations strainers, three locations of valves for each pipe service defined in the "Piping Insulation Schedule, General" Article.

D. All insulation applications will be considered defective Work if sample inspection reveals noncompliance with requirements.

3.11 PIPING INSULATION SCHEDULE, GENERAL

A. Acceptable preformed pipe and tubular insulation materials and thicknesses are identified for each piping system and pipe size range. If more than one material is listed for a piping system, selection from materials listed is Contractor's option.

B. Items Not Insulated: Unless otherwise indicated, do not install insulation on the following:

1. Chrome-plated pipes and fittings unless there is a potential for personnel injury.

3.12 INDOOR PIPING INSULATION SCHEDULE

A. Domestic Cold Water:

1. Insulation shall be the following:

a. Calcium Silicate: 1 inch thick at pipe hangers. Calcium silicate shall be installed in preformed sections 12 inches long enclosing pipe around entire circumference.

2. NPS 2-1/2 and larger: Insulation shall be the following:

a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.

b. Polyolefin: 1 inch thick under floor slab and in walls and chases prior to Building “Dry-In”.

3. NPS 2 and smaller: Insulation shall be the following:

a. Mineral–Fiber, Preformed Pipe Insulation, Type I: 1/2 inch thick.

b. Polyolefin: 1/2 inch thick in walls and chases prior to Building “Dry In”.

B. Domestic Hot and Recirculated Hot Water:

1. Insulation shall be the following:

a. Calcium Silicate: 1-1/2 inch thick at pipe hangers. Calcium silicate shall be installed in preformed sections 12 inches long enclosing pipe around entire circumference.

2. NPS 2-1/2 and Larger: Insulation shall be the following:

a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1- 1/2 inches thick.

b. Polyolefin: 1- 1/2 inches thick in walls and chases prior to Building “Dry-In”.

3. NPS 2”and smaller: Insulation shall be the following:

a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.

b. Polyolefin: 1 inch thick in walls and chases prior to Building “Dry-In”.

END OF SECTION

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SECTION 221116
DOMESTIC WATER PIPING

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. Section Includes:

1. Above ground domestic water pipes, tubes, fittings, and specialties inside the building.

2. Specialty valves.

3. Flexible connectors.

B. Related Sections:

1. Section 03 30 00 – Cast – in Place Concrete

2. Section 22 04 00 – General Requirements for Plumbing

3. Section 22 05 23 – General – Duty Valves for Plumbing Piping

4. Section 22 05 29 – Hangers and Supports for Plumbing Piping and Equipment

5. Section 22 05 53 – Painting and Identification for Plumbing Piping and Equipment

6. Section 22 07 00 – Plumbing Insulation

7. Section 22 11 19 – Domestic Water Piping Specialties

8. Section 22 11 23 – Domestic Water Pumps

9. Section 22 34 00 – Fuel–Fired, Domestic – Water Heaters

10. Section 23 09 00 – Instrumentation and Control for HVAC

11. Division 26 – Electrical

1.03 SUBMITTALS

A. Product Data: For each type of product indicated [S]. Comply with requirements in Division 1 and Section 22 04 00 “General Requirements for Plumbing”.

B. Water Samples: Specified in "Cleaning" Article.

C. Coordination Drawings: For piping in equipment rooms and other congested areas, drawn to scale, on which the following items are coordinated with each other, using input from Installers of the items involved:

1. Fire-suppression-water piping.

2. Domestic water piping.

3. HVAC hydronic piping.

4. Electric Switchgear, Panelboards

D. Field quality-control reports.

1.04 QUALITY ASSURANCE

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

B. NSF Compliance for materials that will be in contact with potable water:

1. Comply with NSF 61, "Drinking Water System Components - Health Effects; Sections 1 through 9."

2. Comply with NSF 372, "Drinking Water System Components- Lead Content."

1.05 PROJECT CONDITIONS

A. Interruption of Existing Water Service: Do not interrupt water service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary water service according to requirements indicated:

1. Notify Owner no fewer than two days in advance of proposed interruption of water service.

PART 2 - PRODUCTS

2.01 PIPING MATERIALS

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

2.02 COPPER TUBE AND FITTINGS

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

1. Cast-Copper Solder-Joint Fittings: ASME B16.18, pressure fittings.

2. Wrought-Copper Solder-Joint Fittings: ASME B16.22, wrought-copper pressure fittings.

3. Bronze Flanges: ASME B16.24, Class 150, with solder-joint ends.

4. Copper Unions: MSS SP-123, cast-copper-alloy, hexagonal-stock body, with ball-and-socket, metal-to-metal seating surfaces, and solder-joint or threaded ends.

5. Copper Pressure-Seal-Joint Fittings:

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

1) Elkhart Products Corporation; Industrial Division.

2) NIBCO INC.

3) Viega; Plumbing and Heating Systems.

b. NPS 2 and Smaller: Wrought-copper fitting with EPDM-rubber O-ring seal in each end.

c. NPS 2-1/2 to NPS 4: Cast-bronze or wrought-copper fitting with EPDM-rubber O-ring seal in each end.

2.03 PIPING JOINING MATERIALS

A. Pipe-Flange Gasket Materials: AWWA C110, rubber, flat face, 1/8-inch thick or ASME B16.21, nonmetallic and asbestos free, unless otherwise indicated; full-face or ring type unless otherwise indicated.

B. Metal, Pipe-Flange Bolts and Nuts: ASME B18.2.1, carbon steel unless otherwise indicated.

C. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.

2.04 SPECIALTY VALVES [S]

A. Comply with requirements in Section 22 05 23"General-Duty Valves for Plumbing Piping" for general-duty metal valves.

B. Comply with requirements in Section 22 11 19 "Domestic Water Piping Specialties" for balancing valves, drain valves, backflow preventers, and vacuum breakers.

2.05 TRANSITION FITTINGS

A. General Requirements:

1. Same size as pipes to be joined.

2. Pressure rating at least equal to pipes to be joined.

3. End connections compatible with pipes to be joined.

B. Fitting-Type Transition Couplings: Manufactured piping coupling or specified piping system fitting.

C. Sleeve-Type Transition Coupling: AWWA C219.

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

a. Cascade Waterworks Manufacturing.

b. Dresser, Inc.; Dresser Piping Specialties.

c. Ford Meter Box Company, Inc. (The).

d. JCM Industries.

e. Romac Industries, Inc.

f. Smith-Blair, Inc; a Sensus company.

g. Viking Johnson; c/o Mueller Co.

2.06 DIELECTRIC FITTINGS

A. General Requirements: Assembly of copper alloy and ferrous materials or ferrous material body with separating nonconductive insulating material suitable for system fluid, pressure, and temperature.

B. Dielectric Unions:

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

a. Capitol Manufacturing Company.

b. Central Plastics Company.

c. EPCO Sales, Inc.

d. Hart Industries International, Inc.

e. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

f. Zurn Plumbing Products Group; Wilkins Water Control Products.

2. Description:

a. Pressure Rating: 150 psig at 180 deg F.

b. End Connections: Solder-joint copper alloy and threaded ferrous.

C. Dielectric Flanges:

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

a. Capitol Manufacturing Company.

b. Central Plastics Company.

c. EPCO Sales, Inc.

d. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Description:

a. Factory-fabricated, bolted, companion-flange assembly.

b. Pressure Rating: 150 psig.

c. End Connections: Solder-joint copper alloy and threaded ferrous; threaded solder-joint copper alloy and threaded ferrous.

D. Dielectric-Flange Kits:

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

    a. Advance Products & Systems, Inc.

    b. Calpico, Inc.

    c. Central Plastics Company.

    d. Pipeline Seal and Insulator, Inc.

2. Description:

    a. Nonconducting materials for field assembly of companion flanges.

    b. Pressure Rating: 150 psig.

    c. Gasket: Neoprene or phenolic.

    d. Bolt Sleeves: Phenolic or polyethylene.

    e. Washers: Phenolic with steel backing washers.

E. Dielectric Couplings:

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

    a. Calpico, Inc.

    b. Lochinvar Corporation.

2. Description:

    a. Galvanized-steel coupling.

    b. Pressure Rating: 300 psig at 225 deg F .

    c. End Connections: Female threaded.

    d. Lining: Inert and noncorrosive, thermoplastic.

F. Dielectric Nipples:

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

    a. Perfection Corporation; a subsidiary of American Meter Company.

    b. Precision Plumbing Products, Inc.

    c. Victaulic Company.

2. Description:

    a. Electroplated steel nipple complying with ASTM F 1545.

b. Pressure Rating: 300 psig at 225 deg F.

c. End Connections: Male threaded or grooved.

d. Lining: Inert and noncorrosive, propylene.

2.07 FLEXIBLE CONNECTORS

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

1. Flex-Hose Co., Inc.

2. Flexicraft Industries.

3. Flex Pression, Ltd.

4. Flex-Weld, Inc.

5. Hyspan Precision Products, Inc.

6. Mercer Rubber Co.

7. Metraflex, Inc.

8. Proco Products, Inc.

9. Tozen Corporation.

10. Unaflex, Inc.

11. Universal Metal Hose; a Hyspan company

B. Bronze-Hose Flexible Connectors: Corrugated-bronze tubing with bronze wire-braid covering and ends brazed to inner tubing.

1. Working-Pressure Rating: Minimum 200 psig.

2. End Connections NPS 2 and Smaller: Threaded copper pipe or plain-end copper tube.

3. End Connections NPS 2-1/2 and Larger: Flanged copper alloy.

PART 3 - EXECUTION

3.01 PIPING INSTALLATION

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of domestic water piping. Indicated locations and arrangements are used to size pipe and calculate friction loss, expansion, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.

B. Install copper tubing under building slab according to CDA's "Copper Tube Handbook."

C. Install shutoff valve immediately upstream of each dielectric fitting.

D. Install domestic water piping level with 0.25 percent slope downward toward drain and plumb.

E. Install piping concealed from view and protected from physical contact by building occupants unless otherwise indicated and except in equipment rooms and service areas.

F. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

G. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal and coordinate with other services occupying that space.

H. Install piping adjacent to equipment and specialties to allow service and maintenance.

I. Install piping to permit valve servicing.

J. Install nipples, unions, special fittings, and valves with pressure ratings the same as or higher than system pressure rating used in applications below unless otherwise indicated.

K. Install piping free of sags and bends.

L. Install fittings for changes in direction and branch connections.

M. Install unions in copper tubing at final connection to each piece of equipment, machine, and specialty.

N. Install thermometers at inlet of hot water circulating pump and outlet piping from each water heater. Comply with requirements in Section 22 11 19 "Domestic Water Piping Specialties" for thermometers.

O. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 22 04 00 "General Requirements for Plumbing."

P. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 22 04 00 "General Requirements for Plumbing."

3.02 JOINT CONSTRUCTION

A. Ream ends of pipes and tubes and remove burrs.

B. Remove scale, slag, dirt, and debris from inside and outside of pipes, tubes, and fittings before assembly.

C. Soldered Joints: Apply ASTM B 813, water-flushable flux to end of tube. Join copper tube and fittings according to ASTM B 828 or CDA's "Copper Tube Handbook."

D. Pressure-Sealed Joints: Join copper tube and pressure-seal fittings with tools recommended by fitting manufacturer.

E. Flanged Joints: Select appropriate asbestos-free, nonmetallic gasket material in size, type, and thickness suitable for domestic water service. Join flanges with gasket and bolts according to ASME B31.9.

F. Dissimilar-Material Piping Joints: Make joints using adapters compatible with materials of both piping systems.

3.03 VALVE INSTALLATION

A. General-Duty Valves: Comply with requirements in Section 22 05 23 "General-Duty Valves for Plumbing Piping" for valve installations.

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

C. Install drain valves for equipment at base of each water riser, at low points in horizontal piping, and where required to drain water piping. Drain valves are specified in Section 22 11 19 "Domestic Water Piping Specialties."

1. Hose-End Drain Valves: At low points in water mains, risers, and branches.

D. Install balancing valve in each hot-water circulation return branch and discharge side of each pump and circulator. Comply with requirements in Section 22 11 19 "Domestic Water Piping Specialties" for balancing valves.

3.04 TRANSITION FITTING INSTALLATION

A. Install transition couplings at joints of dissimilar piping.

B. Transition Fittings in Underground Domestic Water Piping:

1. NPS 1-1/2 and Smaller: Fitting-type coupling.

2. NPS 2 and Larger: Sleeve-type coupling.

3.05 DIELECTRIC FITTING INSTALLATION

A. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.

B. Dielectric Fittings for NPS 2 and Smaller: Use dielectric unions.

C. Dielectric Fittings for NPS 2-1/2 to NPS 4: Use dielectric flanges.

3.06 FLEXIBLE CONNECTOR INSTALLATION

A. Install bronze-hose flexible connectors in copper domestic water tubing.

3.07 HANGER AND SUPPORT INSTALLATION

A. Comply with requirements in Section 22 05 29 "Hangers and Supports for Plumbing Piping and Equipment" for pipe hanger and support products and installation.

1. Vertical Piping: MSS Type 8 or 42, clamps.

2. Individual, Straight, Horizontal Piping Runs:

a. 100 Feet and Less: MSS Type 1, adjustable, steel clevis hangers.

b. Longer Than 100 Feet: MSS Type 43, adjustable roller hangers.

c. Longer Than 100 Feet If Indicated: MSS Type 49, spring cushion rolls.

3. Multiple, Straight, Horizontal Piping Runs 100 Feet or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.

4. Base of Vertical Piping: MSS Type 52, spring hangers.

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

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

D. Install hangers for copper tubing with the following maximum horizontal spacing and minimum rod diameters:

1. NPS 3/4 and Smaller: 60 inches with 3/8-inch rod.

2. NPS 1 and NPS 1-1/4: 72 inches with 3/8-inch rod.

3. NPS 1-1/2 and NPS 2: 96 inches with 3/8-inch rod.

4. NPS 2-1/2: 108 inches with 1/2-inch rod.

5. NPS 3 to NPS 5: 10 feet with 1/2-inch rod.

E. Install supports for vertical copper tubing every 10 feet.

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

3.08 CONNECTIONS

A. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to equipment and machines to allow service and maintenance.

C. Connect domestic water piping to water-service piping with shutoff valve; extend and connect to the following:

1. Water Heaters: Cold-water inlet and hot-water outlet piping in sizes indicated, but not smaller than sizes of water heater connections.

2. Equipment: Cold- and hot-water supply piping as indicated, but not smaller than equipment connections. Provide shutoff valve and union for each connection. Use flanges instead of unions for NPS 2-1/2 and larger.

3.09 IDENTIFICATION

A. Identify system components. Comply with requirements Section 22 05 53 "Painting and Identification for Plumbing Piping and Equipment" for identification materials and installation.

3.10 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Piping Inspections:

1. Do not enclose, cover, or put piping into operation until it has been inspected and approved by authorities having jurisdiction.

2. During installation, notify authorities having jurisdiction at least one day before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction:

   a. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in and before setting fixtures.

   b. Final Inspection: Arrange final inspection for authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.

3. Reinspection: If authorities having jurisdiction find that piping will not pass tests or inspections, make required corrections and arrange for reinspection.

4. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.

C. Piping Tests:

1. Fill domestic water piping. Check components to determine that they are not air bound and that piping is full of water.

2. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit a separate report for each test, complete with diagram of portion of piping tested.

3. Leave new, altered, extended, or replaced domestic water piping uncovered and unconcealed until it has been tested and approved. Expose work that was covered or concealed before it was tested.

4. Cap and subject piping to static water pressure of 50 psig above operating pressure, without exceeding pressure rating of piping system materials. Isolate test source and allow to stand for four hours. Leaks and loss in test pressure constitute defects that must be repaired.

5. Repair leaks and defects with new materials and retest piping or portion thereof until satisfactory results are obtained.

6. Prepare reports for tests and for corrective action required.

D. Domestic water piping will be considered defective if it does not pass tests and inspections.

E. Prepare test and inspection reports.

3.11 ADJUSTING

A. Perform the following adjustments before operation:

1. Close drain valves, hydrants, and hose bibbs.

2. Open shutoff valves to fully open position.

3. Open throttling valves to proper setting.

4. Remove plugs used during testing of piping and for temporary sealing of piping during installation.

5. Remove and clean strainer screens. Close drain valves and replace drain plugs.

6. Remove filter cartridges from housings and verify that cartridges are as specified for application where used and are clean and ready for use.

7. Check plumbing specialties and verify proper settings, adjustments, and operation.

3.12 CLEANING

A. Clean and disinfect potable domestic water piping as follows:

1. Purge new piping and parts of existing piping that have been altered, extended, or repaired before using.

2. Use purging and disinfecting procedures prescribed by authorities having jurisdiction; if methods are not prescribed, use procedures described in either AWWA C651 or AWWA C652 or follow procedures described below:

a. Flush piping system with clean, potable water until dirty water does not appear at outlets.

b. Fill and isolate system according to either of the following:

1) Fill system or part thereof with water/chlorine solution with at least 50 ppm of chlorine. Isolate with valves and allow to stand for 24 hours.

2) Fill system or part thereof with water/chlorine solution with at least 200 ppm of chlorine. Isolate and allow to stand for three hours.

c. Flush system with clean, potable water until no chlorine is in water coming from system after the standing time.

d. Submit water samples in sterile bottles to testing agency for testing. Repeat procedures if biological examination shows contamination.

B. Clean non-potable domestic water piping as follows:

1. Purge new piping and parts of existing piping that have been altered, extended, or repaired before using.

2. Use purging procedures prescribed by authorities having jurisdiction or; if methods are not prescribed, follow procedures described below:

a. Flush piping system with clean, potable water until dirty water does not appear at outlets.

b. Submit water samples in sterile bottles to testing agency for testing. Repeat procedures if biological examination shows contamination.

C. Prepare and submit reports of purging and disinfecting activities.

D. Clean interior of domestic water piping system. Remove dirt and debris as work progresses.

3.13 PIPING SCHEDULE

A. Transition and special fittings with pressure ratings at least equal to piping rating may be used in applications below unless otherwise indicated.

B. Flanges and unions may be used for aboveground piping joints unless otherwise indicated.

C. Above ground, domestic water piping shall be the following:

1. Hard copper tube, ASTM B 88, Type L; cast- or wrought-copper solder-joint fittings; and soldered joints.

2. Hard copper tube, ASTM B 88, Type L; copper pressure-seal-joint fittings; and pressure-sealed joints.

3.14 VALVE SCHEDULE

A. Drawings indicate valve types to be used. Where specific valve types are not indicated, the following requirements apply:

1. Shutoff Duty: Ball valves for piping NPS 3 and smaller. Gate valves for piping NPS 4 and larger.

2. Throttling Duty: Globe or ball valves.

3. Hot-Water Circulation Piping, Balancing Duty: Thermostatic, self-actuated balancing valve.

4. Drain Duty: Hose-end drain valves.

B. Use check valves to maintain correct direction of domestic water flow to and from equipment.

END OF SECTION

SECTION 221119
DOMESTIC WATER PIPING SPECIALTIES

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. Section includes:

1. Backflow Prevention Devices
2. Balancing Valves.
3. Temperature-Actuated Water Mixing Valves.
4. Strainers.
5. Drain Valves.
6. Air Vents.
7. Thermometers

B. Related Sections:

1. Section 22 04 00 – General Requirements for Plumbing
2. Section 22 05 23 – General – Duty Valves for Plumbing Piping
3. Section 22 05 29 – Hangers and Supports for Plumbing Piping and Equipment
4. Section 22 05 53 – Painting and Identification for Plumbing Piping and Equipment
5. Section 22 07 00 – Plumbing Insulation
6. Section 22 11 16 – Domestic Water Piping
7. Section 22 11 23 – Domestic Water Pumps
8. Section 22 30 00 – Fuel– Fired, Domestic – Water Heaters
9. Division 26 – Electrical

1.03 PERFORMANCE REQUIREMENTS

A. Minimum Working Pressure for Domestic Water Piping Specialties: 125 psig, unless otherwise indicated.

1.04 SUBMITTALS

A. Product Data: For each type of product indicated [S]. Comply with requirements in Division 01 and Section 22 04 00 “General Requirements for Plumbing”.

B. Field quality-control test reports.

C. Operation and Maintenance Data: For domestic water piping specialties indicated [O/M], include in emergency, operation, and maintenance manuals. Comply with requirements in Division 01 and Section 22 04 00 “General Requirements for Plumbing”.

1.05 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

B. NSF Compliance for materials that will come in contact with potable water:

1. NSF 14, "Plastics Piping Components and Related Materials," for plastic domestic water piping components.

2. NSF 61, "Drinking Water System Components - Health Effects; Sections 1 through 9."

3. NSF 372, "Drinking Water System Components - Lead Content."

PART 2 - PRODUCTS

2.01 BACKFLOW PREVENTION DEVICES [S] [O/M]

A. Backflow Prevention Devices: All equipment subject to backflow or back siphonage such as, but not limited to Hose Bibbs, etc., shall be equipped with Backflow Prevention Devices to satisfy the requirements of the International Plumbing Code, all local codes and ordinances.

B. Pressure Vacuum Breakers:

1. Manufacturers: Subject to compliance with requirements.

2. Standard:

a. Spill-Resistant: ASSE 1001.

b. Anti-Siphon, Spill-Resistant: ASSE 1056.

3. Operation: Continuous-pressure applications.

4. Pressure Loss: 10 psig maximum, through middle 1/3 of flow.

5. Size: Same as connecting piping.

6. Body: Bronze.

7. End Connections: Threaded.

8. Accessories:

a. Valves: Ball type, on inlet and outlet.

2.02 BALANCING VALVES [S] [O/M]

A. Copper-Alloy Calibrated Balancing Valves:

1. Manufacturers: Subject to compliance with requirements.

2. Type: Directional, self-acting thermostatic recirculation assembly.

3. Body: Stainless steel or bronze with all lead-free components.

4. Size: Same as connected piping, but not larger than NPS 2.

2.03 TEMPERATURE-ACTUATED WATER MIXING VALVES [S] [O/M]

A. Tempering Valve Manifold TVM:

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

a. Leonard Valve Company.

b. Powers; a Watts Industries Co.

c. Symmons Industries, Inc.

2. Description: Factory-fabricated, exposed-mounting, thermostatically controlled, water-mixing-valve assembly in two-valve parallel arrangement.

3. Large-Flow Parallel: Thermostatic water mixing valve and downstream pressure regulator with pressure gages on inlet and outlet.

4. Intermediate-Flow Parallel: Thermostatic water mixing valve and downstream pressure regulator with pressure gages on inlet and outlet.

5. Small-Flow Parallel: Thermostatic water mixing valve.

6. Thermostatic Mixing Valves: Comply with ASSE 1017. Include check stops on hot- and cold-water inlets and shutoff valve on outlet.

7. Water Regulator(s): Comply with ASSE 1003. Include pressure gage on inlet and outlet.

8. Component Pressure Ratings: 125 psig minimum, unless otherwise indicated.

9. Tempered-Water Setting: 120 deg F.

10. Thermostatic Mixing Valve and Water Regulator Finish: Rough bronze.

11. Piping Finish: Copper.

2.04 STRAINERS FOR DOMESTIC WATER PIPING

A. Y-Pattern Strainers:

1. Pressure Rating: 125 psig minimum, unless otherwise indicated.
2. Body: Bronze for NPS 3 and smaller; cast iron for NPS 4 and larger.
3. End Connections: Threaded for NPS 3 and smaller; flanged for NPS 4 and larger.
4. Screen: Stainless steel with round perforations, unless otherwise indicated.
5. Perforation Size:
    a. Strainers NPS 3 and Smaller: 0.020 inch.
    b. Strainers NPS 4 and Larger: 0.045 inch.
6. Drain: Pipe plug.

2.05 DRAIN VALVES

A. Ball-Valve-Type, Hose-End Drain Valves:

1. Standard: MSS SP-110 for standard-port, two-piece ball valves.
2. Pressure Rating: 400-psig minimum CWP.
3. Size: NPS 3/4.
4. Body: Copper alloy.
5. Ball: Chrome-plated brass.
6. Seats and Seals: Replaceable.
7. Handle: Vinyl-covered steel.
8. Inlet: Threaded or solder joint.
9. Outlet: Threaded, short nipple with garden-hose thread complying with ASME B1.20.7 and cap with brass chain.
10. Vacuum Breaker: Integral, non-removable, drainable, hose-connection vacuum breaker complying with ASSE 1011.

2.06 AIR VENTS [S]

A. Bolted-Construction Automatic Air Vents:

1. Body: Bronze.
2. Pressure Rating: 125-psig minimum pressure rating at 140 deg F.
3. Float: Replaceable, corrosion-resistant metal.
4. Mechanism and Seat: Stainless steel.
5. Size: NPS 1/2 minimum inlet.

6. Inlet and Vent Outlet End Connections: Threaded.

2.07 FILLED-SYSTEM THERMOMETERS [S]

A. Direct-Mounted, Metal-Case, Vapor-Actuated Thermometers:

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

a. Ashcroft Inc.

b. Marsh Bellofram.

c. Miljoco Corporation.

d. Palmer Wahl Instrumentation Group.

e. REOTEMP Instrument Corporation.

f. Trerice, H. O. Co.

g. Weiss Instruments, Inc.

2. Standard: ASME B40.200.

3. Case: Sealed type, cast aluminum or drawn steel; 4-1/2-inch nominal diameter.

4. Element: Bourdon tube or other type of pressure element.

5. Movement: Mechanical with link to pressure element and connection to pointer.

6. Dial: Non-reflective aluminum with permanently etched scale markings 0 deg F to 200 deg f.

7. Pointer: Dark-colored metal.

8. Window: Glass.

9. Ring: Metal.

10. Connector Type(s): Union joint, adjustable, 180 degrees in vertical plane with ASME B1.1 screw threads.

11. Thermal System: Liquid-filled bulb in copper-plated steel, aluminum, or brass stem and of length to suit installation.

a. Design for Thermowell Installation: Bare stem.

12. Accuracy: Plus or minus 1 percent of scale range.

B. Thermowells:

1. Standard: ASME B40.200.

2. Description: Pressure-tight, socket-type fitting made for insertion into piping tee fitting.

3. Material for Use with Copper Tubing: CNR or CUNI.

4. Type: Stepped shank unless straight or tapered shank is indicated.

5. External Threads: NPS 1/2, NPS 3/4, or NPS 1, ASME B1.20.1 pipe threads.

6. Internal Threads: 1/2, 3/4, and 1 inch, with ASME B1.1 screw threads.

7. Bore: Diameter required to match thermometer bulb or stem.

8. Insertion Length: Length required to match thermometer bulb or stem.

9. Lagging Extension: Include on thermowells for insulated piping and tubing.

10. Bushings: For converting size of thermowell's internal screw thread to size of thermometer connection.

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

PART 3 - EXECUTION

3.01 INSTALLATION

A. Comply with requirements in other Division 22 Sections for piping joining materials, joint construction, and basic installation requirements.

B. Install backflow preventers in each water supply to mechanical equipment and systems and to other equipment and water systems that may be sources of contamination. Comply with authorities having jurisdiction and the International Plumbing Code.

1. Locate backflow preventers in same room as connected equipment or system.

2. Install drain for backflow preventers with atmospheric-vent drain connection with air-gap fitting, fixed air-gap fitting, or equivalent positive pipe separation of at least two pipe diameters in drain piping and pipe to floor drain. Locate air-gap device attached to or under backflow preventer. Simple air breaks are not acceptable for this application.

3. Do not install bypass piping around backflow preventers.

C. Install thermostatic balancing valves with inlet and outlet shutoff valves in locations where they can easily be serviced. Install check valve on outlet.

D. Install temperature-actuated water mixing valves with check stops or shutoff valves on inlets and with shutoff valve on outlet.

E. Install Y-pattern strainers for water on supply side of each domestic water pump.

F. Install air vents at high points of water piping.

G. Install thermowells of sizes required to match thermometer connectors. Include bushings if required to match sizes.

H. Install thermowells with extension on insulated piping.

I. Fill thermowells with heat-transfer medium.

J. Install direct-mounted thermometers in thermowells and adjust vertical and tilted positions.

K. Install valve and snubber in piping for each pressure gage for fluids.

L. Install thermometers in the following locations:

1. Outlet of each water heater.

2. Inlet of each hot water circulating pump.

3.02 CONNECTIONS

A. Comply with requirements, for piping installation, in Sections 22 11 16 “Domestic Water Piping”. Drawings indicate general arrangement of piping and specialties.

B. Ground equipment according to Section 26 05 26 "Grounding and Bonding for Electrical Systems."

C. Connect wiring according to Section 26 05 23 "Low-Voltage Electrical Power Conductors and Cables."

D. Install gages adjacent to machines and equipment to allow service and maintenance of gages, machines, and equipment.

3.03 ADJUSTING

A. Set field-adjustable temperature set points of temperature-actuated water mixing valves.

B. Adjust faces of thermometers to proper angle for best visibility.

END OF SECTION

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SECTION 221123
DOMESTIC WATER PUMPS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. Section Includes:

1. In-line, high efficiency large wet rotor hot water circulating pumps with ECM motor.

B. Related Sections:

1. Section 22 04 00 – General Requirements for Plumbing
2. Section 22 05 23 – General – Duty Valves for Plumbing Piping
3. Section 22 05 29 – Hanger and Supports for Plumbing Piping and Equipment
4. Section 22 05 53 – Painting & Identification for Plumbing Piping and Equipment
5. Section 22 07 00 – Plumbing Insulation
6. Section 22 11 16 – Domestic Water Piping
7. Section 22 11 19 – Domestic Water Piping Specialties
8. Section 22 34 00 – Fuel Fired, Domestic – Water Heaters
9. Division 24 – Building Automation System
10. Division 26 – Electrical

1.03 DEFINITIONS

A. Low Voltage: As defined in NFPA 70 for circuits and equipment operating at less than 50 V or for remote-control, signaling power-limited circuits.

B. DDC: Direct Digital Control

1.04 SUBMITTALS

A. Product Data: For each type of product indicated [S]. Include materials of construction, rated capacities, certified performance curves with operating points plotted on curves, operating characteristics, electrical characteristics, and furnished specialties and accessories. Comply with requirements in Division 01 and Section 22 04 00 “General Requirements for Plumbing”.

B. Operation and Maintenance Data: For domestic water pumps indicated [O/M], to include in operation and maintenance manuals. Comply with requirements in Division 01 and Section 22 04 00 “General Requirements for Plumbing.

1.05 QUALITY ASSURANCE

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

B. UL Compliance: Comply with UL 778 for motor-operated water pumps.

PART 2 - PRODUCTS

2.01 IN-LINE, HIGH EFFICIENCY LARGE WET ROTOR HOT WATER CIRCULATING PUMPS WITH ECM MOTOR[S] [O/M]

A. Manufacturer: Subject to compliance with requirements.

B. Description: Factory-assembled and -tested, in-line, high efficiency, wet rotor centrifugal pumps.

C. Pump Construction:

1. Pump and Motor Assembly: Hermetically sealed, oil lubricated with hardened steel shaft with flexible spring coupler, designed for installation with pump and motor shaft horizontal.

2. Casing: Lead-Free Bronze, with companion-flange connections.

3. Impeller: Stainless Steel

4. Rotor: Permanent Magnet

5. Motor: Electronically commutated with permanent magnet.

D. Capacities and Characteristics:

1. Capacity: As shown on the drawings.

2. Total Dynamic Head: As shown on the drawings.

3. Minimum Working Pressure: 125 psig.

4. Maximum Continuous Operating Temperature: 225 deg F.

5. Inlet and Outlet Size: As shown on the drawings.

6. Pump Speed: 1725 rpm.

7. Pump Control: Set-point temperature control. The pump shall maintain a constant temperature in the system using a built-in temperature sensor.

8. Motor Horsepower: As shown on the drawings..

9. Electrical Characteristics: As shown on the drawings.

2.02 MOTORS

A. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors.

1. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.

2. Controllers, Electrical Devices, and Wiring: Comply with requirements for electrical devices and connections in Division 26.

2.03 CONTROLS

A. Direct Digital Control: Comply with requirements in Division 24 “Building Automation System”.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine roughing-in of domestic-water-piping system to verify actual locations of connections before pump installation.

3.02 PUMP INSTALLATION

A. Comply with HI 1.4.

B. Install horizontally mounted, in-line, centrifugal pumps with shaft(s) horizontal.

C. Install continuous-thread hanger rods and of size required to support pump weight.

1. Comply with requirements for hangers and supports in Section 22 05 29 "Hangers and Supports for Plumbing Piping and Equipment."

3.03 CONNECTIONS

A. Comply with requirements for piping in Section 22 11 16 "Domestic Water Piping." Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to pumps to allow service and maintenance.

C. Connect domestic water piping to pumps. Install suction and discharge piping equal to or greater than size of pump nozzles.

1. Comply with requirements for flexible connectors in Section 22 11 16 "Domestic Water Piping”

2. Install shutoff valve on suction side of each pump, and check, shutoff, and throttling valves on discharge side of each pump. Install valves same size as connected piping. Comply with requirements for valves specified in Section 22 05 23 "General-Duty Valves for Plumbing Piping" and comply with requirements for strainers in Section 22 11 19 "Domestic Water Piping Specialties."

3. Install thermometer at inlet of each circulating pump. Comply with requirements for thermometers in Section 22 11 19 “Domestic Water Piping Specialties”.

D. Comply with Division 26 requirements for electrical connections, and wiring methods.

E. Connect DDC Controls to pumps that they control.

3.04 IDENTIFICATION

A. Comply with requirements for identification in Section 22 05 53 "Painting and Identification for Plumbing Piping and Equipment" for identification of pumps.

3.05 STARTUP SERVICE

A. Perform startup service.

1. Complete installation and startup check according to manufacturer's written instructions.

2. Check piping connections for tightness.

3. Clean strainers on suction piping.

4. Set DDC Controls**,** for automatic starting and stopping operation of pumps.

5. Perform the following startup checks for each pump before starting:

a. Verify bearing lubrication.

b. Verify that pump is free to rotate by hand and that pump for handling hot liquid is free to rotate with pump hot and cold. If pump is bound or drags, do not operate until cause of trouble is determined and corrected.

c. Verify that pump is rotating in the correct direction.

6. Prime pump by opening suction valves and closing drains and prepare pump for operation.

7. Start motor.

8. Open discharge valve slowly.

9. Adjust temperature settings on thermostats.

10. Adjust timer settings.

3.06 ADJUSTING

A. Adjust domestic water pumps to function smoothly and lubricate as recommended by manufacturer.

B. Adjust initial temperature set points.

C. Set field-adjustable switches and circuit-breaker trip ranges as indicated.

END OF SECTION

SECTION 221613
FACILITY NATURAL-GAS PIPING

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. Section Includes:

1. Pipes, tubes, and fittings.

2. Piping specialties.

3. Piping and tubing joining materials.

4. Valves.

5. Pressure regulators.

B. Related Sections:

1. Section 03 30 00 – Cast-In Place Concrete

2. Section 22 04 00 – General Requirements for Plumbing

3. Section 22 05 29 – Hangers and Supports for Plumbing Piping and Equipment

4. Section 22 05 53 – Painting and Identification for Plumbing Piping and Equipment

5. Section 22 34 00 – Fuel– Fired, Domestic–Water Heaters

1.03 DEFINITIONS

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

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

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

1.04 PERFORMANCE REQUIREMENTS

A. Minimum Operating-Pressure Ratings:

1. Piping and Valves: 100 psig minimum unless otherwise indicated.

B. Natural-Gas System Pressures within Building: Two pressure ranges. Primary pressure is more than 0.5 psig but not more than 1 psig, and is reduced to secondary pressure of 0.5 psig or less.

1.05 SUBMITTALS

A. Product Data: For each type of product indicated [S]. Comply with requirements in Division 01 and Section 22 04 00 “General Requirements for Plumbing”.

B. Field quality-control reports.

C. Operation and Maintenance Data: For Facility natural gas piping indicated [O/M], to include in emergency, operation, and maintenance manuals. Comply with requirements in Division 01 and Section 22 04 00 “General Requirements for Plumbing”.

1.06 QUALITY ASSURANCE

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

B. Pipe Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.

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

1.07 DELIVERY, STORAGE, AND HANDLING

A. Handling Flammable Liquids: Remove and dispose of liquids from existing natural-gas piping according to requirements of authorities having jurisdiction.

B. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and to prevent entrance of dirt, debris, and moisture.

C. Store and handle pipes and tubes having factory-applied protective coatings to avoid damaging coating, and protect from direct sunlight.

D. Protect stored PE pipes and valves from direct sunlight.

1.08 PROJECT CONDITIONS

A. Perform site survey, research public utility records, and verify existing utility locations. Contact utility-locating service for area where Project is located.

B. Interruption of Existing Natural-Gas Service: Do not interrupt natural-gas service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide purging and startup of natural-gas supply according to requirements indicated:

1. Notify Owner no fewer than two days in advance of proposed interruption of natural-gas service.

1.09 COORDINATION

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

B. Coordinate requirements for access panels and doors for valves installed concealed behind finished surfaces. Comply with requirements in Section 08 31 00 "Access Doors and Frames."

PART 2 - PRODUCTS

2.01 PIPES, TUBES, AND FITTINGS

A. Steel Pipe: ASTM A 53, black steel, Schedule 40, Type E or S, Grade B.

1. Malleable-Iron Threaded Fittings: ASME B16.3, Class 150, standard pattern.

2. Wrought-Steel Welding Fittings: ASTM A 234 for butt welding and socket welding.

3. Unions: ASME B16.39, Class 150, malleable iron with brass-to-iron seat, ground joint, and threaded ends.

4. Forged-Steel Flanges and Flanged Fittings: ASME B16.5, minimum Class 150, including bolts, nuts, and gaskets of the following material group, end connections, and facings:

a. Material Group: 1.1.

b. End Connections: Threaded or butt welding to match pipe.

c. Lapped Face: Not permitted underground.

d. Gasket Materials: ASME B16.20, metallic, flat, asbestos free, aluminum o-rings, and spiral-wound metal gaskets.

e. Bolts and Nuts: ASME B18.2.1, carbon steel aboveground and stainless steel underground.

5. Mechanical Couplings:

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

1) Dresser Piping Specialties; Division of Dresser, Inc.

2) Smith-Blair, Inc.

b. Steel flanges and tube with epoxy finish.

c. Buna-nitrile seals.

d. Steelbolts, washers, and nuts.

e. Coupling shall be capable of joining PE pipe to PE pipe, steel pipe to PE pipe, or steel pipe to steel pipe.

f. Steel body couplings installed underground on plastic pipe shall be factory equipped with anode.

2.02 PIPING SPECIALTIES

A. Appliance Flexible Connectors:

1. Indoor, Fixed-Appliance Flexible Connectors: Comply with ANSI Z21.24.
2. Corrugated stainless-steel tubing with polymer coating.
3. Operating-Pressure Rating: 0.5 psig.
4. End Fittings: Zinc-coated steel.
5. Threaded Ends: Comply with ASME B1.20.1.
6. Maximum Length: 72 inches.

B. Quick-Disconnect Devices: Comply with ANSI Z21.41.

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

C. Y-Pattern Strainers:

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

D. Basket Strainers:

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

E. T-Pattern Strainers:

1. Body: Ductile or malleable iron with removable access coupling and end cap for strainer maintenance.
2. End Connections: Grooved ends.

3. Strainer Screen: 40-mesh startup strainer, and perforated stainless-steel basket with 50 percent free area.

4. CWP Rating: 750 psig

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

2.03 JOINING MATERIALS

A. Joint Compound and Tape: Suitable for natural gas.

B. Welding Filler Metals: Comply with AWS D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

C. Brazing Filler Metals: Alloy with melting point greater than 1000 deg F complying with AWS A5.8. Brazing alloys containing more than 0.05 percent phosphorus are prohibited.

2.04 MANUAL GAS SHUTOFF VALVES [S]

A. Refer to "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles for where each valve type is applied in various services.

B. General Requirements for Metallic Valves, NPS 2 and Smaller: Comply with ASME B16.33.

1. CWP Rating: 125 psig.

2. Threaded Ends: Comply with ASME B1.20.1.

3. Dryseal Threads on Flare Ends: Comply with ASME B1.20.3.

4. Tamperproof Feature: Locking feature for valves indicated in "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.

5. Listing: Listed and labeled by an NRTL, according to the International Fuel Gas Code and acceptable to authorities having jurisdiction.

C. General Requirements for Metallic Valves, NPS 2-1/2 and Larger: Comply with ASME B16.38.

1. CWP Rating: 125 psig.

2. Flanged Ends: Comply with ASME B16.5 for steel flanges.

3. Tamperproof Feature: Locking feature for valves indicated in "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.

4. Listing: Listed and Labeled by an NRTL, according to the International Fuel Gas Code and acceptable to the authorities having jurisdiction.

D. One-Piece, Bronze Ball Valve with Bronze Trim: MSS SP-110.

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

a. BrassCraft Manufacturing Company; a Masco company.

b. Conbraco Industries, Inc.; Apollo Div.

c. Lyall, R. W. & Company, Inc.

d. McDonald, A. Y. Mfg. Co.

e. Perfection Corporation; a subsidiary of American Meter Company.

2. Body: Bronze, complying with ASTM B 584.

3. Ball: Chrome-plated brass.

4. Stem: Bronze; blowout proof.

5. Seats: Reinforced TFE; blowout proof.

6. Packing: Separate packnut with adjustable-stem packing threaded ends.

7. Ends: Threaded, flared, or socket as indicated in "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.

8. CWP Rating: 600 psig.

9. Service: Suitable for natural-gas service.

E. Two-Piece, Full-Port, Bronze Ball Valves with Bronze Trim: MSS SP-110.

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

a. BrassCraft Manufacturing Company; a Masco company.

b. Conbraco Industries, Inc.; Apollo Div.

c. Lyall, R. W. & Company, Inc.

d. McDonald, A. Y. Mfg. Co.

e. Perfection Corporation; a subsidiary of American Meter Company.

2. Body: Bronze, complying with ASTM B 584.

3. Ball: Chrome-plated bronze.

4. Stem: Bronze; blowout proof.

5. Seats: Reinforced TFE; blowout proof.

6. Packing: Threaded-body packnut design with adjustable-stem packing.

7. Ends: Threaded, flared, or socket as indicated in "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.

8. CWP Rating: 600 psig.

9. Service: Suitable for natural-gas service with "WOG" indicated on valve body.

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

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

   a. McDonald, A. Y. Mfg. Co.

   b. Mueller Co.; Gas Products Div.

   c. Xomox Corporation; a Crane company.

2. Body: Cast iron, complying with ASTM A 126, Class B.

3. Plug: Bronze or nickel-plated cast iron.

4. Seat: Coated with thermoplastic.

5. Stem Seal: Compatible with natural gas.

6. Ends: Threaded or flanged as indicated in "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.

7. Operator: Square head or lug type with tamperproof feature where indicated.

8. Pressure Class: 125 psig.

9. Service: Suitable for natural-gas service with "WOG" indicated on valve body.

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

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

   a. Flowserve.

   b. Homestead Valve; a division of Olson Technologies, Inc.

   c. McDonald, A. Y. Mfg. Co.

   d. Milliken Valve Company.

   e. Mueller Co.; Gas Products Div.

   f. R&M Energy Systems, A Unit of Robbins & Myers, Inc.

2. Body: Cast iron, complying with ASTM A 126, Class B.

3. Plug: Bronze or nickel-plated cast iron.

4. Seat: Coated with thermoplastic.

5. Stem Seal: Compatible with natural gas.

6. Ends: Threaded or flanged as indicated in "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.

7. Operator: Square head or lug type with tamperproof feature where indicated.

8. Pressure Class: 125 psig.

9. Service: Suitable for natural-gas service with "WOG" indicated on valve body.

2.05 PRESSURE REGULATORS [S] [O/M]

A. General Requirements:

1. Single stage and suitable for natural gas.

2. Steel jacket and corrosion-resistant components.

3. Elevation compensator.

4. End Connections: Threaded for regulators NPS 2 and smaller; flanged for regulators NPS 2-1/2 and larger.

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

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

a. Actaris.

b. American Meter Company.

c. Eclipse Combustion, Inc.

d. Fisher Control Valves and Regulators; Division of Emerson Process Management.

e. Invensys.

f. Maxitrol Company.

g. Richards Industries; Jordan Valve Div.

2. Body and Diaphragm Case: Cast iron or die-cast aluminum.

3. Springs: Zinc-plated steel; interchangeable.

4. Diaphragm Plate: Zinc-plated steel.

5. Seat Disc: Nitrile rubber resistant to gas impurities, abrasion, and deformation at the valve port.

6. Orifice: Aluminum; interchangeable.

7. Seal Plug: Ultraviolet-stabilized, mineral-filled nylon.

8. Single-port, self-contained regulator with orifice no larger than required at maximum pressure inlet, and no pressure sensing piping external to the regulator.

9. Pressure regulator shall maintain discharge pressure setting downstream, and not exceed 150 percent of design discharge pressure at shutoff.

10. Overpressure Protection Device: Factory mounted on pressure regulator.

11. Atmospheric Vent: Factory- or field-installed, stainless-steel screen in opening if not connected to vent piping.

12. Maximum Inlet Pressure: 2 psig.

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

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

a. Canadian Meter Company Inc.

b. Eaton Corporation; Controls Div.

c. Harper Wyman Co.

d. Maxitrol Company.

e. SCP, Inc.

2. Body and Diaphragm Case: Die-cast aluminum.

3. Springs: Zinc-plated steel; interchangeable.

4. Diaphragm Plate: Zinc-plated steel.

5. Seat Disc: Nitrile rubber.

6. Seal Plug: Ultraviolet-stabilized, mineral-filled nylon.

7. Factory-Applied Finish: Minimum three-layer polyester and polyurethane paint finish.

8. Regulator may include vent limiting device, instead of vent connection, if approved by authorities having jurisdiction.

9. Maximum Inlet Pressure: 2 psig.

2.06 DIELECTRIC FITTINGS

A. Dielectric Unions:

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

a. Capitol Manufacturing Company.

b. Central Plastics Company.

c. Hart Industries International, Inc.

d. McDonald, A. Y. Mfg. Co.

e. Watts Regulator Co.; Division of Watts Water Technologies, Inc.

f. Wilkins; Zurn Plumbing Products Group.

2. Minimum Operating-Pressure Rating: 150 psig.

3. Combination fitting of copper alloy and ferrous materials.

4. Insulating materials suitable for natural gas.

5. Combination fitting of copper alloy and ferrous materials with threaded, brazed-joint, plain, or welded end connections that match piping system materials.

B. Dielectric Flanges:

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

a. Capitol Manufacturing Company.

b. Central Plastics Company.

c. Watts Regulator Co.; Division of Watts Water Technologies, Inc.

d. Wilkins; Zurn Plumbing Products Group.

2. Minimum Operating-Pressure Rating: 150 psig.

3. Combination fitting of copper alloy and ferrous materials.

4. Insulating materials suitable for natural gas.

5. Combination fitting of copper alloy and ferrous materials with threaded, brazed-joint, plain, or welded end connections that match piping system materials.

C. Dielectric-Flange Kits:

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

a. Advance Products & Systems, Inc.

b. Calpico Inc.

c. Central Plastics Company.

d. Pipeline Seal and Insulator, Inc.

2. Minimum Operating-Pressure Rating: 150 psig.

3. Companion-flange assembly for field assembly.

4. Include flanges, full-face- or ring-type neoprene or phenolic gasket, phenolic or PE bolt sleeves, phenolic washers, and steel backing washers.

5. Insulating materials suitable for natural gas.

6. Combination fitting of copper alloy and ferrous materials with threaded, brazed-joint, plain, or welded end connections that match piping system materials.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine roughing-in for natural-gas piping system to verify actual locations of piping connections before equipment installation.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

A. Close equipment shutoff valves before turning off natural gas to premises or piping section.

B. Inspect natural-gas piping according to the International Fuel Gas Code to determine that natural-gas utilization devices are turned off in piping section affected.

C. Comply with the International Fuel Gas Code requirements for prevention of accidental ignition.

3.03 INDOOR PIPING INSTALLATION

A. Comply with the International Fuel Gas Code for installation and purging of natural-gas piping.

B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements are used to size pipe and calculate friction loss, expansion, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.

C. Arrange for pipe spaces, chases, slots, sleeves, and openings in building structure during progress of construction, to allow for mechanical installations.

D. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.

E. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

F. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

G. Locate valves for easy access.

H. Install natural-gas piping at uniform grade of 2 percent down toward drip and sediment traps.

I. Install piping free of sags and bends.

J. Install fittings for changes in direction and branch connections.

K. Verify final equipment locations for roughing-in.

L. Comply with requirements in Sections specifying gas-fired appliances and equipment for roughing-in requirements.

M. Drips and Sediment Traps: Install drips at points where condensate may collect, including service-meter outlets. Locate where accessible to permit cleaning and emptying. Do not install where condensate is subject to freezing.

1. Construct drips and sediment traps using tee fitting with bottom outlet plugged or capped. Use nipple a minimum length of 3 pipe diameters, but not less than 3 inches long and same size as connected pipe. Install with space below bottom of drip to remove plug or cap.

N. Extend relief vent connections for line regulators and overpressure protection devices to outdoors and terminate with weatherproof vent cap with screen.

O. Conceal pipe installations in walls, pipe spaces, utility spaces, above ceilings, below grade or floors, and in floor channels unless indicated to be exposed to view.

P. Concealed Location Installations:

1. Above Accessible Ceilings: Natural-gas piping, fittings, valves, and regulators may be installed in accessible spaces without containment conduit.

2. In Walls or Partitions: Protect tubing installed inside partitions or hollow walls from physical damage using steel striker barriers at rigid supports.

a. Exception: Tubing passing through partitions or walls does not require striker barriers.

3. Prohibited Locations:

a. Do not install natural-gas piping in or through circulating air ducts, clothes or trash chutes, chimneys or gas vents (flues), ventilating ducts, or dumbwaiter or elevator shafts.

b. Do not install natural-gas piping in solid walls or partitions.

c. Do not install gas valves in ceiling plenums.

Q. Use eccentric reducer fittings to make reductions in pipe sizes. Install fittings with level side down.

R. Connect branch piping from top or side of horizontal piping.

S. Install unions in pipes NPS 2 and smaller, adjacent to each valve, at final connection to each piece of equipment. Unions are not required at flanged connections.

T. Do not use natural-gas piping as grounding electrode.

U. Install strainer on inlet of each line-pressure regulator and automatic or electrically operated valve.

V. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves in Section 22 04 00 "General Requirements for Plumbing."

W. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons in Section 22 04 00 "General Requirements for Plumbing."

3.04 VALVE INSTALLATION

A. Install manual gas shutoff valve for each gas appliance ahead of connecting piping and connectors.

B. Install regulators and overpressure protection devices with maintenance access space adequate for servicing and testing.

3.05 PIPING JOINT CONSTRUCTION

A. Ream ends of pipes and tubes and remove burrs.

B. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.

C. Threaded Joints:

1. Thread pipe with tapered pipe threads complying with ASME B1.20.1.

2. Cut threads full and clean using sharp dies.

3. Ream threaded pipe ends to remove burrs and restore full inside diameter of pipe.

4. Apply appropriate tape or thread compound to external pipe threads unless dryseal threading is specified.

5. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.

D. Welded Joints:

1. Construct joints according to AWS D10.12, using qualified processes and welding operators.

2. Bevel plain ends of steel pipe.

3. Patch factory-applied protective coating as recommended by manufacturer at field welds and where damage to coating occurs during construction.

E. Flanged Joints: Install gasket material, size, type, and thickness appropriate for natural-gas service. Install gasket concentrically positioned.

3.06 HANGER AND SUPPORT INSTALLATION

A. Comply with requirements for pipe hangers and supports in Section 22 05 29 "Hangers and Supports for Plumbing Piping and Equipment."

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

1. NPS 1 and Smaller: Maximum span, 96 inches; minimum rod size, 3/8 inch.

2. NPS 1-1/4: Maximum span, 108 inches; minimum rod size, 3/8 inch.

3. NPS 1-1/2 and NPS 2 Maximum span, 108 inches; minimum rod size, 3/8 inch.

4. NPS 2-1/2 to NPS 3-1/2: Maximum span, 10 feet; minimum rod size, 1/2 inch.

5. NPS 4 and Larger: Maximum span, 10 feet; minimum rod size, 5/8 inch.

3.07 CONNECTIONS

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

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

C. Install piping adjacent to appliances to allow service and maintenance of appliances.

D. Connect piping to appliances using manual gas shutoff valves and unions. Install valve within 72 inches of each gas-fired appliance and equipment. Install union between valve and appliances or equipment.

E. Sediment Traps: Install tee fitting with capped nipple in bottom to form drip, as close as practical to inlet of each appliance.

3.08 LABELING AND IDENTIFYING

A. Comply with requirements in Section22 05 53 "Painting and Identification for Plumbing Piping and Equipment" for piping and valve identification.

B. Install detectable warning tape directly above gas piping, 12 inches below finished grade, except 6 inches below subgrade under pavements and slabs.

3.09 PAINTING

A. Comply with requirements in Section 22 05 53 “Painting and Identification for Plumbing Piping and Equipment” painting interior and exterior natural-gas piping.

3.10 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Tests and Inspections:

1. Test, inspect, and purge natural gas according to the International Fuel Gas Code and authorities having jurisdiction.

C. Natural-gas piping will be considered defective if it does not pass tests and inspections.

D. Prepare test and inspection reports.

3.11 INDOOR PIPING SCHEDULE FOR SYSTEM PRESSURES LESS THAN 0.5 PSIG

A. Aboveground, distribution piping shall be the following:

1. NPS 2 and smaller: Steel pipe with malleable-iron fittings and threaded joints.

2. NPS 2-1/2 and larger: Steel pipe with wrought-steel fittings and welded joints.

3.12 INDOOR PIPING SCHEDULE FOR SYSTEM PRESSURES 0.5 PSIG TO 5 PSIG

A. Aboveground, distribution piping shall be the following:

1. Steel pipe with steel welding fittings and welded joints.

3.13 ABOVEGROUND MANUAL GAS SHUTOFF VALVE SCHEDULE

A. Valves for pipe sizes NPS 2 and smaller shall be one of the following:

1. One-piece, bronze ball valve with bronze trim.

2. Two-piece, full-port, bronze ball valves with bronze trim.

B. Valves for pipe sizes NPS 2-1/2 and larger shall be the following:

1. Cast-iron, nonlubricated plug valve.

END OF SECTION

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SECTION 223400
FUEL-FIRED, DOMESTIC-WATER HEATERS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. Section Includes:

1. Commercial, grid-type, finned-tube, gas-fired, domestic-water heaters.

2. Domestic-water heater accessories.

B. RELATED SECTIONS:

1. Section 03 30 00 – Cast – in Place Concrete

2. Section 22 04 00 – General Requirements for Plumbing

3. Section 22 05 13 – Common Motor Requirements for Plumbing Equipment

4. Section 22 05 23 – General – Duty Valves for Plumbing Piping

5. Section 22 05 29 – Hangers and Supports for Plumbing Piping and Equipment

6. Section 22 05 53 – Painting and Identification for Plumbing Piping and Equipment

7. Section 22 11 16 – Domestic Water Piping

8. Section 22 11 19 – Domestic Water Piping Specialties

9. Section 22 16 13 – Facility Natural– Gas Piping

10. Section 23 09 00 – Instrumentation and Control for HVAC

11. Section 23 50 00 – Central Heating Equipment

12. Division 26 - Electrical

1.03 SUBMITTALS

A. Product Data: For each type and size of domestic-water heater indicated [S]. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories. Comply with requirements in Division 01 and Section 22 04 00 “General Requirements for Plumbing”.

B. Product Certificates: For each type of commercial, gas-fired, domestic-water heater, from manufacturer.

C. Domestic-Water Heater Labeling: Certified and labeled by testing agency acceptable to authorities having jurisdiction.

D. Operation and Maintenance Data: For fuel-fired, domestic-water heaters indicated [O/M], to include in emergency, operation, and maintenance manuals. Comply with requirements Division 01 and Section 22 40 00 “General Requirements for Plumbing”.

E. Warranty: Sample of special warranty.

1.04 QUALITY ASSURANCE

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

B. ASHRAE/IESNA 90.1 Compliance: Fabricate and label fuel-fired, domestic-water heaters to comply with ASHRAE/IESNA 90.1.

C. ASME Compliance:

1. Where ASME-code construction is indicated, fabricate and label commercial, finned-tube, domestic-water heaters to comply with ASME Boiler and Pressure Vessel Code: Section IV.

D. NSF Compliance: Fabricate and label equipment components that will be in contact with potable water to comply with NSF 61, "Drinking Water System Components - Health Effects" and NSF 372, "Drinking Water System Components - Lead Content".

1.05 COORDINATION

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

1.06 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of fuel-fired, domestic-water heaters that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Structural failures including storage tank and supports.

b. Faulty operation of controls.

c. Deterioration of metals, metal finishes, and other materials beyond normal use.

2. Warranty Periods: From date of Substantial Completion.

a. Commercial, Finned-Tube, Gas-Fired, Domestic-Water Heaters:

1) Heat Exchanger: Five years.

2) Controls and Other Components: Two years.

b. Thermal Expansion Tanks: Five years.

PART 2 - PRODUCTS

2.01 COMMERCIAL, FINNED-TUBE, GAS-FIRED, DOMESTIC-WATER HEATERS[S] [O/M]

A. Commercial, Grid-Type, Finned-Tube, Gas-Fired, Domestic-Water Heaters:

1. Manufacturers: Subject to compliance with requirements.

2. Standard: ANSI Z21.13/CSA 4.9 for hot-water-supply boilers.

3. Description: Packaged unit with boiler, storage tank, pump, piping, and controls.

4. Boiler Construction: ASME code with 160-psig working-pressure rating for hot-water-boiler-type, domestic-water heater.

a. Heat Exchanger: Horizontal, straight, finned-copper tubes with bronze headers.

b. Connections: Factory fabricated of materials compatible with boiler. Attach to boiler before testing.

1) NPS 2 and Smaller: Threaded ends according to ASME B1.20.1.

2) NPS 2-1/2 and Larger: Flanged ends according to ASME B16.5 for steel and stainless-steel flanges and according to ASME B16.24 for copper and copper-alloy flanges.

5. Boiler Appurtenances:

a. Insulation: Comply with ASHRAE/IESNA 90.1. Surround entire boiler except connections and controls.

b. Jacket: Steel with enameled finish.

c. Burner: For use with grid-type, finned-tube, gas-fired, domestic-water heaters and natural-gas fuel.

d. Automatic Ignition: ANSI Z21.20/CSA C22.2 No. 199, intermittent electronic-ignition system.

e. Temperature Control: Adjustable, storage-tank temperature-control fitting and flow switch, interlocked with circulator and burner.

f. Safety Control: Automatic, high-temperature-limit cutoff device or system.

6. Support: Steel base or skids.

7. Circulating Pump: UL 778, all-bronze, centrifugal, overhung-impeller, separately coupled in-line pump as defined in HI 1.1-1.2 and HI 1.3. Include mechanical seals, 125-psig minimum working-pressure rating, and 225 deg F continuous-water-temperature rating.

8. Piping: Copper tubing; copper, solder-joint fittings; and brazed or flanged joints.

9. Mounting: Domestic-water heater, tank, and accessories factory mounted on skids.

10. Capacity and Characteristics:

a. Refer to drawing schedule.

11. Combustion-Air Intake and Direct Vent: PVC, concentric vent kit., horizontal vent piping.

12. Neutralizing Kit: Provide each water heater with manufacturer supplied acid neutralization kit.

13. Storage tank shall be glass lined.

2.02 DOMESTIC-WATER HEATER ACCESSORIES [S]

A. Thermal Expansion Tanks:

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

a. AMTROL Inc.

b. Flexcon Industries.

c. Honeywell International Inc.

d. Pentair Pump Group (The); Myers.

e. Smith, A. O. Water Products Co.; a division of A. O. Smith Corporation.

f. State Industries.

g. Taco, Inc.

2. Description: Steel, pressure-rated tank constructed with welded joints and factory-installed butyl-rubber diaphragm. Include air precharge to minimum system-operating pressure at tank.

3. Construction:

a. Tappings: Factory-fabricated steel, welded to tank before testing and labeling. Include ASME B1.20.1 pipe thread.

b. Interior Finish: Comply with NSF 61 barrier materials for potable-water tank linings, including extending finish into and through tank fittings and outlets.

c. Air-Charging Valve: Factory installed.

B. Air Precharge Pressure: 40 psig.

C. Manifold Kits: Domestic-water heater manufacturer's factory-fabricated inlet and outlet piping for field installation, for multiple domestic-water heater installation. Include ball-, butterfly-, or gate-type shutoff valves to isolate each domestic-water heater and calibrated balancing valves to provide balanced flow through each domestic-water heater.

1. Comply with requirements for ball or gate-type shutoff valves and check valves in Section 22 05 23 "General-Duty Valves for Plumbing Piping."

2. Comply with requirements for balancing valves in Section 22 11 19 "Domestic Water Piping Specialties."

D. Gas Shutoff Valves: ANSI Z21.15/CSA 9.1-M manually operated. Furnish for installation in piping.

E. Gas Pressure Regulators: ANSI Z21.18/CSA 6.3, appliance type. Include pressure rating as required to match gas supply.

F. Automatic Gas Valves: ANSI Z21.21/CSA 6.5, appliance, electrically operated, on-off automatic valve.

G. Combination Temperature-and-Pressure Relief Valves: Include relieving capacity at least as great as heat input, and include pressure setting less than domestic-water heater working-pressure rating. Select relief valves with sensing element that extends into storage tank.

1. Gas-Fired, Domestic-Water Heaters: ANSI Z21.22/CSA 4.4-M.

H. Vacuum Relief Valves: ANSI Z21.22/CSA 4.4-M.

I. Domestic-Water Heater Supports: Factory-fabricated steel wall mounted unit with welded gussets and brackets, front rings for threaded rod support capable of supporting domestic-water heater and water.

2.03 SOURCE QUALITY CONTROL

A. Factory Tests: Test and inspect assembled domestic-water heaters specified to be ASME-code construction, according to ASME Boiler and Pressure Vessel Code.

B. Hydrostatically test commercial domestic-water heaters to minimum of one and one-half times pressure rating before shipment.

C. Domestic-water heaters will be considered defective if they do not pass tests and inspections. Comply with requirements in Division 01 Section "Quality Requirements" for retesting and reinspecting requirements and Division 01 Section "Execution" for requirements for correcting the Work.

D. Prepare test and inspection reports.

PART 3 - EXECUTION

3.01 DOMESTIC-WATER HEATER INSTALLATION

A. Commercial, Domestic-Water Heater Mounting: Install commercial domestic-water heaters on concrete base.

1. Maintain manufacturer's recommended clearances.

2. Arrange units so controls and devices that require servicing are accessible.

3. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of concrete base.

4. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.

5. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.

6. Install anchor bolts to elevations required for proper attachment to supported equipment.

7. Anchor domestic-water heaters to substrate.

B. Install domestic-water heaters level and plumb, according to layout drawings, original design, and referenced standards. Maintain manufacturer's recommended clearances. Arrange units so controls and devices needing service are accessible.

1. Install shutoff valves on domestic-water-supply piping to domestic-water heaters and on domestic-hot-water outlet piping. Comply with requirements for shutoff valves specified in Section 22 05 23"General-Duty Valves for Plumbing Piping."

C. Install gas-fired, domestic-water heaters according to The International Fuel Gas Code.

1. Install gas shutoff valves on gas supply piping to gas-fired, domestic-water heaters without shutoff valves.

2. Install gas pressure regulators on gas supplies to gas-fired, domestic-water heaters without gas pressure regulators if gas pressure regulators are required to reduce gas pressure at burner.

3. Install automatic gas valves on gas supplies to gas-fired, domestic-water heaters if required for operation of safety control.

4. Comply with requirements for gas shutoff valves, gas pressure regulators, and automatic gas valves specified in Section 22 16 13 "Facility Natural-Gas Piping."

D. Install combination temperature-and-pressure relief valves in water piping for domestic-water heaters without storage. Extend commercial-water-heater relief-valve outlet, with drain piping same as domestic-water piping in continuous downward pitch, and discharge by positive air gap onto closest floor drain.

E. Install water-heater drain piping as indirect waste to spill by positive air gap into open drains or over floor drains. Install hose-end drain valves at low points in water piping for domestic-water heaters that do not have tank drains. Comply with requirements for hose-end drain valves in Section 22 11 19 "Domestic Water Piping Specialties."

F. Install thermometer on outlet piping of domestic-water heaters. Comply with requirements for thermometers in Section 22 11 19 "Domestic Water Piping Specialties."

G. Assemble and install inlet and outlet piping manifold kits for multiple domestic-water heaters. Fabricate, modify, or arrange manifolds for balanced water flow through each domestic-water heater. Include shutoff valve and thermometer in each domestic-water heater inlet and outlet, and throttling valve in each domestic-water heater outlet. Comply with requirements for valves in Section 22 05 23 "General-Duty Valves for Plumbing Piping," and comply with requirements for thermometers in Section 22 11 19 "Domestic Water Piping Specialties".

H. Install piping-type heat traps on inlet and outlet piping of domestic-water heater storage tanks without integral or fitting-type heat traps.

I. Fill domestic-water heaters with water.

J. Charge domestic-water thermal expansion tanks with air.

3.02 CONNECTIONS

A. Comply with requirements for domestic-water piping in Section 22 11 16 "Domestic Water Piping."

B. Comply with requirements for gas piping in Section 22 16 13 "Facility Natural-Gas Piping."

C. Drawings indicate general arrangement of piping, fittings, and specialties.

D. Where installing piping adjacent to fuel-fired, domestic-water heaters, allow space for service and maintenance of water heaters. Arrange piping for easy removal of domestic-water heaters.

3.03 IDENTIFICATION

A. Identify system components. Comply with requirements for identification in Section 05 53 "Painting and Identification for Plumbing Piping and Equipment."

3.04 FIELD QUALITY CONTROL

A. Perform tests and inspections.

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

2. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.

3. Operational Test: After electrical circuitry has been energized, start units to confirm proper operation.

4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

B. Domestic-water heaters will be considered defective if they do not pass tests and inspections. Comply with requirements in Division 01 Section "Quality Requirements" for retesting and reinspecting requirements and Division 01 Section "Execution" for requirements for correcting the Work.

C. Prepare test and inspection reports.

3.05 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain commercial, gas-fired, domestic-water heaters.

END OF SECTION

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SECTION 230010
HVAC GENERAL REQUIREMENTS

PART 1 - GENERAL

1.01 SUMMARY

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

B. Work Included:

Every item of labor, materials, equipment and appurtenances for installing complete new Heating, Ventilating and Air Conditioning Systems included in Division 23 of the Specifications.

1.02 DRAWINGS

A. The mechanical Drawings are diagrammatic in nature and show the general arrangement of all ductwork, piping, equipment and appurtenances and shall be followed as closely as actual building construction and the work of other trades will permit. Because of the small scale of the mechanical Drawings, it is not feasible to indicate all offsets, fittings and accessories that may be required. The Contractor shall investigate the construction conditions affecting the work and provide fittings and accessories as required to meet actual conditions.

B. Where discrepancies in scope of work as to which Trade provides specific items, such as starters, disconnects, flow switches, electrical control components, etc. exist, such conflicts shall be reported to the Engineer. If such action is not taken, the Contractor, as applicable, shall furnish such items as part of his work, for complete and operable systems and equipment, as determined by the Engineer.

1.03 REGULATIONS AND STANDARDS

A. The completed installation and all materials and equipment shall conform to local ordinances and codes, other regulations and standards listed herein or in related sections. These are intended as a minimum and shall be exceeded if required by the specifications or the Drawings. In the event of conflict between the codes, standards, or regulations, and information contained in the Contract Documents, the applicable code, standards, or regulation shall take precedence.

B. Refer to Division 1 and Supplementary Instructions to Bidders for construction permitting requirements.

1.04 INSPECTION CERTIFICATES

A. The Contractor shall furnish three copies of certificates of final acceptance to the Engineer from all inspection authorities having jurisdiction.

1.05 SUBSTANTIAL COMPLETION INSPECTION

A. The Engineer will visit the site for the purpose of conducting a substantial completion inspection once the following items have been met by the Contractor:

1. All HVAC systems shall be complete, operational and under automatic control.

2. HVAC systems cleaning, balancing, and testing as described in Section 23 05 93 shall be complete and the final report shall be approved by the Engineer.

3. Letters, signed by representatives of the manufacturer, for the boiler, chiller, cooling tower, heat pump, and air conditioning unit shall be provided attesting that their respective equipment has been started, tested, and set to operate safely and at the control points required as an integral part of the systems in which they are installed.

4. A letter, signed by a representative of the temperature controls manufacturer as described in Section 23 09 00, shall be provided attesting that the installation of the temperature controls system is complete, proper control of all equipment, valves, dampers, and the like has been verified, set points have been established to provide proper control of installed equipment, and graphics are accurate with real time data.

5. The Contractor shall provide certification from an authorized official of the equipment manufacturer(s) stating that all refrigerant piping as described in Section 23 20 00 and specialties have been installed in accordance with the manufacturer's recommendations.

6. The noise and vibration control supplier as described in Section 23 05 48 shall provide a letter stating that all items have been installed properly and that all equipment is adequately isolated and/or restrained.

7. The Contractor shall attest by letter that all equipment has been wired and tested to verify that the indicated sequence of motor control is established, that all safety controls function properly, that all motor protective devices are sized correctly, and that the systems are operating at the proper set points.

8. Certificate of inspection for all boilers and pressure vessels shall have been completed.

B. All discrepancies noted in the substantial completion report shall be corrected prior to the final inspection. The Contractor shall provide a detailed item-by-item description of all corrections made for each item on the substantial completion discrepancy list prior to scheduling final inspection by the Engineer. Additional visits required after the final inspection, for the reason that previously documented discrepancies had not been corrected at the time of the final inspection, will be made at the Contractor's expense.

1.06 ASBESTOS

A. Asbestos Free Materials: The intention of these Drawings and specifications is that there are no asbestos-containing materials installed on this project. To the best of the Architects and Engineers knowledge, none of the material or equipment specified herein or shown on the Drawings contains asbestos. The Contractor shall make every effort to prevent any asbestos materials from being installed in or used on the construction of the project. At the completion of the project, the Contractor shall certify by letter that to the best of his knowledge, no asbestos-containing materials were used for or in the construction of this project.

B. Existing Materials:

1. Contractor shall review the Owners asbestos management plan to ensure suspected asbestos containing materials are under surveillance.

2. Discovery: If during the construction of this project, work involving friable asbestos is suspected, or encountered, all work in this area shall be discontinued and the Owner or the Owner's representative, shall be notified immediately and the Owner with his own forces or by separate contract shall be responsible for complete investigation, removal,

and disposition of the friable asbestos hazard in accordance with applicable laws and regulations. If the Contractor claims that delay or additional cost is involved because of such action by the Owner, he shall make such claim as provided elsewhere in the Contract Documents.

3. Removal: All work involving the removal of friable asbestos will be done under a separate contract.

1.07 MATERIALS AND WORKMANSHIP

A. Equipment and material used in the project shall be new and undamaged. The mechanical installation shall fit into the space allotted and shall allow adequate and acceptable clearances for entry, servicing and maintenance. Similar types of equipment shall be the products of the same manufacturer unless specified otherwise. Work shall be performed by mechanics or tradesmen skilled in the trade involved.

B. All ductwork, piping and conduit shall be installed in a neat and organized manner, parallel to other work and the nearest building elements, unless specifically shown otherwise on the Drawings.

C. Equipment and materials shall be suitable for use in the environment in which they are installed. Equipment exposed to outside conditions shall be adequately protected from the weather, manufactured from materials suitable for outdoor use, and designed specifically for use in outdoor environments.

1.08 SUBMITTALS

A. Submit shop drawings, product data and samples in accordance with Division 1 for all items as specified in related sections of these specifications. One (1) electronic (PDF) copy of the submittal shall be submitted. One (1) electronic (PDF) copy of the submittal will be returned to the Contractor. If additional copies are required, they will be the responsibility of the Contractor. Where drawings are submitted, the Contractor shall submit a minimum of two (2) sets of full scale prints. One (1) copy will be marked and returned to the Contractor, and the Contractor shall be responsible for all additional copies required for his use. All submittal data shall be correctly identified to show project name, and the exact model, style or size of item being submitted. Improperly identified submittals will not be reviewed by the Engineer. Each item submitted for review shall bear the Subcontractor's stamp which states that they have reviewed the submission, that it is complete, and that in their opinion it meets the contract requirements. Contractor's stamp shall identify the specification section, paragraph, and page number for which the submittal is being made. Shop drawings will be reviewed only for general compliance with the Contract Documents. Review will not include correctness of details, proper configuration, utility connections, dimensions, sizes, quantities, and the like. Any submission which has not been reviewed and stamped by the M/E Subcontractor will not be reviewed by the Engineer. No reviews prior to award of Contract will be considered or accepted. Re-submissions of shop drawings, product data and samples shall include the entire original submittal. **Partial submittals will not be reviewed by the Engineer.**

B. Submissions will be stamped by the Engineer in one of the following ways:

"No Exceptions Taken"	No exceptions are taken and subject to compliance\ with the Contract Documents.
"Make Corrections Noted"	Minor corrections are noted and a re-submittal is not required subject to compliance with the corrections and the Contract Documents.

"No Exceptions Taken"	No exceptions are taken and subject to compliance\ with the Contract Documents.
"Correct and Resubmit "	The submitted material, method or system meets the intent of the specifications, yet has insufficient data to determine compliance with the Contract Documents. Re-submittal is required.
"Rejected"	The submitted material, method or system does not meet the intent of the specifications, or has insufficient data to determine compliance with the Contract Documents.

C. Submission Procedures:

1. If a submission is satisfactory to the Engineer, the Engineer will annotate the submission, "No Exceptions Taken" or "Make Corrections Noted" and transmit the electronic copy to the Contractor. If a resubmission is required, the Engineer will annotate the submission “Correct and Resubmit” or "Rejected" and transmit the electronic copy to the Contractor for appropriate action.

2. The Contractor shall revise and resubmit submissions as required by the Engineer until submissions are acceptable to the Engineer.

3. Approval of a working and/or shop drawings by the Engineer will constitute acceptance of the subject matter for which the drawing was submitted and not for any other structure, material, equipment or appurtenances indicated as shown.

4. The Engineer's review of the Contractor's submissions shall in no way relieve the Contractor of any of his responsibilities under the Contract. An approval of a submission shall be interpreted to mean that the Engineer has no specific objections to the submitted material, subject to conformance with the Contract Documents.

5. Where as-built drawings, record drawings and specifications are available and when provided to the Contractor for use in performing the work, the Contractor shall verify the content of such drawings and specifications, the suitability of their use in performing the work and their accuracy for the purposes in which the Contractor intends to use any record or historical documents which may be obtained. In no case shall the Contractor assume that such documents reflect a true and accurate record of the construction. Acceptance of any such materials, records, and/or drawings shall in no way result in additional cost to the Owner should an error and/or omission in these documents result in additional costs to the Contractor.

6. When major equipment being submitted is a different manufacturer or model than the basis of design, the shop drawing shall include sketches of the proposed equipment and associated service clearances overlaid against other equipment and architectural features.

7. On the first pages of all submittals, the Contractor shall provide a table showing all individual specification section paragraphs and drawings that apply to the equipment/component and a statement for each paragraph and drawing that the requirements have been met. The table shall be similar in format to the following, but shall include all relevant specification paragraphs and drawings:

Section 23 07 00 (example)	
1.2 A	Comply
1.2 B	Comply
1.3 A	Comply
1.3 B	Comply
1.3 C	Comply
1.4 A	Comply
1.4 A.1	Comply
1.4 A.2	Comply
Drawing M0.01	Comply

D. Equivalents: Manufacturers, trade names, and model numbers indicated herein and on Drawings shall be interpreted as establishing a standard of quality and shall not be construed as limiting competition. Unless definitely stated otherwise and upon complying with Division 1, the Contractor may use any article which, in his judgment is equal to that specified and is accepted by the Engineer. The ten day prior approval requirements of Instructions to Bidders (AIA Document A701) are waived for this Division of the Specifications, and unless stated otherwise the Contractor may use items that he deems as equivalent in quality and performance to the specified item subject to final acceptance of substituted items by Engineer upon his review of shop drawings. Where three (3) or more manufacturers are named in the specifications for any item, the Contractor shall use one of the named manufacturers. No others will be reviewed or accepted. Manufacturers listed first in these specifications and on Drawings were used as a basis of design. It will be the responsibility of the Contractor to verify all connections, physical sizes, capacities, etc. of all other manufacturer's items, both named or proposed. If the equipment necessitates changes in ductwork, piping, wiring or other building systems from that indicated on the Drawings, the Contractor shall be responsible for all additional costs included and notify other trades. Where such changes are required, detail drawings indicating all required changes shall be submitted for review at the same time the manufacturers drawings are submitted for approval.

E. Shop drawings, diagrams, catalog data and such other data necessary to fully describe and substantiate compliance with these specifications shall be submitted for all equipment and materials where specifically required by specification and all items identified with an [S] behind the product title. Submittals not required by the Contract Documents will not be reviewed.

F. Operation and Maintenance manual(s) shall be submitted in accordance with Division 1 and shall include a complete product index in each volume, installation and maintenance data, sequence of controls, parts lists, a copy of all approved shop drawings and the name, address and telephone number of supplier or nearest representative. All mechanical devices, equipment and systems marked [O/M] in these specifications shall be included and all other such mechanical items that will require servicing before the duration of its useful life has been reached. Manual(s) shall be presented to the Engineer for review and transmittal to the Owner before final payment is recommended.

1.09 WARRANTY

A. The Contractor shall provide a warranty for a period of one year for all work provided under the Contract to include, but not necessarily limited to, all systems, equipment, materials, and workmanship. This shall not be construed to limit any extended warranty periods of longer than one year for specific items or systems specified elsewhere in the Contract Documents.

B. The warranty period shall commence on the date of acceptance by the Owner and shall cover all parts and labor as required to fulfill the warranty at no cost to the Owner.

C. Refer to Division 1 for additional warranty requirements.

D. Information on all warranties shall be included in the O&M Manuals specified herein to be provided to the Owner.

E. In phased construction, warranties shall not begin until substantial completion of the FINAL phase. Contractor shall maintain all new equipment and systems until that time. Owner will maintain all existing equipment and systems. Where new systems are connected to existing, the Contractor and Owner shall determine coordination of maintenance responsibilities at the preconstruction meeting.

1.10 EXCAVATION, BEDDING AND BACKFILLING

A. Excavation:

1. Perform all excavation of every description and of whatever substance encountered to the depths required for installation of the work as indicated on the Drawings or specified herein. The amount of trench opened at one time shall not exceed 200 feet including the backfilled portion of any trench which is not in condition for traffic. All excavated materials not required, or which are not suitable for backfill, shall be removed by the Contractor. Shoring shall be provided as necessary to protect existing facilities, new work, and the safety of personnel. Sheathing for pipe trenches shall be left in place at the Contractor’s expense. Provide cofferdams or other structures required for construction at no additional cost.

2. Trenches shall be necessary width for the proper laying of the pipe with the banks as nearly vertical as practicable. Trench width at the top of the pipe shall not exceed 8 inches on either side of pipe. In rock excavation, the rocks shall be removed to a minimum of 6 inches from the sides of the pipe. Trenches shall be excavated to a depth of 4” below the normal pipe depth except where rock, shale or other hard material is encountered. Where rock, shale, or other hard material is encountered, the trench shall be excavated to a depth of 6” below normal pipe depth. Except where rock, shale, or other hard material is encountered, care shall be taken not to excavate below the depths indicated. Unauthorized over depths shall be backfilled with No. 10 crushed stone to levels previously specified. Whenever wet or otherwise unsuitable soil that is incapable of properly supporting the pipe is encountered in the bottom of the trench, such soil shall be removed to the depth required as determined by the Engineer and the trench backfilled to the proper grade with material as specified above for over depth.

3. Trenches for the utility piping shall be of a depth that will provide a minimum of 4 feet of cover from top of pipe to finished grade, unless otherwise indicated.

4. Excavation for Appurtenances: Excavation for manholes and similar appurtenances shall be sufficient to leave at least 12 inches in the clear between their outer surfaces and the embankment or shoring. Final earth supporting elevations shall be of bearing

capacity for loads encountered. Rock and over depth shall be treated same as described for trench excavation.

B. Bedding and Backfilling:

1. Backfilling shall not commence until all tests have been performed and all utility systems conform to the Contract Documents.

2. Trenches shall be accurately graded and bedded with No. 10 crushed stone to the pipe level and thoroughly compacted as specified hereinafter. Bedding shall be installed and shaped in accordance with details shown on the Drawings. The pipe shall rest firmly on the bedding along the entire length of pipe except as necessary for proper jointing. Trenches shall be backfilled, thoroughly haunched and tamped. Settling the backfill with water will not be permitted. The surface shall be graded to reasonable uniformity and mounded over trenches. Sewers shall be checked to determine any displacement of the pipe after trenches have been backfilled to two (2) feet above the pipe. A light shall be flashed between manhole or structure locations for straight sections of pipe and poor alignment or any other defects shall be remedied.

3. Compacted Backfill: All backfill material used in trenches under paved areas shall be classified as “compacted backfill”. Backfill materials shall be approved excavated material, or other select material, as approved by the Engineer, free from large clods of earth, cinders, ashes, refuse, vegetable or organic matter, and rocks or stones over 1” dimension. Backfill from the bottom of the trench to the center line of the pipe shall be compacted bedding. Backfill from this point to the top of the trench shall be placed in 6 inch layers and compacted to prevent future settlement. Methods and materials used in backfilling shall be provided to obtain 95 percent of maximum density at optimum moisture as determined by AASHO Standard T99, and as sufficient to prevent settlement of the pavement or surface.

4. Normal Backfill: For all backfill <u>not</u> under paved or future paved areas, backfill material shall be free from cinders, ashes, refuse, vegetable or organic matter, boulders, rocks or stones over 3” dimension. Backfill from the bottom of trench to centerline of pipe shall be compacted bedding. Above this point, backfill shall be placed and compacted in 6 inch layers to one foot above the top of the pipe. The remainder of the backfill shall be placed in one foot layers and tamped.

5. The Contractor shall supply the backfill material as specified herein without additional cost to the Owner.

1.11 EROSION AND SEDIMENT CONTROL

A. Furnish all materials required by the Erosion and Sediment Control Plan and applicable provisions of the Commonwealth of Virginia’s Erosion and Sediment Control Ordinance.

B. Any control measure disturbed or modified by any days operation shall be repaired or replaced prior to leaving job site at end of each days operation.

C. Upon completion of the work and when all permanent structures, seeding and other control measures are in place, remove all temporary control components.

1.12 SEEDING

A. The work consists of providing seeding the Construction Site disturbed by excavation and backfilling for the installation of pipe lines.

B. All disturbed areas shall receive sufficient top soil as required to support grass. Topsoil shall not be placed while in frozen or muddy condition.

C. After the topsoil has been spread and approved, it shall be cleared of all surface trash, and other objects that would hinder maintenance of seeded areas. The Contractor shall machine rake or hand rake in small confined areas, all areas to be seeded, to provide a seed bed ready for fertilizing and seeding.

D. Prior to planting seed, the areas shall be brought to proper finished grades and previously graded areas shall be repaired as necessary. Commercial fertilizer 10-10-10 shall be uniformly spread over the entire area at a rate of 1000 lbs. per acre. Work fertilizer into soil to depth of 3 inches by raking, tilling, or other approved methods.

E. The Contractor shall use a fresh, clean, new crop grass seed to match the existing surrounding grass, as close as possible. Seed shall be uniformly sown at a rate as recommended for type seed used. After sowing, seed shall be lightly covered by means of harrowing or raking and then compacted by rolling. Mulch immediately with straw mulch at the rate of 2000 lbs. per acre.

F. At the Contractor's option, seed, mulch and 10% of fertilizer may be applied by a hydro-seeding method. 90% of fertilizer shall be applied as hereinbefore specified. A letter stating the mix proportions, rate of application, application procedure to be followed, and previous qualifications of applier shall be sent to the Engineer for approval prior to doing the work.

G. The seeded areas shall be maintained for a period of two months after completion of seeding operations. Maintenance shall consist of providing protection against traffic, re-seeding, weeding, re-fertilizing, watering, and mowing as necessary to produce completely established grass. The Contractor shall do such replanting as required to establish a uniform stand of grass. The work under this area will be accepted only after a uniform stand of grass has been established, and in no case in less than 2 months after seeding.

H. Seeding shall be done between March 15 and May 15 or August 15 and October 15 unless a supplemental irrigation system is used in summer months.

1.13 CUTTING AND PATCHING OF EXISTING PAVEMENT AND CONCRETE

A. Pavement and concrete removed for trenching shall be saw cut before removal. All paving removed for trenches shall be restored to original condition with materials that match adjacent surfaces, as close as possible. The Contractor shall be responsible for any sinking of the backfill or pavement which may occur within one year from acceptance by the Owner.

1.14 EXISTING UNDERGROUND UTILITIES

A. The location of underground utilities shown on the Drawings shall be considered approximate, and any locations may not be indicated or known. Care shall be exercised by the Contractor during construction to locate and protect the known and unknown utilities, and to prevent disrupting the affected utility. The Contractor shall be responsible for repairing damage to any utility caused by his work.

B. Where any existing utilities are damaged, they shall be repaired as directed by the Engineer, with materials approved by the local utility company or the Owner, at no additional cost to the Owner.

1.15 VERIFYING MEASUREMENTS AND CONDITIONS

A. The exactness of grades, elevations, dimensions, or locations given on the Drawings, is not guaranteed by the Engineer. The Contractor shall, therefore, satisfy himself as to the

accuracy of all grades, elevations, dimensions and locations. In all cases of interconnection of his work with existing or other work, he shall verify at the site all dimensions relating to such existing or other work. Any errors due to the Contractor's failure to so verify all such grades, elevations, locations, or dimensions shall be promptly rectified by him without cost to Owner.

B. The Contractor shall base his bid on site examinations performed by him. This requirement is mandatory. The Contractor shall visit the site of the proposed project where work is scheduled to be performed, visit the existing buildings scheduled to be renovated, inspect piping systems where new-to-existing connections shall be made, etc., and ascertain for himself the amount of work required to fulfill the intent of his Contract and the complexity of the installation. The Contractor shall not hold the Engineer, his Consultants, agents or employees responsible for or bound by, any schedule, estimate or for any plan thereof. The Contractor shall study all Contract Documents to determine exactly the extent of work to be provided under each Section, and in installing new equipment and systems and coordinating the work with the other Trades and existing conditions.

1.16 INTERRUPTION OF UTILITY SERVICES

A. It is necessary that close liaison be maintained with the Administrative Authorities in all matters affecting interruptions of any utility services serving the facility and existing buildings. Prior to interrupting any utility service, the Administrative Authorities shall be consulted and interruptions for connections made at a time (or times) suitable to the Administrative Authorities. Work shall be laid out and planned to limit the interruption times to a minimum.

1.17 COORDINATION OF WORK

A. General: The Contract Documents indicate the extent and general arrangement of the mechanical systems. The Contractor shall be responsible for the coordination and proper relation of the mechanical work to the building structure and to the work of other trades. No additional compensation or extension of completion time will be granted for extra work caused by the lack of coordination.

B. Cooperation: The Contractor shall provide dimensions and locations of all openings, shafts and similar items to the proper trades and install work as required so as not to interfere with, or delay, the building construction.

C. Locations of lines and equipment shall be determined from actual field measurements. The outlines of the building shown on the mechanical Drawings are intended only as a guide to indicate relative locations of the mechanical work. Refer to architectural and structural Drawings for building construction details. The Contractor shall determine the exact routing and location of his systems prior to fabrication or installation of any system component. Accurate measurements and coordination shall be completed to verify dimensions and characteristics for the installation of each system.

D. Unless necessitated by equipment access or otherwise indicated in the Contract Documents, all piping, ductwork, and conduit concealed above ceilings and in finished or utility spaces shall be routed as high as possible.

E. Offsets, transitions and changes of direction in all systems shall be made as required to maintain proper headroom and pitch of sloping lines whether or not indicated on the drawings. The Contractor shall provide manual air vents and drains as required for his work to affect these offsets, transitions and changes in direction, as applicable.

F. Cutting and Patching: See Division1.

G. Roughing-In: Verify the locations of other buildings machines, door swings, block coursing, alignment of tile end and other similar features before roughing-in for mechanical equipment components and/or controls.

H. Damage to Other Work: Each Contractor is responsible for damage to other work caused by his work or workmen. Repairing of damaged work shall be done by the Contractor who installed the work, and as directed by the Architect-Engineer; the cost of which shall be paid for by the Contractor responsible for the damage.

1.18 EQUIPMENT INSTALLATION

A. General: Equipment shall be installed in accordance with manufacturer's instructions to conform with the details and application indicated. Where manufacturer's recommendations or installation instructions require options or accessories not specified, they shall be included and installed by the Contractor.

B. Supports: Provide necessary supports for all equipment and appurtenances as required; this includes but is not limited to frames or supports for items such as tanks, compressors, boilers, plumbing fixtures, pumps, valves, fans, and other similar items requiring supports. Floor mounted equipment in Equipment Rooms shall be set on 4-inch high concrete foundation pads unless shown otherwise. All pads shall be poured such that the top of the pad is level. Foundation drawings, bolt setting information and foundation bolts shall be furnished by the subcontractors furnishing the equipment for all equipment required to have concrete foundations. Concrete for foundations shall be provided by mechanical subcontractor unless indicated otherwise. Except where indicated in Section 23 05 48, all equipment shall be anchored to concrete pads. Structural supports shall be firmly anchored to concrete housekeeping pads. Unless otherwise noted, outdoor equipment (on grade) shall be installed on 4-inch thick cast-in-place concrete equipment pads.

C. Service Area: All equipment and appurtenances shall be located to permit adequate service clearance in accordance with manufacturer's recommendations and as otherwise required. Service clearance shall include but not be limited to service and removal of filters, coils, motors, controls and removal of equipment sections. Service clearance shall include adequate space for rodding and removing tubes from boilers. All piping, ductwork, and other equipment shall be located outside of the service area or shall be flanged for easy removal to facilitate equipment service. All equipment shall be located with sufficient distance from building features, structural components, and the equipment of other trades. Service clearance in front of electrical panels shall be minimum as required by National Electric Code (NEC) where applicable. Equipment requiring service and located above ceiling shall be located within two feet of the ceiling vertically to allow for proper maintenance access.

D. All equipment indicated to be installed exposed within finished spaces shall be installed such that all conduit, piping, and appurtenances are concealed. Air conditioning units utilizing gravity condensate drains shall be installed at an elevation necessary for the specified pipe slope.

1.19 EXISTING EQUIPMENT

A. General: Care shall be exercised to protect all existing equipment to be reused. The Contractor shall remove from operation all equipment that is shown to be reused and provide adequate protection including but not limited to prevention of corrosion, protection of seals, prevention of leaking, and prevention of internal/external contamination. All electronic components shall be protected from weather and moisture, deterioration and loss of programming.

1.20 SLEEVES AND INSERTS

A. General: Sleeves and inserts shall be provided and correctly located in the structure, as require for the work.

B. Inserts shall be steel and proper size for loads encountered.

C. Sleeves shall be provided for all pipes passing through concrete or masonry walls, partitions, concrete beams or slabs installed during construction of the wall, partition, beam or slab. Sleeves through existing concrete walls and slabs may be omitted if wall or slab can be core drilled and properly sealed in a manner acceptable to the Engineer. Sleeves placed horizontally in walls or in any position in beams shall be standard weight ASTM A53 steel pipe of length equal to thickness of wall or beam. Those placed vertically in non-waterproof floors shall be 20 gauge galvanized sheet steel of length equal to thickness of slab, flared and nailed to the form, or fastened to reinforcing fabric and filled with sand during pouring to prevent deformation. Sleeves occurring in floors of rooms where hose bibs or floor drains occur, and in pipe spaces, shall be standard weight steel pipe projecting 2” above the finished floor except in Equipment Rooms they shall project four (4) inches above floor. Sleeves in floors with waterproof membrane shall be provided with flanges or flashing rings and shall be clamped or flashed into membrane. All sleeves (and core drilled openings) shall be of sufficient diameter to clear bare or covered pipes by 1/4” all around except sleeves on lines subject to movement by expansion which shall clear the bare pipe or insulation on insulated pipe at least one inch all around. Pipes through exterior walls below grade and above footings shall be installed in sleeves having a minimum size of two larger pipe diameters and sealed watertight with flexible synthetic rubber seals. Sleeve shall have anchor and water stop plate. The entire assembly shall be tightened and adjusted and made watertight. Sleeves for pipes and conduit, penetrating fire (and smoke) rated partitions, walls and floors shall be sealed in accordance with the terms of U.L. Listed Through-Penetration Firestop Systems XHEZ as published in the U.L. Fire Resistance Directory. Penetrations shall exactly conform to details of the Firestop System indicated for the type of partition, wall and floor construction encountered. All penetrations through nonfireresistance rated floor assemblies and through the ceiling membrane of nonfireresistance rated roof assemblies shall be fireblocked with tightly packed mineral-wool insulation secured in place. All penetrations through equipment room walls and other areas of noise or heat generation shall be tightly sealed with mineral fiber rope. All penetrations through draftstop partitions shall be sealed to maintain the integrity of the partition. All firestopping and draftstopping of sleeves for mechanical work shall be provided under Division 23.

1.21 WOODEN STRUCTURE

A. Where piping, ductwork and conduit are supported from wooden structure, all connections shall be made in strict accordance with this Section. For spacing of piping and ductwork supports, see Section 23 05 00.

B. Engineered wooden trusses shall not be drilled or cut under any circumstances. Where equipment or piping is supported from trusses, the Contractor shall provide steel supports bearing at panel points and spanning a minimum of two trusses. Any wooden blocking shall be fire retardant lumber in accordance with ASTM E-84 and shall bear the mark of an approved testing agency.

C. All connections to wooden framing shall be made thru shear hangers at the face of wooden members. All connections shall be made by screws.

D. Hangers for multiple pipes or ducts shall be staggered to distribute weight on trusses as evenly as possible.

1.22 PREMANUFACTURED LIGHT GUAGE METAL STRUCTURE

A. Where piping, ductwork and conduit are supported from the light gauge structure, all connections shall be made in strict accordance with this Section and with details indicated on the Drawings. For spacing of piping and ductwork supports, see Section 23 05 00.

B. Piping 4" or larger shall not be supported by light gauge metal roof framing, but rather shall be supported only by the designated steel channels shown on the structural drawings. Any connections to the light gauge metal roof framing shall be limited to 150 pounds per connection and to a maximum of two such connections to any individual light gauge member.

C. All connections to the light gauge roof framing shall be made thru shear hangers at the face of the light gauge members. No clamps or eccentric connections shall be used that will induce twisting of the light gauge members. All connections shall be made by screws. No welding to the light gauge members will be allowed.

D. Hangers for multiple pipes or ducts shall be staggered to distribute weight on light gauge framing as evenly as possible.

1.23 PENETRATIONS THROUGH PRE-CAST HOLLOW-CORE SLAB SYSTEM

A. General: Contractor shall coordinate work with the pre-cast system. Refer to architectural and structural documents for details. Installation of work shall be in strict accordance with the pre-cast system manufacturer's recommendations, as approved by the Architect.

B. Openings: Holes in the slabs made in the field shall be made by the trade involved. Openings shall be made only through hollow cells, shall not exceed the width of the hollow cells, and shall not penetrate the webs between the cells or the pre-stressed strands unless prior approval is obtained from the Architect and the slab manufacturer. Holes shall not exceed 6" diameter without approval. Certain holes for pipe and duct shafts may be pre-cut. See structural Drawings for locations.

C. Cutting holes: Holes may be drilled or cut and trimmed with a chisel. Generally, holes will be made by cutting the outline of the hole through the lower portion of the slab from the underside and then cutting out the top side. All holes shall be made prior to the installation of the topping slab.

D. Sleeves: Sleeves are not required through pre-cast system slabs except where required to support packing material at hollow cores. Sleeves are required to be placed through concrete topping slab on top of the pre-cast slabs.

E. Supports: Hangers shall be supported from inserts or approved sockets, or toggle bolts in core slab construction. Hanger spacing shall be such that weight on hanger does not exceed 250 pounds for any one hanger. All hanger rods shall be minimum 3/8 inch in diameter. Where hanger rods must extend through slab, they shall be secured by two bolts over steel washers or plates on top of the slab in the floor fill or roof insulation space. Washers or plates shall not be less than 2" size and 1/4" thick. Larger plates are required for larger pipe supports. Cumulative thickness of plates, washers and bolts shall be 1/4" less than thickness of topping slab.

F. Explosives: Inserts set with explosives shall not be used.

1.24 ESCUTCHEONS

A. Where pipes pass through floors, walls or ceilings in finished rooms, they shall be fitted with chromium plated escutcheons of suitable pattern to effectively cover the rough opening. Where sleeves project above floors, special deep type escutcheons shall be provided.

1.25 ACCESS DOORS

A. Provide for all concealed valves, controls, dampers, junction boxes, equipment, or any item requiring access. Doors shall be of sufficient size and so located that the concealed items may be serviced or completely removed and replaced. Doors required for Mechanical work shall be furnished as a part of this Division to the General Contractor for installation. The Mechanical Contractor shall provide locations of all access doors such that service may be safely performed from a ladder, lift, or platform without the need for support from the ceiling system. Doors in acoustic tile ceilings shall be furnished in multiples of tile sizes. Doors are not required in exposed grid type ceilings where tiles are removable. Doors shall be metal access doors with cam lock, style to match ceiling or wall construction. Doors occurring in rated construction shall be fire rated U.L. labeled access doors correlated to preserve the integrity of the rated construction. Doors leading to concealed spaces shall be provided with means to open from the inside. Doors shall be prime finish steel except those in toilets, shower rooms, locker rooms, kitchens and other similar areas shall be stainless steel with brushed finish.

1.26 ELECTRICAL WIRING AND EQUIPMENT

A. Wiring, low voltage (100 volts or less) control wiring shall be provided as a part of Division 23 in strict accordance with Division 26 and shall be in accordance with manufacturer's recommendations to comply with the sequence of control indicated. Verify that wiring of all motors and controls required by equipment furnished is accomplished for the correct sequence of operation.

B. Wiring, line voltage (101 volts or higher) power or control wiring shall be furnished and installed under Division 26.

C. Disconnects shall be provided for each item of equipment under Division 26 unless specified otherwise in other sections.

D. Miscellaneous manual or automatic control and protective or signal devices required for the sequence of operation indicated for mechanical equipment shall be provided under the section of the specifications where the item of equipment is specified unless indicated otherwise.

1.27 PROTECTION FROM MOVING PARTS

A. Belts, pulleys, chains, gears, shafts, couplings and other rotating or moving parts located so that any person may come in close proximity thereto shall be fully enclosed or properly guarded.

1.28 RECORD OF UNDERGROUND LINES

A. On completion of the project, the Contractor shall prepare and submit to the Engineer a drawing on tracing paper and one blue line print to show the location of any underground lines installed in locations different from those on the Architect-Engineer's Drawings. The location of cleanouts, and the distance from the building to outside sewers, mains, and manholes shall be dimensioned.

1.29 CHARTS AND DIAGRAMS

A. General: Material as listed below shall be provided by the Contractor and shall be mounted in separate hardwood frames where directed in the field or folded and stored in a plastic document folder and located in the control cabinets. All charts, diagrams and schemes shall be photographic positives prepared from original tracings. A copy of charts and diagrams shall be included with O/M manuals.

B. Automatic Temperature Control Diagrams identified as to name, sequence of operation, location and number of systems. Components of a control system shall be identified as to location, function, temperature setting and manufacturer's part number.

C. Electric Sequence Control Diagrams of entire Mechanical system.

D. Charts for identification of valves.

1.30 INSTRUCTION OF OWNER'S REPRESENTATIVE

A. Contractors shall instruct the representative of the Owner in the proper operation and maintenance of all elements of the Mechanical systems. Competent representatives of the Contractor shall spend such time as necessary to fully prepare the Owner to operate and maintain the Mechanical and Electrical systems.

1.31 COMMISSIONING OF HVAC SYSTEMS:

A. Commissioning of this project will be coordinated and managed by the Owner's Commissioning Agent. Refer to the Commissioning Plan and Division 1 for the scope and requirements for commissioning of mechanical systems.

1.32 CONSTRUCTION STATUS REPORT

A. Each item of discrepancies noted on Construction Status Report prepared by the Engineer shall be answered in detail in writing by the Contractor before payment can be recommended.

1.33 GRAPHICS DATABASE

A. This project's Computer Aided Design & Drafting (CADD) drawing files may be obtained through the Architect/Engineer for use in preparing computer graphics specific to this project. See Appendix A at the end of this Section for Letter of Indemnification and ordering instructions.

1.34 DEMOLITION

A. Contractor shall visit site before bidding to determine extent of demolition.

B. Removal of Ducts, Piping and Equipment: Remove all ductwork and piping connections, plugging outlets, etc., such that are not required for present equipment and fixtures, or are not reused or needed for reconnecting new equipment and fixtures. Remove all equipment, fixtures, etc., indicated to be removed, or not reused or needed after the renovations are complete.

C. Where piping, conduit, ductwork or other similar items passing through rated assemblies are removed; the assemblies shall be patched in accordance with UL so as to maintain the integrity of the assembly.

D. Where demolition of equipment, pipes, conduit, ducts or other components occurs in a finished space, all ceilings, floors, walls, and casework or other affected building elements shall be patched to match existing finishes and construction.

E. The Owner will select and retain such existing equipment and materials which are indicated to be removed and not reused, as he desires. All other existing equipment and materials indicated to be removed and not reused shall become the property of the Contractor, who shall promptly remove them from the premises. All existing equipment and fixtures indicated to be relocated shall be disconnected, removed, relocated and reconnected. All equipment and fixtures shall be protected from damage during demolition.

F. Miscellaneous: In all altered portions of the buildings, the Contractor shall remove or alter as necessary all existing mechanical work that is not coordinated to operate with the new construction. Demolition shall not begin until the work schedule is approved by the owner. The work shall be scheduled to prevent any disruption to the normal operations of the building.

G. General Scope of Demolition: Removal of existing heating water system, boilers, expansion tanks, valves, piping within the mechanical room, controls and pumps.

1.35 PHASING OF WORK

A. Coordinate phasing requirements with Division 1.

PART 2 - PRODUCTS – Not Used

PART 3 - EXECUTION – Not Used

END OF SECTION

APPENDIX A
LETTER OF INDEMNIFICATION

Project Name: William Byrd Middle School – Boiler Replacements

Project Location: 2910 E Washington Ave, Vinton, VA 24179

The Contractor may obtain from Ascent Engineering Group a CD-ROM or electronic mail version of the projects Revit / CADD database. All seals, details, schematics, tables, controls, etc. will be deleted. All drawings will be provided in Autocad™ 2014 format.

Ascent Engineering Group reserves all rights to the original drawing files.

The Recipient agrees, to the fullest extent permitted by the law, to hold harmless and indemnify Ascent Engineering Group, as defined in the Bid Documents, from and against all claims, liabilities, losses, damages, and costs, including but not limited to attorney's fees, arising out of or in any way connected with the use, modification, misinterpretation, misuse, or reuse by the Recipient or others of the machine readable information and data provided by Ascent Engineering Group under this Agreement. The foregoing indemnification applies, without limitation, to any use of the project documentation on other projects, for additions to this project, or for completion of this project by others, excepting only such use as may be authorized, in writing, by Ascent Engineering Group.

The electronic drawing files are not part of the Contract Documents for the Project. The Recipient assumes all risks associated with the use of the transmitted files. Ascent Engineering Group will not be responsible for any differences in the information included in the transmitted files and the information shown on the Contract Documents. Modifications to the Contract Documents made before or during construction may or may not be included in the transmitted electronic drawing files.

The Recipient further agrees that the drawing files will only be used in graphics preparation for the above-referenced project.

Company Name of Recipient: _____

Recipient's Designated Representative: _____

Title: _____

Signature: _____

Address: _____

Return to: Ascent Engineering Group
5228 Valleypointe Parkway, Suite 4
Roanoke, VA 24019
AEG # 23070

SECTION 230100
OPERATION AND MAINTENANCE OF HVAC SYSTEMS

PART 1 - GENERAL

1.01 SUMMARY

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

B. Work Included:

1. To aid the continued instruction of operating and maintenance personnel, and to provide a source of information regarding the products incorporated into the work, furnish and deliver the data described in this section and in pertinent other sections of these specifications.

C. Related Sections:

1. Section 23 00 10 – HVAC General Requirements

2. Section 23 05 00 – Common Work Results for HVAC

3. Section 23 20 00 – HVAC Piping and Pumps

4. Section 23 30 00 – HVAC Air Distribution

5. Section 23 50 00 – Central Heating Equipment

6. Section 23 80 00 – Decentralized HVAC Equipment

1.02 SUBMITTALS

A. Unless otherwise directed in other sections, or in writing by the Engineer, submit three copies of the final manual to the Engineer for approval prior to indoctrination of operation and maintenance personnel.

B. Operation and Maintenance manual(s) shall be submitted in accordance with Division 1 and shall include a complete product index in each volume, installation and maintenance data, sequence of controls, parts lists, a copy of all approved shop drawings and the name, address and telephone number of supplier or nearest representative. All mechanical devices, equipment and systems marked [O/M] in these specifications shall be included and all other such mechanical items that will require servicing before the duration of its useful life has been reached. Motor driven equipment shall include data for the motor. Manual(s) shall be presented to the Engineer for review and transmittal to the Owner before final payment is recommended.

1.03 QUALITY ASSURANCE

A. In preparing data required by this section, use only personnel who are thoroughly trained and experienced in the operation and maintenance of the described items, completely familiar with the requirements of this section, and skilled communicating the essential data.

PART 2 - PRODUCTS

2.01 INSTRUCTION MANUALS

A. Where instruction manuals are required to be submitted under other sections of these specifications, prepare in accordance with the provisions of this section.

B. Format:
Size: 8-1/2" x 11"
Paper: White bond, at least 20 lb. weight.
Text: Typed (Hand printed or written is not acceptable)
Drawings: 11" x 8-1/2" preferable; bind in with text; foldouts are acceptable; larger drawings are acceptable if folded to fit within the manual and provide a drawing pocket inside rear cover or bind in with text.
Fly Sheets: Separate each portion of the manual with neatly prepared Fly Sheets or tabbed index sheets briefly describing the contents of the ensuing portion. Fly sheets or index tabs may be in color.
Binding: Use heavy-duty plastic covers with binding mechanism concealed inside the manual; 3-ring binders are required. All binding is subject to the Engineer's approval.

C. Provide front and back covers for each manual, using durable plastic material approved by the A.E, and clearly identified on the front cover with at least the following information:

OPERATING AND MAINTENANCE INSTRUCTIONS

FOR

(Item/system name and description)

(Name and address of Contractor and sub-contractor)

(General subject of this manual)

(Name and address of Engineer)

(Engineer's approval and date approved)

D. Contents:
Neatly prepared and typewritten detailed table of contents.
Complete instructions regarding operation and maintenance of all equipment involved including lubrication, disassembly, and reassembly.
Complete nomenclature of all parts of all equipment.
Complete nomenclature and part number of all replaceable parts, name and address of nearest vendor, and all other data pertinent to procurement procedures.
Copy of all guarantees and warranties issued.
Manufacturer's bulletin, cuts, and descriptive data, where pertinent, clearly indicating the precise items included in this installation and deleting, or otherwise clearly indicating, all manufacturers' data with which this installation is not concerned.
Such other data as required in pertinent sections of these specifications.

PART 3 - EXECUTION

3.01 INSTRUCTION MANUALS

A. Revisions:

1. Following the indoctrination and instruction of operation and maintenance personnel, review all proposed revisions of the Manual with the Engineer.

END OF SECTION

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SECTION 230500
COMMON WORK RESULTS FOR HVAC

PART 1 - GENERAL

1.01 SUMMARY

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

B. Work Included:

1. Common Motor Requirements for HVAC Equipment
2. Variable Frequency Drives
3. Expansion Fittings for HVAC Piping
4. Meters and Gages for HVAC Piping
5. General-Duty Valves for HVAC Piping
6. Hangers and Supports for HVAC Piping and Equipment

C. Related Sections:

1. Division 01 -- Commissioning
2. Section 23 00 10 – HVAC General Requirements
3. Section 23 05 48 – Vibration and Seismic Controls for HVAC Systems
4. Section 23 05 53 – Identification for HVAC Piping and Equipment
5. Section 23 05 93 – Testing, Adjusting and Balancing for HVAC
6. Section 23 09 00 – Instrumentation and Control for HVAC
7. Section 23 20 00 – HVAC Piping and Pumps
8. Section 23 30 00 – HVAC Air Distribution
9. Section 23 50 00 – Central Heating Equipment
10. Section 23 80 00 – Decentralized HVAC Equipment

1.02 REFERENCES

A. General: The following standards or codes form a part of this specification to the extent indicated by the reference thereto.

B. American Society of Mechanical Engineers (ASME):

C. ASME 95 Boiler and Pressure Vessel Code

D. B16.3 Malleable Iron Threaded Fittings

E. B16.4 Cast Iron Threaded Fittings

F. B31.9 Building Services Piping

G. National Electrical Manufacturers Association (NEMA)

H. Underwriters Laboratories, Inc. (UL)

1.03 COMMISSIONING OF HVAC SYSTEMS:

A. The Contractor shall provide contact information to the Commissioning Agent indicated in Division 1 for all major items of Equipment.

B. Provide additional submittal copy of major equipment for Commissioning Agent specified in Division 1.

1.04 SUBMITTALS

A. Submit shop drawings and product data in accordance with Division 1 and Section 23 00 10.

B. Shop drawings, diagrams, catalog data and such other data necessary to fully describe and substantiate compliance with these specifications shall be submitted for all equipment and materials marked with notation set forth in Section 23 00 10.

C. Operation and maintenance data shall be submitted in accordance with Division 1, for all items of equipment and materials marked with notation set forth in Section 23 01 00.

PART 2 - PRODUCTS

2.01 COMMON MOTOR REQUIREMENTS FOR HVAC EQUIPMENT

A. Motors shall be provided in place as an integral part of the driven equipment, ready for electrical connections. Motors shall be in accordance with NEMA Standards and of design suitable for the starting and running characteristics of the driven equipment. Motors over 5 HP shall be “premium” efficiency as defined by NEMA MG-1, latest edition.

B. All three phase motors over 5 HP shall be provided with minimum power factor of 90%. Power factor correction capacitors shall be provided if required and shall be furnished to the electrical subcontractor for installation. Shop Drawing submittals for motors over 5 HP shall list efficiency and power factor. Unless specified otherwise, all motors shall have continuous duty classification, 40° Centigrade ambient temperature, shall have enclosure suitable for indicated application and shall be wound for 120 volt, single phase, 60 cycle current, except motors above 1/2 horsepower (unless indicated otherwise) shall be wound for 200V or 230V/460V as required by the secondary voltage specified for main service in Division 26. Each motor shall be selected and rated at the voltage indicated so that the driven load does not exceed the nameplate rating and service factor of the motor. All motors 460V/480V 20 HP and above and 208V/230V 10 HP and above shall be wound for wye-delta (6 or 12 lead) starting with capabilities of being wired for across-the-line starting.

C. Motors for use with variable frequency drives (VFD) shall be wound for across-the-line type starting and shall be rated for “VFD-duty” or shall be Premium Efficiency type with Class F (1500 volt) insulation and thermal overload protection. Motors for VFD applications shall meet or exceed IEEE 519-1992. Motors for VFD applications shall have maximum 4:1 speed range corresponding to 60 Hz and 15 Hz. Power factor correction is not required when motor is used with VFD. Motors for VFD service shall be Inverter Duty Rated with internal shaft grounding to prevent common mode voltage (shaft current) bearing failures.

D. Where 2-speed motors are indicated for motors above 1/2 horsepower, motors shall have two separate windings.

E. Motor starters and motor protective switches shall be provided under Division 26 except where specified to be furnished specifically with the driven equipment. Accessories such as auxiliary contacts, hand-off-automatic switches, start-stop switches, pilot lights, control power transformers and other similar items shall be provided in or on the controllers as required by the control sequence indicated. Starting equipment, unless factory mounted on the equipment, shall be installed under Division 26.

2.02 VARIABLE FREQUENCY DRIVES [S] [O/M]:

A. Variable Frequency Drives (VFD) shall convert primary power to adjustable voltage/frequency three phase AC power for stepless motor control from 5% to 105% of motor base speed. Units shall be pulse-width-modulation (PWM) type. Units shall be UL listed and suitable for installation in return air plenums, complete with Hand/Off/Auto switch, Run or Stop switch and display to indicate unit status, frequency and fault diagnostics. Unit shall have automatic soft restart after power outage, soft start/stop, and interface provisions for start/stop and control from the DDC system specified in Section 23 09 00 interconnections. Unit shall have all motor protective devices as required by NEC. Unit shall have line circuit breaker, bypass switch, motor thermal overload relay, phase-loss protection, ground-fault protection, harmonic compensated load side reactor and control transformer.

B. All drives provided for the project shall be supplied by the same manufacturer, including those installed with equipment at the factory. The VFD shop drawing shall be inclusive of all drives on the project.

C. Drives shall be suitable for operation without damage to the connected motor. Drives shall have multiple, adjustable deadbands across the entire speed range for operation of connected equipment without vibration. Units shall have display on each drive to indicate all faults and diagnostics.

D. Drives shall be matched to driven motors in accordance with motor and drive manufacturers' recommendations.

E. Drives shall be suitable for speed control by the DDC System specified in Section 23 09 00 using any of the following signals, 3-15 psi, 0-5 vdc, 0-10 vdc or 4-20 ma dc.

F. Drives shall be provided with current sensing device to indicate abnormal conditions such as broken belt.

G. Where wiring to the driven motor exceeds 150 feet or as otherwise recommended by the manufacturer, a load side drive filter shall be furnished and installed. Where drives have remote disconnects at the driven motor, a run contact shall be provided to stop the drive without harm if the remote disconnect is opened.

H. Drives shall be installed in NEMA classified cabinets suitable for the location in which installed. Units located outdoors shall be NEMA 3R or NEMA 4.

I. Harmonics: The drives provided shall not add significant voltage harmonic distortion to the electrical system. If voltage harmonic distortions exceed 5%, line reactors or isolation transformers shall be provided in a separate enclosure.

J. VFD shall be provided with communication interface to allow two-way communication with the DDC System specified in Section 23 09 00.

K. Warranty: Provide parts and labor warranty for a period of five (5) years.

L. Installation and Start-up:

1. The services of a qualified manufacturer's technical representative shall supervise the contractor's installation, testing, and start-up of all the drives furnished under this specification. A maximum total of one (1) supervision day (8 hours) shall be provided by the manufacturer's representative.

2. System start-up shall include a checkout of vibration at various frequencies through field observation and manufacturer's data on the driven equipment. Frequency deadbands shall be set-up for each point of equipment vibration.

3. Upon acceptance of the drive equipment, training of the operators shall consist of one (1) training day (8 hours).

2.03 EXPANSION FITTINGS FOR HVAC PIPING

A. Expansion joints [S] shall be Flexonic internally guided, corrugated bellows, expansion compensator, type H or HB, 2" minimum stroke, suitable for steam or hot water service.

B. Anchors and guides for pipe shall be provided as indicated or as required at the job site to localize expansion and contraction of pipe. Anchors shall consist of heavy steel or brass collars bolted or welded to the pipe and rigidly connected to the building structure unless indicated otherwise. Anchor braces shall not be attached in places where they will damage or injure the structure during installation or by the weight or expansion force of the pipe line after installation. Detail drawings of pipe anchors shall be approved before anchor installation.

C. Flexible pipe joints at chillers, pumps, air handling units or other pieces of equipment isolated from the structure by vibration isolators as specified elsewhere shall be pipe line size and shall be Flexonics standard 125 psi, Series PCS, stainless steel or bronze, flanged, screw or sweat type connectors with longitudinally welded stainless steel bellows and braided jacket.

2.04 METERS AND GAGES FOR HVAC PIPING

A. Thermometers ([S]) shall be 5" diameter adjustable angle, industrial type complete with stainless steel case, bezel, union (or 360° swivel) and stem, shatterproof lens, brass well, aluminum scale plate with black numbers and accurate to $\pm$1°F.

B. Pressure gauges ([S]) shall be equal to Ashcroft bourdon tube type suitable for 125 psi service. Gauges shall be not less than 4" dial type with aluminum case and bar stock needle type gauge cock. Gauges shall be graduated in feet of water and psi. Minimum range 1.5 times normal operating pressure.

2.05 GENERAL-DUTY VALVES FOR HVAC PIPING

A. General: Valves shall be Apollo, Bray, Center Line, Crane, Jenkins, Jamesbury, Nibco, Milwaukee, Stockham, or Weco. All valves shall be suitable for 150 psi working pressure. Class 125 is not acceptable. Valves shall have threaded connections; except where flanges are specified they shall have fully lugged flanged connections suitable for dead-end service connections, and where installed in hard drawn copper lines they may have sweat connections. All valves shall be line size for the piping section indicated.

1. Equipment Service Valves over 4" ([S]): Valves shall be carbon steel or iron body fully lugged flanged high performance butterfly (HPBV) double offset type with 316 stainless

steel disc and reinforced PTFE or RTFM replaceable seats, pressure assisted for tight shutoff. Butterfly valves shall provide bi-directional service, with downstream flange removed, and API 609 blow-out proof stem retention. Valves shall have upper and lower stem bearings of 316 stainless steel with PTFE seals.

2. Equipment Service Valves up to and including 2" ([S]): Valves shall be full port ball valves with stainless steel ball, 2-piece or 3-piece, brass body, bronze body, LF bronze body, or iron body, or shall be HPBV.

3. Equipment Service Valves 2-1/2" to 4" ([S]): Valves shall be full port ball valves with chromium plated brass ball, 2-piece or 3-piece, brass body, bronze body, LF bronze body, or iron body, or shall be HPBV.

4. Piping Branch Line Service Valves over 4" ([S]): Valves shall be iron body fully lugged flanged butterfly disc type with aluminum-bronze disc and EPT Nordel seats.

5. Piping Branch Line Service Valves up to and including 4" ([S]): Valves shall be full port ball valves, as specified for equipment service valves.

6. All valves for chilled water service shall have integral insulated handle equal to Nibco Nibseal. All valves for hot water service shall have stem extension for lever handle operator to accommodate up to 2" thick insulation.

7. Globe valves ([S]) shall be all brass or bronze, with brass disc except globe valves over 2" size may be butterfly valves as specified above, under service valves. Non-rising stems are not acceptable.

B. Check valves ([S]) shall be brass or iron body, swing type, regrinding seat and shall be suitable for 125 psi working pressure.

C. Balancing cocks ([S]) shall be all brass or bronze, venturi type, plated ball valves with Teflon seats, Tee handles, memory stops, and temperature/pressure ports. All balancing cocks shall be suitable for positive shut-off at 125 psi working pressure.

D. Circuit setter [S] [O/M] shall be Bell & Gossett, Armstrong, or Taco. Those 2-1/2" and smaller shall be bronze, ball type or brass, globe type balancing valves. Valves 3" and larger shall be cast iron globe or ball type. All circuit setters shall have provisions for connecting a portable differential pressure meter. Meter connections shall have built-in check valves. An integral pointer shall register degree of valve opening. Each balance valve shall be constructed for 125 lbs. working pressure at 250°F. Furnish one differential meter model RO-2 complete with meter, cutoffs, piping, fitting and dual hoses. Circuit setters shall not be intended for use as shutoff valves. A circuit setter with memory stop is not a substitute for service valves.

E. Triple Duty Valves [S]: Units shall be equal to Bell & Gossett straight pattern type for installation in vertical piping as indicated. Units shall provide functions of check valve, throttling valve, shut-off valve and calibrated valve with differential pressure ports. Valves shall be suitable for 125 psig and 250°F service. Valves shall be fitted with brass or bronze seat, replaceable bronze disc, stainless steel stem and spring. Valve rating shall not exceed 5 feet of water pressure drop at 100% flow and shall not exceed manufacturer's recommendations.

F. Safety Valves [S]:

1. Safety relief valves for water heating systems shall be equal to Watts ASME rated, series 740 or 174A. Valves for heating systems shall be sized to relieve the full heating capacity of the heater installed in the heating system at set pressure of 5 psi over

operation pressure. Pipe discharge port full size to floor and support so that no strain is on the valve body.

2.06 HANGERS AND SUPPORTS FOR HVAC DUCTWORK, PIPING AND EQUIPMENT

A. Suspended horizontal piping shall be supported by adjustable wrought steel clevis hangers except that straight runs of hot piping (>100°F) with 40 ft. or more between anchor and expansion device shall be supported on roller type hangers or supports. See Section 23 07 00 for calcium silicate hanger inserts at clevis hangers. All piping connected to motor driven reciprocating or rotating equipment shall have vibration isolation hangers as specified in Section 23 05 48. Protection saddle, welded to pipe, shall be provided at each roller support except on chilled water lines, saddle shall be external metal shield with calcium silicate preformed section as specified in Section 23 07 00, vapor sealed. Calcium silicate inserts may be omitted for pipe smaller than 2 inches. Where supports bear on copper pipe they shall be copper plated. Chain, strap or other makeshift devices will not be permitted as hangers of supports.

B. Maximum pipe support spacing for steel piping shall be ten feet on center, -copper and brass tubing 1-1/4” and smaller shall be supported six feet on center.

C. Vertical steel piping shall be guided or supported in the center of each riser and not over 15 feet on center, copper or brass tubing shall be supported at not over 10 feet on center; and supported at the base of each riser and/or at the top of each riser as required by the piping run. All vertical piping shall be guided or braced where required to prevent lateral movement. Bracing shall include auxiliary stanchions where piping is not in close proximity to suitable structure.

D. Rigid support sway bracing shall be provided at changes in direction greater than 45 degrees for all pipe 4 inches and larger.

E. Pipe and suspended equipment hanger rods shall be attached to the top chord only on steel joists and beams by joist or beam clamps without welding. Welding of support rods and connection at any place other than the top chord will not be permitted unless written approval is granted by the Engineer and the Architect. C-clamp hangers shall be limited to 50 lb. or less when used at joists. Threaded rod shall be used through joist chords for loads greater than 50 lb.

F. Pipe and suspended equipment supported from concrete structure shall be high-strength screw anchor and threaded rod system. Anchor shall be zinc plated, heat treated, carbon steel with integral flanged head to accept threaded rod. Anchor shall be selected to provide a minimum safety factor of 2 for the load to be supported and shall be approved for use in cracked and uncracked concrete applications. Anchor shall be Simpson Strong-Tie Titen HD or equal.

G. Duct supports shall consist of not less than 1” by 1/16” galvanized strap iron hangers spaced not over 4 feet on center, except medium and high pressure flat-oval ducts wider than 48 inches shall be supported by trapeze angles. Straps shall be lapped across the bottom ducts a minimum of 1 inch. Ductwork shall be supported from the building structure. Ductwork shall not be supported from the ceiling system or any other building services. Heavy ductwork such as medium or high pressure duct supported by hanger rods, shall be attached to the top chord only on steel joists and beams by joist or beam clamps without welding. Welding of support rods and connection at any place other than the top chord will not be permitted unless written approval is granted by the Engineer and the Architect. All ductwork shall be braced as required to prevent lateral movement.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Install products in accordance with manufacturer's recommendations.

B. Support riser piping independently from the connected horizontal piping.

C. Hangers shall be spaced so that the supported load does not exceed the load recommended by the manufacturer. The supported load shall not overstress the building structural members. Where required hangers for the suspension of heavy items do not correspond with the building structural members, provide supplemental steel members fastened to the building structural members.

D. Valves in horizontal lines shall be installed with stems horizontal or above. Flanged butterfly valves shall be provided with spacer or spool piece between valve and adjacent appurtenance. Isolation service valves shall be installed on each side of each major piece of equipment such as a pump, boiler, and other similar items; and at any other points indicated or required for draining, isolation or sectionalizing purposes. Control valves shall be installed in accordance with control manufacturer's recommendations.

E. Install all thermometers and gages such that they can be easily readable standing on floor. Gages subject to vibration or physical damage shall be adequately supported and protected.

F. Where pressure/temperature ports are indicated on the drawings, they shall be provided with full port gauge cocks that allow penetration of instrument probes.

G. All outdoor water piping that does not contain glycol shall be provided with heat trace under insulation. All accessories shall be provided as necessary for a complete operating system.

H. Butterfly valves in horizontal lines shall be installed with the stem horizontal.

END OF SECTION

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SECTION 230548
VIBRATION AND SEISMIC CONTROLS FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.01 SUMMARY

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

B. Work Included:

1. Vibration Isolators

2. Inertia Bases

C. Related Sections:

1. Section 23 00 10 – HVAC General Requirements

2. Section 23 20 00 – HVAC Piping and Pumps

3. Section 23 30 00 – HVAC Air Distribution

4. Section 23 50 00 – Central Heating Equipment

5. Section 23 80 00 – Decentralized HVAC Equipment

6. Division 26 - Electrical

1.02 QUALITY ASSURANCE

A. All vibration control apparatus shall be supplied by a single recognized manufacturer. The supplier of noise and vibration control equipment shall supervise, inspect and approve the installation of their equipment. The supplier shall submit a letter to the Engineer at the conclusion of the project stating that all items have been installed properly and that all equipment is adequately isolated.

1.03 SHOP DRAWINGS

A. Submit shop drawings and product data in accordance with Division 1.

B. Shop drawings, cuts, diagrams, catalog data sheets or such other data necessary to fully describe and substantiate compliance with the specifications shall be submitted for all vibration isolation equipment and materials. The Contractor shall submit drawings for review stating the static deflection, load capacity and location of the isolators, inertia slab dimensions and installation instructions.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Kinetics Noise Control, Vibration Mountings and Control, Inc., Vibration Eliminator Co., Mason Industries, Vibro-Acoustics or Amber/Booth Company.

B. Model numbers used in this specification are those of Kinetics Noise Control and are included to establish a standard of quality.

2.02 ISOLATOR TYPES

A. Floor Mounted Equipment:

1. Type S spring vibration isolators shall be free-standing, unhoused, laterally stabile, steel springs, wound using high strength heat treated spring alloy steel, and shall have a horizontal spring stiffness equal to or greater than 1.0 times the rated vertical spring stiffness. Springs shall be selected to provide the tabulated minimum operating static deflections and shall provide a 50% overload capacity before reaching a solid state. Springs shall be designed to reach a solid state before exceeding the spring steel fatigue point. Springs used to isolate floor mounted equipment shall include a drilled and tapped steel top load plate, and a steel bottom load plate bonded to a 1/4" thick ribbed neoprene noise stop pad. Each spring mount shall include a steel leveling bolt, locknuts, and washers for attachment to supported equipment. Type S units shall be Kinetics Model FDS. Springs shall have the following minimum outside diameters:

Spring Deflection,	Rated Capacities, Lbs.		
Inches	Up to 370	371 to 1600	1601 to 11000
Up to 1.5	1.75" dia.	3.00" dia.	3.00" dia.
1.51 to 2.25	3.50"	5.0"	5.0"

2. Type 3, vertically restrained, spring mounts shall incorporate a single spring vibration isolator having all of the characteristics of Type S spring isolators as previously specified in a steel mount assembly designed to limit vertical movement of isolated equipment. If equipment loads are reduced or equipment is subject to external loads, vertical movement shall be limited without degrading the vibration isolation of the spring element during normal equipment operating conditions. The mounts shall have a flat steel top load plate, for welding to supporting equipment, vertically restrained by noise isolated bolts, connected to steel channel and drilled plated assemblies welded to a steel base plate. The base plate shall be bonded to a 1/4" thick ribbed neoprene noise stop pad and drilled for bolting to supporting structures. Type 3 units shall be Kinetics FLS.

3. Type 1 fiberglass isolators shall be precompressed molded fiberglass noise and vibration isolation pads, individually coated with a flexible moisture impervious elastomeric membrane. The fiberglass pads shall have been stabilized by ten (10) compression cycles to three (3) times the maximum published load. Load range and natural frequency shall be as recommended by the isolator manufacturer for each specific application. But, in no case shall a natural frequency higher than 12 Hz be provided for applications intended to isolate sound, nor higher than 15Hz for applications intended to isolate impact noise and shock. Type 1 units shall be Kinetics Model KIP.

4. Type N neoprene isolation mounts shall incorporate a cast-in tapped steel load plate, to permit bolting to supported equipment. The neoprene pad shall be molded using 2500 psi tensile strength, oil resistant compounds, and shall have no color additives in the compound. The neoprene isolator shall be selected to achieve the minimum operating static deflection tabulated, while not exceeding the published load capacity for the isolator used. Each neoprene isolation mount shall be externally color coded to identify load capacity and shall incorporate a cast-in drilled steel anchor/base plate. Type N units shall be Kinetics Model RD.

5. Type NIP neoprene isolation pads shall be single rib or crossed, double rib neoprene in shear pads in combination with steel shims. Neoprene pads shall be molded using 2500 psi tensile strength, oil resistant compounds. Type NIP units shall be Kinetics Model NPS, NPD, NGS, or NGD.

B. Suspended Equipment:

1. Type 2 hangers shall consist of a steel spring and a elastomer-in-shear isolator placed in series and encased in a welded steel bracket. The spring element of the hangers shall meet all specified characteristics of a “Type S” spring as previously specified. Springs shall be color coded for ease of load capacity identification and removable for field correction of overloaded hangers. The elastomer noise stop pad shall be selected to operate within the published load range for the pad for each spring capacity when placed in the bracket used. The hanger bracket shall be designed to carry five (5) times overload without failure, and shall allow up to 15° rod misalignment without metal to metal contact. Type 2 units shall be Kinetics Model SRH.

2. Type F hangers shall consist of an elastomer-in-shear isolator encased in a welded steel bracket. The elastomer shall be bonded to the hanger bracket and shall be selected to support the load within its published load rating. The hanger bracket shall be designed to carry a five (5) times overload without failure and allow up to 15° rod misalignment without short circuiting. Type F hanger shall be Kinetics Model RH.

2.03 BASE TYPES

A. Type 7 inertia bases shall consist of a concrete slab, cast into a prefabricated inertia base frame assembly designed and supplied by the isolation materials manufacturer. Frames shall be welded steel channel with a depth greater than 8% of the longest dimension, a minimum of 6” thick, and shall include welded-in 1/2” steel reinforcing rods on 8” centers each way. Prelocated equipment anchor bolts shall be fixed into position, and housed in steel bolt sleeves allowing minor bolt location adjustment. Isolator support brackets, when required, shall be welded into the corners of perimeter channel frames with 1/2” reinforcing rods 1-1/2” above bottom of brackets running continuous in two directions between isolator brackets. Where bases are used under pumps, the base shall be large enough to support riser elbows. Type 7 bases shall be Kinetics Model CIB-L or CIB-H.

B. Type B equipment bases shall consist of structural support members, with welded on isolator support brackets, and prelocated and drilled anchor bolt holes, designed and supplied by the isolation materials manufacturer. The structural steel bases shall have beams of minimum section depth equal to 8% of the longest span between support isolators, a minimum of 6”, and shall be of sizes and shapes required for equipment to be supported. Isolator support brackets shall be welded to the structural beam base as required to provide the lowest possible mounting height of supported equipment. Anchor bolt holes shall be prelocated and drilled into all equipment bases to bolt down equipment. The structural steel bases shall provide a rigid, distortion free mounting base for supporting equipment, which allows no excessive differential motion between driven equipment components. Type B bases shall be Kinetics Model SFB or SBB.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Equipment: All equipment listed hereinafter shall be isolated from the structure and fixed parts by means of resilient vibration and noise isolators. Isolators for floor and roof mounted equipment shall be solidly anchored to the support base or floor and to the supported equipment unless indicated otherwise.

B. Piping and Conduit: All piping and electrical conduit connected to the pumps or other pieces of moving equipment which are isolated from the structure by spring type vibration isolators shall be isolated from these units by flexible pipe connectors and shall be suspended on isolation hangers to a point 10 feet away. Use Type 2 hangers for suspended piping, Type

S mounts for floor mounted piping. Flexible pipe connectors are specified as part of the piping work.

C. Ductwork: Flexible connections shall be incorporated in the ductwork adjacent to all air moving units as part of the sheet metal work. Ductwork shall be suspended on Type F hangers for a distance of 30 feet from these units, except isolators shall not be required beyond wall surrounding the equipment room.

3.02 MINIMUM VIBRATION ISOLATOR STATIC DEFLECTION

Type of Equipment	Base Type	Isolator Type	Deflection, In.
Base Mounted Pumps	N/A	N/A	N/A
Inline Water Pumps (HVAC & Domestic)	N/A	2	0.75

3.03 EQUIPMENT WITH INTERNAL ISOLATION

A. Where air handling units have fan and motor assembly internally isolated from the unit casing, using both spring isolators and flexible fan discharge connections, external isolators for the air handling unit shall not be provided.

END OF SECTION

SECTION 230553
IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.01 SUMMARY

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

B. Work Included:

1. Prepare and paint Division 23 equipment, accessories, ductwork, piping and miscellaneous materials located in Equipment Rooms, Boiler Rooms, pipe trenches and other utility areas housing mechanical equipment and materials.

2. Identification of piping in exposed and accessible locations.

3. Marking and designation of equipment.

C. Work Not Included:

1. Painting of ductwork, piping or equipment located on the building exterior.

2. Painting of ductwork, piping or equipment exposed in finished areas other than those listed under WORK INCLUDED above.

3. Painting of existing equipment, piping or ductwork.

D. Related Sections:

1. Section 09 90 00 – Painting and Coating

2. Section 23 00 10 – HVAC General Requirements

3. Section 23 05 00 – Common Work Results for HVAC

4. Section 23 07 00 – HVAC Insulation

5. Section 23 09 00 – Instrumentation and Control for HVAC

6. Section 23 20 00 – HVAC Piping and Pumps

7. Section 23 30 00 – HVAC Air Distribution

8. Section 23 50 00 – Central Heating Equipment

9. Section 23 80 00 – Decentralized HVAC Equipment

10. Division 26 - Electrical

1.02 REFERENCED STANDARDS:

A. General: The following standards or codes (latest edition) form a part of this specification to the extent indicated by the reference thereto.

B. American National Standards Institute (ANSI):

1. ANSI A13.1 Scheme for Identification of Piping Systems

C. American Society for Testing and Materials (ASTM):

1. ASTM E 84 Standard Test Method for Surface Burning Characteristics of Building Materials

2. ASTM C 411 Standard Test Method for Hot-Surface Performance of High-Temperature Thermal Insulation

D. National Fire Protection Association (NFPA):

1. Standard 255 Method of Test of Surface Burning Characteristics of Building Materials

E. Underwriters Laboratories, Inc. (UL)

1. Standard 723 Tests for Surface Burning Characteristics of Building Materials

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS:

A. Except as otherwise specified, materials shall be the products of the following manufacturers:

1. Sherwin-Williams

2. Pratt and Lambert

3. Pittsburgh Paints (PPG)

4. Benjamin Moore

5. Porter Paints

6. Seton Identification Products

2.02 MATERIALS:

A. Deliver all paints and materials to the project site in their unopened original containers with all labels intact and legible at the time of use.

B. All coatings exposed to supply and return airstreams and where applied to exposed surfaces in a return air plenum, shall have a composite flame spread rating not exceeding 25, and a smoke developed rating not exceeding 50 as tested under procedure ASTM E-84-75, NFPA 255 and UL 723. Coatings shall not flame, glow, smolder or smoke when tested in accordance with ASTM C411, latest edition.

C. Sherwin-Williams Industrial Maintenance Coatings System 4000 products are listed below to establish color and a standard of quality.

1. All Hangers and Supports: One coat Series 54 Gloss Black Alkyd Enamel.

2. All major items of equipment and equipment supports including boilers, compressors, pumps, tanks, air handling units, condensers, fans and all other similar items shall be painted as follows:

a. Uninsulated hot surfaces on equipment, operating at or above 150°F, shall be painted with two coats of No. B59S8 Heat Resistant Aluminum.

b. Other equipment surfaces of aluminum, iron and steel shall be primed with one coat of No. B50Y1 Zinc Chromate Primer. Galvanized surfaces shall be chemically prepared and primed with one coat of Galvite B50W3 Primer. Field insulated surfaces shall be primed with No. B28W200 Wall Primer. Where equipment is furnished with factory prime or finish coat, only patch priming is required at any damaged areas before finish coats are applied. Finish all equipment with two coats of Series 54 Alkyd Gloss Enamel, No. SW4063 Robotic Blue. Exterior of belt guards and other protective guards shall be finished with two coats of Series 54 Alkyd Gloss Enamel, No. SW4084 safety yellow color. Interior of and all items covered by belt guards and other protective guards shall be finished with two coats of No. SW4083 safety orange color.

c. Nameplates and Testing Agency Labels on equipment or machinery shall not be painted.

3. Ducts:

a. Exposed in equipment rooms and other unfinished areas such as storage areas and utility type spaces; uninsulated galvanized steel ducts shall be chemically prepared and primed with one coat of Galvite B50W3 Primer. Aluminum ducts and insulated ducts with aluminum jacket shall be primed with one coat of No. B50Y1 Zinc Chromate Primer. Canvas or paper insulation jacket shall be primed with one coat of No. B28W200 Wall Primer. Finish with Series 54 Alkyd Gloss Enamel, gray No. SW4028 Gypsum applied in sufficient number of coats to effectively cover the prime coat.

4. Piping: Exposed in equipment rooms and where connections are made to equipment located in storage rooms and other utility type areas.

a. Priming:

1) Insulation Canvas or Paper Jacket: One coat No. B28W200 Wall Primer.

2) Insulation Aluminum Jacket: One coat No. B50Y1 Zinc Chromate Primer.

3) Bare Iron or Steel or Copper: One coat No. B50Y1 Zinc Chromate Primer.

4) Galvanized Steel: Pipes and ductwork shall be chemically prepared and primed with one coat of Galvite B50W3 Primer.

5) Asphalt Coated Pipe: One coat No. B28W200 Wall Primer.

b. Finish: All pipe lines and the supports or hangers therefore, shall be finished with Series 54 Alkyd Gloss Enamel, gray No. SW4028 Gypsum applied in sufficient number of coats to effectively cover the prime coat. Painting of pipe hangers is specified hereinbefore.

c. Materials shall be as recommended by the manufacturer for the surface to be finished.

d. Unless otherwise specified, primer shall be by the same manufacturer as the finish coat.

e. Materials shall not be thinned or cut except as recommended by the coating manufacturer. Thinners shall be by the same manufacturer as the primer and finish coat.

D. Valve tags ([S]) shall be neat circular brass with designations stamped thereon, attached with solid brass jack chain to each valve stem or handle.

E. Each item of equipment such as pumps, air handlers, etc., and equipment control devices such as motor starters, disconnect switches, etc. shall be properly marked with laminated engraved plastic nameplates ([S]) fastened with sheet metal screws, bolts or permanent adhesive. Pressure sensitive tape is not acceptable.

F. All piping, insulated and uninsulated, shall be identified ([S]) with Seton Setmark or equal wrap around piping system markers and arrow flow directional marker. Markers shall be pre-coiled, semi-rigid plenum-rated plastic or polyester with sealed color graphics. Markers shall be minimum 12 inches long with 1-¼ inch high letters, formed to cover entire circumference of the pipe. Markers shall be attached to piping using plenum-rated plastic tie wraps. Pipe identification shall use the same designations or abbreviations used on the drawings. Marker colors shall be in accordance with ANSI.

PART 3 - EXECUTION

3.01 WORKMANSHIP:

A. The work shall be accomplished by qualified mechanics skilled in the painting trade. Painting of equipment, piping, ductwork and other materials shall not commence until all testing is complete and systems are ready for operation. Materials shall be applied according to manufacturer's directions. All containers shall be securely closed when not in use. Flammable materials shall not be stored on premises. Flammable waste shall be disposed of daily in devices approved for such purposes. Materials shall be evenly spread, and smoothly flowed on without runs or sags. Each coat shall be thoroughly dry before application of succeeding coats.

3.02 PROTECTION OF WORK:

A. The painters shall protect all adjacent surfaces with drop covers during the process of painting. Upon completion, paint spots, if any, shall be removed from all surfaces.

3.03 PREPARATION OF SURFACE:

A. Surfaces to be painted shall be completely dry before applying paint. Metal surfaces shall be cleaned with mineral spirits before applying materials. Rust and scale shall be removed by wire brushing or sanding. Galvanized surfaces shall be chemically pretreated with crystalline (zinc phosphate) phosphate in strict accordance with the manufacturer's recommendations. Surfaces shall not be painted when the temperature is, or is likely to be, near the freezing point, nor when they are exposed to hot sun.

3.04 IDENTIFICATION OF PIPES AND EQUIPMENT:

A. Equipment: After all other painting is completed, each major item of equipment shall be properly identified with nameplates. Identification symbols and designations shall be the same as shown on the Contract Documents.

B. Apply piping system markers after completion of required insulation and finishes on piping systems. Markers shall be applied in the following locations and where identified by the Engineer:

1. At each valve and at connection to equipment.
2. At every tee and branch connection.
3. At each riser including branch risers from mains.
4. At each side of a pipe passage through floors, walls and partitions.
5. Every 15 feet on straight runs of piping mains and branches.
6. Within 6 feet of elbows (each side).
7. At access doors or similar points that permit view of concealed piping.
8. Markers shall be provided on all piping above lay-in ceilings.
9. Provide arrow markers showing direction of flow incorporated into, or adjacent to, each piping system marker.
10. Apply all piping system markers where view is unobstructed, and legends can be read and easily identified.
11. Apply all tags and piping system markers in accordance with the supplier’s instructions.

END OF SECTION

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SECTION 230593
TESTING, ADJUSTING AND BALANCING FOR HVAC

PART 1 - GENERAL

1.01 SUMMARY

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

B. Work Included:

1. Cleaning

2. Adjusting and Balancing

C. Related Sections:

1. Division 01 -- Commissioning

2. Section 23 00 10 – HVAC General Requirements

3. Section 23 05 00 – Common Work Results for HVAC

4. Section 23 07 00 – HVAC Insulation

5. Section 23 09 00 – Instrumentation and Control for HVAC

6. Section 23 20 00 – HVAC Piping and Pumps

7. Section 23 30 00 – HVAC Air Distribution

8. Section 23 50 00 – Central Heating Equipment

9. Section 23 80 00 – Decentralized HVAC Equipment

1.02 REFERENCES

A. General: The following publications listed below, form a part of this specification to the extent indicated by the reference thereto.

B. Sheet Metal and Air Conditioning Contractors National Association, Inc. (SMACNA):

Balancing and Adjustment Manual

C. Associated Air Balancing Council (AABC):

National Standards for Total System Balance

D. National Environmental Balancing Bureau (NEBB):

Procedural Standards for Testing, Balancing and Adjusting of Environmental Systems.

1.03 QUALIFICATIONS

A. For the air conditioning, heating and ventilation systems the Contractor shall obtain the services of a qualified, independent testing organization specializing in total system air and

water testing and balancing. The Contractor shall be responsible for making changes in pulleys, belts and dampers where necessary to obtain the required air volume as determined by the Testing and Balancing Contractor. The Testing and Balancing Contractor shall provide all labor, engineering and test equipment required to adjust, test and balance all heating, ventilating, air conditioning and exhaust systems as hereinafter specified. All personnel involved in the execution of the work under the balancing contract shall be experienced and factory trained specifically in the total balancing of mechanical systems, as well as being regular employees of the Balancing Contractor. The Test and Balance Contractor shall work in close coordination with the Controls Contractor to ensure that the system is operating as designed and to aid in adjusting setpoints as necessary for proper system operation.

1.04 TAB COORDINATION AND RESPONSIBILITIES

A. The TAB Agent shall provide the following:

1. All instrumentation used in the course of testing and balancing shall be accurate and shall have been calibrated within the six months prior to commencing test and balance work for this project.

2. Where existing air or hydronic systems are to be renovated, the TAB Contractor shall provide a complete measurement of air and water flow for systems indicated to remain prior to any construction or demolition of existing systems. For air systems, the data shall be taken and recorded for each piece of air handling equipment serving the area of renovation and those indicated on the drawings for ductwork or other mechanical renovations. Data shall be provided as outlined for balancing data hereinafter. For hydronic systems, pump flow data for each system shall be provided as well as flow to each terminal device being modified, replaced, or removed. Any discrepancies in the data shall be reported to the Architect/Engineer prior to commencing any mechanical work.

3. The TAB Agent shall conduct a pre-TAB inspection two weeks prior to commencing the test and balance. The TAB Agent shall notify the Contractor in writing of any deficiencies that would affect the ability to successfully complete the test and balance or result in an incomplete or unacceptable report.

4. During the course of the test and balance, the TAB Agent shall immediately notify the Contractor of any equipment or system discrepancies discovered that need to be corrected prior to the satisfactory completion of the test and balance procedures.

5. Equipment settings, including damper positions, valve positions, fan speed controls, and similar devices shall be marked to show final settings.

B. The Contractor shall provide the following:

1. Prior to the commencement of testing and balancing, the installation of building systems shall be fully complete. Building controls systems shall be complete, operational, and verified by the Contractor.

2. The Contractor shall resolve any discrepancies noted by the TAB Agent in the Pre-TAB Inspection prior to commencing the test and balance. The Contractor shall provide written confirmation of the corrective action that was taken to correct each deficiency.

3. The Contractor shall make available qualified personnel during the period in which the test and balance is being conducted for the purpose of problem resolution and controls support.

4. The Contractor shall resolve any deficiencies noted by the TAB Agent prior to the submission of the report and prior to any subsequent visits required by the TAB Agent.

1.05 SUBMITTALS

A. Prior to commencing work under this section, the Contractor shall submit the name of the testing organization, a proof of certification by the Associated Air Balance Council or National Environmental Balancing Bureau, and a list of five local projects on which testing and balancing has been completed for two years, for approval by the Architect/Engineer. The submittal shall include TAB procedures proposed for the systems specific to this project.

B. Heating, Air Conditioning and Ventilation Systems Balance and Performance Data: At a time no later than the Substantial Completion Inspection, the Contractor shall provide the Architect/Engineer with two (2) typewritten copies of schedules containing air and water system balance and performance data.

C. Equipment and System Verification: Letters, signed by representatives of boiler, and temperature control manufacturers, shall attest that their respective equipment installed on this project has been started, tested and set to operate safely and at the control points required as an integral part of the systems specified herein. The Contractor shall attest by letter that all equipment has been wired and tested to see that the indicated sequence of motor control is established, that all safety controls function properly, that all motor protective devices are sized correctly and that the systems are operating at the points set on the controls. The Engineers will not conduct a site visit for the purpose of determining the status of final payment until these letters are received.

D. Test data shall be submitted for all equipment and systems where specifically required by this specification and all items identified with [TD] behind the product data.

1.06 COMMISSIONING OF HVAC SYSTEMS

A. Participate in Commissioning Meetings designated by the Commissioning Agent.

B. Participate in resolving controls issues identified by the Commissioning Agent.

C. Notify Commissioning Agent a minimum of 2 weeks in advance of start-up of Testing, Adjusting and Balancing (TAB) work. Arrange and attend meeting between Commissioning Agent and TAB agency for review of TAB procedures, TAB work plan, and TAB schedule. Refer to Division 1 for complete scope of Commissioning work.

D. Provide Commissioning Agent with a copy of preliminary and final balance reports.

1.07 CONDITIONS

A. Partial Testing: As much as practical, systems shall be tested as complete systems. Tests on portions of a system will be permitted to facilitate proper progress scheduling. When systems are tested in segments, a system diagram indicating portion tested and a separate and complete report including the date of test is required for each segment.

B. Concealed Work:

1. All concealed work shall be tested and approved by the Architect/Engineer prior to the application of insulation or construction of chase walls.

2. Covering shall not be applied to any piping nor shall any piping be concealed or covered until pipes have been tested, all leaks stopped, retested and approved.

C. Work in Existing Buildings: Where new piping systems are connected to existing systems, test the new system prior to making connections to existing system. Connections to existing systems are not to be tested unless required by local authorities.

PART 2 - PRODUCTS

2.01 GENERAL

A. All equipment, instruments, materials and utilities required for cleaning, testing and balancing of the air and hydronic systems shall be provided by the Contractor.

2.02 INSTRUMENTATION

A. All instruments used by this Contractor shall be accurately calibrated and maintained in good working condition.

2.03 TESTS OF MATERIALS

A. Manufacturers' certificates will be accepted in lieu of tests of materials. If individual laboratory tests are desired by the Architect-Engineer, they will be secured by this Contractor and paid for by the Owner.

PART 3 - EXECUTION

3.01 CLEANING

A. Each boiler shall be cleaned in accordance with manufacturer's instructions before being connected to the system.

B. Equipment shall be wiped clean to remove all dust, oil, dirt or paint spots. Trash, plaster, mortar or paint shall be removed from all coils, plenums and end pockets.

C. Heating Piping, and Ductwork shall be thoroughly blown out or flushed and cleaned of all foreign matter before connections are made to equipment. Temporary bypasses shall be provided around coils, control valves, ice tanks, heat exchangers and other similar items to prevent trash from being flushed into these items. Care shall be taken at time of installation to prevent pipe compound, scale or other objectionable matter from entering the piping systems. Strainers shall be cleaned. After all construction dirt has been removed from the building, new filters shall be installed in all air units.

3.02 ADJUSTING AND BALANCING:

A. Equipment: Before attempting to adjust and balance the air and water systems, the Contractor shall verify that the following items have been completed and are correct.

1. Motor and bearings are properly lubricated.

2. Direction of rotation of motors.

3. Belt tension.

4. Electric current flow in each phase of motors and electric heating elements.

5. Motor protective devices are sized to properly protect installed motors.

6. Thermostats, controls, accessories and other items requiring setting or adjustment shall be set as indicated.

B. Water Systems Balancing Procedure.

1. Prior to commencing water balancing, the TAB Agent shall confirm that all systems have been properly filled and bled of air; strainers have been cleaned, and balancing valves (except bypass valves) are fully open.

2. All heating water systems shall be adjusted to provide required quantity to or through each component as indicated on drawings.

3. Venturi tubes, orifices or other metering fittings and pressure gauges shall be used to measure water flow rates and balance systems.

4. Systems shall be adjusted to provide the approved pressure drops through the heat transfer equipment prior to the capacity testing.

5. Where flow metering fittings are not installed, flow balance shall be determined by measuring temperature differential across the heat transfer equipment.

6. Automatic control valves shall be positioned for full flow through the heat transfer equipment of the system during tests. Flow through by-pass circuits at three-way valves shall be adjusted to balance that through the supply circuit.

7. Adjustment of distribution shall be effected by means of balancing devices (cocks, valves and fittings) and automatic flow control valves as provided; service valves shall not be used.

8. Where automatic flow control valves are utilized only pressure differential need be recorded, provided that the pressure is at least the minimum applicable to the tag rating.

9. Where available pump capacity (as designed) is less than total flow requirements of individual heat transfer units of system served, full flow may be simulated by the temporary restriction of flow to portions of the system; specific procedures shall be delineated in the agenda.

10. Water flows through multiple boilers shall be balanced.

11. Domestic hot water system shall be balanced to provide indicated temperature hot water at all times to the point where the hot water return pipe connects to the hot water pipe.

3.03 BALANCE AND PERFORMANCE DATA REPORT [TD]:

A. General: Each heating, ventilating and air conditioning system shall be operated and tested continuously for at least two consecutive days to verify that the system is operating satisfactorily and safely and that all equipment is producing the required capacity. To be successful, this test must be conducted with all controls in automatic position and all lights on or off to simulate day time or night time use of the building. Submit two typewritten copies of reports covering air and water system balance and performance. Reports must be received by the Architect-Engineer at least one week prior to the Contractor’s request for a substantial completion inspection. Reports that contain deficiencies related to incomplete or improper system installation will be rejected by the Engineer without further review.

B. Calibration Data: The report shall include a list of all instrumentation used and the date of the most recent calibration for each instrument.

C. Balance Data: The following balance data shall be provided. Design and actual water and air flows shall be provided in tabular form.

1. Pumps:

a. System nomenclature and identification.

b. Nameplate information: Manufacturer, model and serial number, impeller diameter, horsepower, rpm, voltage, phase, maximum amperage.

c. Pump discharge and suction pressures along with total dynamic head (ft. H2O) at dead head and operating point.

d. Final operating GPM plotted on the appropriate pump curve.

e. Actual running motor amperage.

f. Triple duty valve position.

g. For all variable volume pumping systems, provide location of downstream static pressure sensor, set point, and reading.

2. Boilers:

a. Nameplate information: Manufacturer, model and serial number.

b. Water flow through each boiler hot water.

D. Performance Data: The following information shall be recorded twice each day and twice each night during the performance test. Reading shall be taken for each item at a different time each succeeding day at least two hours later than the time the reading was taken on the preceding day.

1. Water Boiler:

a. Nameplate information: Manufacturer, model and serial number.

b. Boiler identification number.

c. Boiler water flow.

d. Water supply and return temperature.

e. Boiler stack temperature and CO_2.

2. Domestic water heater:

a. Nameplate information: Manufacturer, model and serial number.

b. Boiler water flow.

c. Boiler water temperatures entering and leaving heat exchanger.

d. Storage tank temperature and setpoint.

3. Temperature: Each Room in Building. Temperature measurements shall be taken with the Contractor's calibrated equipment. Trended data from the temperature control system is not acceptable.

E. Control Setting: During the performance and balance tests, control settings may require adjustment, and if so, shall be adjusted to produce the best balanced system operation. The final setting of each operating and safety control shall be recorded. This shall include, but not be limited to, thermostats, limit controls, damper position switches, firestats, freezestats, humidistats, aquastats and other similar items.

3.04 HVAC SYSTEMS FINAL TESTS:

A. Upon completion of the work, in accordance with these drawings and specifications, the Contractor shall make a final test in the presence of the Architect-Engineer. With all equipment energized and all controls in automatic position, the systems and equipment specified herein shall be proven to operate safely and to heat and cool the structure uniformly. If not, adjustments and corrections shall be made until satisfactory operation is achieved.

3.05 HVAC SYSTEM POST ACCEPTANCE TESTS:

A. Should completion of the building occur at such time that the required performance test must be conducted and test data recorded and submitted during a season when both heating and cooling system performance cannot be checked, the Contractor shall perform the tests and record all such data as is available with system operating automatically under the prevailing weather conditions. That part of the system portion which cannot be recorded because of the prevailing weather shall be delayed until the weather is appropriate at which time the remaining part of the required tests shall be conducted and data recorded accordingly. Portions of the tests may not be delayed without written consent of the Engineer.

END OF SECTION

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SECTION 230700
HVAC INSULATION

PART 1 - GENERAL

1.01 SUMMARY

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

B. Work Included:

1. Piping Insulation

2. Ductwork Insulation

3. Equipment Insulation

C. Related Sections:

1. Section 23 00 10 – HVAC General Requirements

2. Section 23 05 00 – Common Work Results for HVAC

3. Section 23 20 00 – HVAC Piping and Pumps

4. Section 23 30 00 – HVAC Air Distribution

5. Section 23 50 00 – Central Heating Equipment

6. Section 23 80 00 – Decentralized HVAC Equipment

1.02 SUBMITTALS:

A. Submit shop drawings in accordance with Division 1 and Section 23 00 10.

B. Submit shop drawings and catalog data for each type of material proposed for this project. Indicate thickness of material for individual services, and installation methods.

1.03 REFERENCES:

A. General: The following standards or codes (latest edition) form a part of this specification to the extent indicated by the reference thereto.

B. American Society for Testing and Materials (ASTM):

ASTM E 84 Standard Test Method for Surface Burning Characteristics of Building materials.

ASTM C 411 Standard Test Method for Hot-Surface Performance of High-Temperature Thermal Insulation

C. National Fire Protection Association (NFPA):

Standard 255 Method of Test of Surface Burning Characteristics of Building Materials

D. Underwriters Laboratories, Inc. (UL)

Standard 723 Tests for Surface Burning Characteristics of Building Materials

PART 2 - PRODUCTS:

2.01 GENERAL

A. Acceptable Manufacturers:

1. Manville, Owens Corning, Armstrong, IMCOA, Knauff or Certain-Teed except where specific manufacturer is named.

B. All insulation materials, jackets and fitting covers shall have a composite flame spread rating not exceeding 25, and a smoke developed rating not exceeding 50 as tested under procedure ASTM E-84-75, NFPA 255 and UL 723. Duct coverings and linings shall not flame, glow, smolder or smoke when tested in accordance with ASTM C411.

2.02 MATERIALS

A. Piping:

1. Hot Water (100°-225°F): Fine heavy density fibrous glass, rigid phenolic foam or calcium silicate insulation with general purpose jacket, molded to conform to piping, 0.25 btu•in./sq.ft./°F/hr. maximum “K” value at 75°F.

B. Ductwork:

1. Breeching: As indicated hereinafter for hot equipment.

C. Hot Equipment:

1. Calcium silicate block insulation molded to conform to shape of equipment, 0.40 btu•in./sq.ft./°F/hr. maximum “K” value at 150°F., suitable for 1000°F service.

2. Finish, two 1/2” thick coats of insulating cement, last coat mixed 2 to 1 by weight with Portland cement.

Sealants, Mastics and Adhesives: Products either manufactured by or recommended by the insulation material manufacturer.

PART 3 - EXECUTION:

3.01 PREPARATION

A. Do not install insulation before piping and equipment have been tested and approved.

B. Ensure surface is clean and dry prior to installation. Ensure insulation material is undamaged and dry before application. Finish with system at operating conditions and temperature.

3.02 INSTALLATION

A. General: Ensure insulation is continuous through inside walls and partitions. Insulated piping passing through (smoke barriers,) smoke partitions, fire walls, fire partitions, and fire rated floors shall have insulation of type, thickness and density to match U.L. Through-Penetration Firestop Systems as specified in Section 23 00 10 under Sleeves and Inserts. Insulated piping passing through nonfireresistance rated floors shall be fireblocked as specified in Section 23 00 10 under Sleeves and Inserts. Insulated ducts passing through

smoke partitions and fire rated assemblies where a fire damper is not required shall be insulated with calcium silicate for a length equal to twice the thickness of the wall with all voids between the sleeve and duct insulation tightly packed with mineral-wool insulation or U.L. approved packing with sealant. All penetrations through equipment room walls and other areas of noise or heat generation shall be tightly sealed with mineral fiber rope. Finish insulation neatly at hangers, supports and other protrusions.

B. Piping:

1. General:

a. All pipe insulation (except refrigerant piping) shall be secured with outward clinching stainless steel staples and sealer.

b. Fittings and valves shall be insulated and jacketed with the same material as the adjacent piping or it may be finished with a smooth coat of approved insulating cement and jacketed with an approved recovering cloth and vapor sealed. Where PVC fitting covers are used, insulation shall be wrapped tightly using sufficient quantities to prevent deformation of covers.

OR

Use mitered segments of insulation on elbows and oversized insulation on valves and tees coated with two coats of vapor barrier mastic, reinforced with glass fabric extending two inches onto adjacent pipes, and same diameter as adjoining covering. No plastic materials on fittings will be allowed.

c. Mitering of straight pipe insulation to form elbows will not be acceptable or allowed.

d. All jacket joints and seams shall be lapped not less than 2”.

e. Insulation exposed to weather (and insulation exposed to abuse in finished spaces) shall be covered with minimum 0.016 aluminum jacket with all joints sealed weather-tight.

f. Insulation at pipe hangers (except for rain conductors and domestic water piping 2” size and smaller) shall be calcium silicate in preformed sections 12” long enclosing pipe around entire circumference. Insulation at pipe hangers for domestic water piping 2” size and smaller shall be as specified for piping. Pipe hangers shall be oversized to enclose pipe and insulation. Provide sheet metal saddle between hanger and insulated pipe. Pipe hanger insulation shall be as manufactured by Pipe Shields, Inc., Bergen-Power Pipe Supports, Inc., Rilco Mfg. Co., Inc. or Valued Engineered Products, Inc.

g. Elastomeric and other foam insulations shall be installed without stretching or compressing individual lengths.

2. Hot Piping:

a. Insulation shall be terminated neatly at unions, flanges, and valves. All exposed edges of insulation materials shall be sealed.

b. Where heating coils are located downstream from cooling coils and at variable air volume units, piping shall be insulated continuously up to the coil. Insulation shall be vapor sealed and installed as specified for cold piping for a distance of 5 feet from the coil.

C. Hot Equipment: Apply insulation with edges tightly butted, joints staggered and secured in place by steel bands not over 12” on center. Provide sufficient clearance around openings for normal operation of equipment. Finish with two 1/2” thick coats of insulating cement over chicken wire. Second coat shall be mixed 2 to 1 by weight with Portland cement and troweled smooth.

D. Boiler Breeching: Insulation shall be similar to that specified for Hot Equipment except insulation shall be held away from breeching at least one inch with angles, welded studs or clips.

E. Damaged Insulation: All existing thermal coverings that are removed or damaged during construction shall be replaced or repaired to not less than original condition. Repaired sections shall provide equal or better thermal performance and vapor protection.

F. Patching: Where existing control, monitoring or other penetrating devices are removed from ductwork or piping, the insulation shall be patched to match thickness, type and finish of existing insulation.

Where existing insulation has been removed under the scope of asbestos removal, insulation shall be replaced as indicated for new work. Refer to the drawings for the extent of the existing piping to be reinsulated.

3.03 INSULATION THICKNESS SCHEDULE

A. Piping:

Type	Size, Inches	Insulation Thickness, Inches
Heating Water	1-1/4” and Under	1-1/2
	1-1/2” and Over	2
	*Runouts 1” and Under	1

*Runouts to individual terminal units less than 4 feet in length (between the control valve and coil for HVAC piping).

B. Hot Equipment:

Type	Insulation Thickness, Inches
Expansion Tanks	1
Hot Water Storage Tanks	2
Air Separator	1

END OF SECTION

SECTION 230800
COMMISSIONING OF HVAC

PART 1 - GENERAL

1.01 SUMMARY

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

B. Work Included:

1. Coordination and Cooperation with Commissioning Agent and participation in the commissioning process indicated in Section 019113.

2. Providing for commissioning work in the project construction schedule.

3. Commissioning work shall be a team effort to ensure that all mechanical equipment and systems have been completely and properly installed, function together correctly to meet the design intent, and document system performance parameters for fine-tuning of control sequences and operational procedures. Commissioning shall coordinate system documentation, equipment start-up, control system calibration, testing and balancing and performance testing.

4. The commissioning team shall be made, up of representatives from the owner, design professionals, major equipment suppliers, and construction trades. The trades represented on the commissioning team shall include, but not be limited to, sheet metal, piping and fitting, controls, test and balance, and electrical. The lead person for each trade who will actually perform or supervise the work is to be designated as the representative to the commissioning team.

C. Related Sections:

1. Section 23 00 10 – HVAC General Requirements

2. Section 23 05 00 – Common Work Results for HVAC

3. Section 23 05 53 – Identification for HVAC Piping and Equipment

4. Section 23 05 93 – Testing, Adjusting, and Balancing for HVAC

5. Section 23 09 00 – Instrumentation and Control for HVAC

6. Section 23 20 00 – HVAC Piping and Pumps

7. Section 23 30 00 – HVAC Air Distribution

8. Section 23 50 00 – Central Heating Equipment

9. Section 23 80 00 – Decentralized HVAC Equipment

10. Section 24 00 10 – Commissioning Requirements of HVAC Systems

1.02 SUBMITTAL DATA:

A. Require all equipment suppliers to provide data required by the Commissioning Agent of type and in quantities as indicated in Section 24 00 10.

1.03 CONTRACTOR RESPONSIBILITIES:

A. General: Division 23 contractor responsibilities shall include active participation in the commissioning process as defined in Section 24 00 10 to facilitate successful completion of the contract. Ensuring all subcontractors and equipment suppliers cooperate in the Commissioning process. The Contractor shall coordinate with the Commissioning Agent to produce complete, operating systems, properly adjusted and tuned for comfortable operation and optimum efficiency.

B. Commissioning is primarily the responsibility of the Commissioning Agent indicated in Section 24 00 10, with support for start-up, testing, and support for commissioning, the responsibility of Division 23 contractor. The commissioning process does not relieve Division 23 contractor from participation in the process or diminish the role and obligations of Division 23 contractor to complete all portions of the work in a satisfactory and fully operational manner. In general, Division 23 is to perform all check-outs, start-ups, testing, adjusting and balancing with the Commissioning Agent witnessing all tests and performing verification tests as follow-up. The Commissioning Agent will also serve as an additional reviewer of all equipment and material installations for compliance with the Contract.

C. Division 23 contractor shall be an active member of the Commissioning Team composed of representatives from the Owner, Architect/Engineer, Contractor, contractor's trades and major equipment suppliers.

D. See Section 24 00 10 for additional Division 23 responsibilities.

PART 2 - PRODUCTS – Not Used

PART 3 - EXECUTION

3.01 DIVISION 23 COMMISSIONING RESPONSIBILITIES:

A. Identify a Division 23 Contractor's representative to the Commissioning team within one month after award of Contract. The representative shall have authority to make decisions on behalf of the Contractor.

B. Participate in Commissioning Meetings designated by the Commissioning Agent.

C. Performance verification tests shall be conducted as appropriate during cooling season and during heating season. Provide qualified personnel for participation in commissioning tests including seasonal testing required after initial commissioning.

D. Provide qualified personnel from each trade for participation in commissioning meetings as designated by the meeting agenda.

E. Participate in resolving issues identified by the Commissioning Agent.

F. Correct identified deficiencies to fulfill contract and warranty requirements.

G. Provide copies of all Contract documentation to the Commissioning Agent.

H. Participate in Owner Training as set up by the Commissioning Agent.

I. Inspect, check and confirm the correct and complete installation of all equipment in accordance with verification checklists as provided by, or as approved by the Commissioning Agent. Contractor's standard quality control verification checklists may be used, however minimum requirements shall be as indicated under Section 24 00 10, system

Verification Checklists. Copies of all Contractor's completed, signed verification checklists shall be furnished to the Commissioning Agent.

J. Notify Commissioning Agent a minimum of 2 weeks in advance of scheduled equipment and system verifications and start-ups. See Section 24 00 10 for listing of systems and subsystems to be evaluated by the Commissioning Agent in the commissioning process.

K. Notify Commissioning Agent a minimum of 2 weeks in advance of start-up of Testing, Adjusting and Balancing (TAB) work. Arrange and attend meeting between Commissioning Agent and TAB agency for review of TAB procedures, TAB work plan and TAB schedule.

L. Notify Commissioning Agent a minimum of 2 weeks in advance of controls work of Section 23 09 00 for the following procedures:

1. Point-to-point wiring check-out,

2. Owner verification of controls graphics, setpoints and alarms,

3. System start-up and check-out,

4. Initial system tuning,

5. Owner training.

M. Correct all construction and equipment deficiencies found during the commissioning process where in accordance with the Contract. Where any correction, improvement or change is outside of the Contract, as agreed by the Commissioning Team, prepare and submit a contract change proposal for the work in a timely manner. The Owner may elect to accept, reject or negotiate such contract change proposals.

END OF SECTION

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SECTION 230900
INSTRUMENTATION AND CONTROL FOR HVAC

PART 1 - GENERAL

1.01 SUMMARY

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

B. Work Included:

1. Complete System of Automatic Controls

2. Electric Appurtenances

3. Direct Digital Controls (DDC)

C. Related Sections:

1. Division 01 -- Commissioning

2. Section 23 00 10 – HVAC General Requirements

3. Section 23 05 00 – Common Work Results for HVAC

4. Section 23 05 53 – Identification for HVAC Piping and Equipment

5. Section 23 05 93 – Testing, Adjusting, and Balancing for HVAC

6. Section 23 09 93 – Sequence of Operations for HVAC Controls

7. Section 23 20 00 – HVAC Piping and Pumps

8. Section 23 30 00 – HVAC Air Distribution

9. Section 23 50 00 – Central Heating Equipment

10. Section 23 80 00 – Decentralized HVAC Equipment

11. Division 26 – Electrical

12. Division 27 – Electrical

1.02 SUBMITTALS:

A. Submit shop drawings and product data in accordance with Division 1 and Section 23 00 10.

B. Provide complete shop drawings, catalog data sheets and such other data necessary to fully describe and substantiate compliance with these specifications for all control items and systems included in this section.

C. Shop drawings shall indicate the exact location(s) of the outdoor temperature sensor(s).

D. Operation and maintenance data shall be submitted in accordance with Division 1, for all items of equipment and materials indicated in this Section.

E. Application Software Documentation: Contractor shall provide a blueprint documentation of the software application program for each stand-alone digital controller. Documentation shall include block software flowchart showing the interconnection between each of the control algorithms and sequences. A program listing shall be printed on the same blueprint, along with the program flowchart, and description of the sequence of operation. This blueprint shall be stored and maintained in each stand-alone digital controller. System acceptance shall not be completed until this documentation is provided and located in each panel.

1.03 QUALITY ASSURANCE:

A. When all temperature controls have been installed, the temperature control contractor shall completely commission the system to verify that all systems and components are operating in accordance with the specifications. Where corrections or adjustments to the controlled equipment are required, the temperature control contractor shall document such changes to the Contractor, and recheck the control system once the changes have been made.

1. All equipment and subsystems shall be operated through all specified modes of control and sequences of operation, including full load and part load conditions.

2. All physical valve and damper positions shall be visually verified to correspond with the positions indicated by the controls software.

3. All instrumentation shall be properly calibrated.

B. Final point-to-point check-out and commissioning of the Temperature Control System shall be by the temperature control manufacturer or its exclusive authorized representative.

C. At the completion of this project, the Contractor shall submit a letter to the Engineer stating that all controls have been installed as specified, that each system has been calibrated and that each system is operating in a safe and efficient manner. Included with the letter, the Contractor shall provide a printout of all status control and monitoring points for a 48-hour period at 4-hour intervals, one printout of each type report available, and a copy of the completed start-up checklist used by the technician during system verification.

1.04 SCOPE OF WORK:

A. Furnish and install complete direct digital temperature control systems (DDC) which will tie into Owner’s existing Schneider Controls. The direct digital control system shall be comprised of a network of various independent, stand-alone digital controllers, together with Centralized Control Stations, and Centralized Host Stations as specified to provide centralized access and facility wide control functions. The stand-alone digital controllers shall be interconnected in a communicating network to provide facility wide access and sharing of information. A Local Area Network (LAN) shall be provided to interconnect the stand-alone digital controllers for high-speed data transmission within each building.

1. The Temperature Controls Subcontractor shall provide technical support for the Testing and Balancing Subcontractor. The technicians shall be fully qualified in all aspects of the system and shall have extensive knowledge of the project. Support shall include, but not be limited to the following:

2. Assistance in determining hydronic and air systems pressure setpoints.

3. Assistance in determining proper automatic damper positions for all air handling units, air conditioning units, and VAV units.

4. Simulating conditions as necessary for proper and optimized testing and balancing of the air and hydronic systems.

B. Programming shall be provided in accordance with commonly accepted industry standards and practices to ensure proper and efficient control of all equipment and systems. Where ASDC's with factory programming are not capable of operating systems in the sequence described herein, the Contractor shall provide a digital controller with custom programming.

C. Programming shall be provided to accomplish the sequence of operations as described in Section 23 09 93. Changes to the operational sequences shall be made only with written approval from the Engineer.

1.05 COMMISSIONING OF HVAC SYSTEMS:

A. Refer to Division 1 for work of Commissioning Agent and coordination with work of Division 23.

B. Notify Commissioning Agent a minimum of two weeks in advance of controls work for the following procedures:

1. Point-to-point wiring check-out,

2. Owner verification of controls graphics, setpoints, and alarms,

3. System start-up and check-out,

4. Initial system tuning,

5. Owner training.

1.06 SPARE PARTS:

A. Provide spare controllers of the following types and quantities:

1. Valve Actuators – one (1) of each size/type

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS:

A. Component parts of this system shall be manufactured by Schneider. Schneider is used as basis of design.

B. Installation shall be by qualified employees or authorized representative of the temperature control manufacturer. Temperature control work by independent contractors performing work without direct supervision from the authorized representative will not be accepted.

2.02 SYSTEM REQUIREMENTS:

A. The system shall be a complete system of automatic temperature regulation of the DDC type with electric and electronic accessories and components as indicated. The system shall be backwards-compatible with the Owner's existing operating and control systems.

B. The software shall not require any licensing fees or annual fees. The host must be able to support a minimum of 50 simultaneous users with the ability to expand the system to accommodate an unlimited number of users.

C. All control items except thermostats, sensors and transmitters located in rooms shall be properly identified with engraved plastic nameplates permanently attached.

D. Room thermostat, sensor and transmitter locations shall be coordinated to align vertically or horizontally with adjacent light switches or control instruments. Room thermostats and sensors shall be mounted with bottom 5'-4" above the floor.

E. All components and materials shall be UL or ASTM rated for use in air plenums.

2.03 MATERIALS:

A. Sensors, Transmitters and Thermostats:

1. Temperature sensors for the Direct Digital Control (DDC) System shall be precision RTD's or thermistor. Accuracy shall be plus or minus 1 degree F over the entire control range. Sensors for pipe applications shall be immersion type, provided with pipe well. Sensors for duct application shall be of the averaging type, with a 5 foot or a 22 foot length element. Duct element length shall be adequate to serpentine across the entire duct area. Where sensors are located downstream of fans or at least 10 duct diameters downstream of coils, elbows, junctions, or dampers, single point sensors may be used. Outdoor temperature sensors shall be provided with sunshield of copper or painted aluminum on a northern exposure. Space temperature sensors shall be compatible with unit controller and shall be provided in a decorative metal or plastic enclosure. Sensors located in gymnasiums or multi-purpose rooms shall be provided with heavy-duty wire guards.

2. Differential pressure transmitters for measuring hydronic system differential pressure shall be two-wire type with true differential pressure sensing, ceramic sensor technology, stainless steel housing, NEMA 4 rated, and shall have an approximate range of no greater than two times the maximum differential pressure of the piping system. Unit shall be equal to Kele DPW-692.

3. Humidity sensors shall provide a range of 0-100% relative humidity and an accuracy of plus or minus 2% RH from 0 to 93.8% RH at 25 degrees Celsius. Accuracy shall be plus or minus 1% RH within 10% RH of the user setpoint. Operating temperatures shall be from -40 degrees Fahrenheit to +176 degrees Fahrenheit. The unit shall not be damaged when exposed to 100% relative humidity.

4. High temperature thermostat for detection of excessive temperature in the duct shall be U.L. listed, manual reset type with an adjustable temperature setting. Set at 136°F.

5. Low temperature thermostat for detection of low temperature in the duct shall be manual reset type with 20' temperature sensitive element, located downstream from the coil. If any portion of the element senses a temperature below its setting, the contacts shall break. Set at 35°F. Units shall be double pole for connection to the fan starter circuit and for monitoring by the DDC.

6. Electric thermostats shall be line voltage type complete with auto-off switch. The thermostat shall be rated for 6 amps at 120 volts.

7. Remote bulb electric thermostats shall be equipped with a liquid-filled capillary tube 8' long. The electrical rating shall be 10 amps at 120 volts.

8. Surface-mounted aquastats shall have adjustable set point and 10° differential. Contacts shall be rated 10 amps at 120 volts.

9. Flow switches for water shall be McDonnell Miller.

10. Space mounted combination carbon dioxide/relative humidity/temperature sensors. Where the drawings indicate multiple space sensors at a single location, a combination sensor shall be used. The combination sensor shall provide the functions matching the sensor annotations on the drawings. Operating range shall be 32°F to 122°F. Outputs shall be 0-10 VDC or 4-20 mA. Unit shall be provided with a one (1) year warranty.

    a. Temperature accuracy shall be ± 1 degree. Sensors shall be provided with set-point adjustment and override switch/button.

    b. Carbon dioxide sensing (where indicated) shall be auto-calibration type with utilizing non-dispersive infrared (NDIR) with gold-plated optical chamber. Range shall be 0-2000 ppm CO2. Units shall have accuracy of ±3%. Field replaceable carbon dioxide element shall be provided with a lifetime warranty on calibration.

    c. Humidity sensors (where indicated) shall provide a range of 10-90% relative humidity and an accuracy of plus or minus 2% RH with an operating range of 0 to 100% RH at 25 degrees Celsius. Field replaceable relative humidity element shall be provided with a one (1) year warranty

11. Current relays shall be Hawkeye 700 Series or approved equal. Units shall be self-induced powered, solid state electronic with status and power LED's and binary output. Units shall be automatically self adjusting to detect loss-of-load and under current conditions (broken belt, etc.) with a range of 3 to 135 amps. Units shall be suitable for use with variable frequency drives, automatically compensating for changes in frequency and voltage. Operating range shall be 5°F to 185°F. Units shall have a limited five (5) year warranty.

12. Water Flow Sensor/Transmitter

    a. The flow sensor shall be an insertion type with a non-magnetic, spinning impeller (paddle wheel) as the only moving part. The sensor sleeve will be brass with the sensor housing being glass-filled PPS. The impeller shall be glass-filled nylon or Tefzel® with a UHMWPE or Tefzel® sleeve bearing. The shaft material shall be tungsten carbide. The flow sensor shall be supplied with a 2" full bore gate valve in brass and a nipple threaded for a 2" NPT connection. A bleed valve and three ethylene-polypropylene O-Rings shall be supplied with the 2" NPT adapter portion of the sensor. A removable installation tool shall be attachable to the sensor for insertion or removal of the flow sensor from the pipe. The sensor will have all electronics epoxy-sealed with a 2-conductor, shielded cable extending out through a ½" conduit connection on the top of the sensor. Insertion of the sensor into any pipe size shall be a fixed 1 ½" depth from the inside wall to the end of the sensor housing. The sensor shall operate in line pressures up to 200 psi and liquid temperatures up to 220° F, and operate in flows of 1 foot per second to 30 feet per second in pipes of 3" diameter up to 40" diameter with linearity of ± 1% and repeatability of ± 1%. This sensor shall be equal to Data Industrial Model 225. The detachable installation tool shall be Model HTT.

    b. The analog flow transmitter shall be a loop powered device capable of transmitting a linear 4 - 20 mA signal proportional to frequency. The unit shall be microprocessor controlled with no switches or potentiometers to set. The transmitter shall meet ISA Class L, H and U non-isolated requirements. All circuitry shall be encapsulated in a 3.65" by 1.50" low profile epoxy body to meet MIL spec M.1-146058C type AR, for humidity, moisture and fungus resistance. Operating range shall be 32° F to 158°F. All programming, including flow sensor selection, pipe size, flow range setting, response time and filtering shall be set digitally via a computer using Windows based software with a programming kit (disk and cable). The transmitter shall be easily programmed in the field using a lap top computer.

The transmitter shall have a ground lug to maximize EMI protection when necessary. The transmitter may be mounted directly on any Data Industrial 200 Series insertion flow sensor or up to 500 feet remotely from the sensor, on a DIN Rail, as a panel mount or in a weather proof or NEMA 4X enclosure. The analog transmitter shall be equal to Data Industrial Model 310-00.

B. Valves shall be sized by the control manufacturer and shall have threaded connections except valves over 2" which shall have flanged connections. Valve packing shall be U-cup silicone or reinforced Teflon except where indicated. Maximum allowable pressure drop shall be 5 psi for water valves and 60% of inlet steam pressure for steam valves. All valves shall be equipped with positive positioners where indicated.

1. DDC valve actuators shall be electronic, low voltage modulating type, hydraulic or gear train, with spring return. Actuators shall be sized to provide smooth and positive operation and tight shutoff against full design system pressure. Valves for VAV boxes shall be drive-open, drive-closed type.

2. Control valves shall bronze globe valve with stainless steel trim, pneumatic actuator with low pressure pilot positioner, proportional, spring return to closed position at steam converter and chilled water cooling coil, and spring return to open position at hot water heating coils. Actuators shall be sized to provide smooth and positive operation and tight shutoff against full design system pressure.

3. Valves for heating water service shall be normally open type. Valves for cooling water service shall be normally closed type. Valve bodies 2" and smaller shall be bronze or high grade red brass in sizes 1/2" through 2". Valve bodies 2-1/2" and larger shall be iron.

4. All modulating valves shall have a minimum rangeability of 25 to 1. All modulating valves 4" and below shall be globe type. Modulating valves larger than 4" shall be butterfly type. (Modulating valves 2" and smaller may be ball type.)

5. All valves shall have stainless steel stems with replaceable packing, stem, seats and disk (,ball) or plug.

6. The pressure characteristics of all valves shall be the same or better than the piping in which installed and shall be suitable for the design system pressures indicated. Valve bodies shall have minimum ratings of 125 psig water service unless noted otherwise.

7. Cooling tower diverting (hot water heating reset mixing) valve shall be Continental, Fisher, or accepted equal, water butterfly valve. Valves and electric (pneumatic) actuator shall be factory mounted and linked on a cast iron "T" ready for installation in the condenser water line.

C. Dampers and Damper Motors:

1. Control dampers shall be Ruskin Model CD36 low leakage type manufactured specifically to control the air flow in heating, ventilating and air conditioning systems. Frames shall be made of galvanized sheet steel, formed into channels and riveted. In addition to the rigid frame construction, corner brackets shall be used to maintain alignment of the damper. Blades shall consist of formed galvanized sheets, formed for extra strength to withstand high velocities and static pressures. Square or hex blade pins shall be furnished to assure non-slip pivoting of the blades when a damper is used as a single module or is interconnected with others. Motor operated dampers shall be Class 1A with maximum leakage rate of 4 cfm/ft2 at 1.0 inch water gauge when tested in accordance with AMCA 500D. Maximum blade width shall be 8".

2. Damper actuators shall be provided for all automatic dampers. Damper actuators controlled from the DDC shall be electronic (pneumatic) modulating type, low voltage, spring return and shall be of sufficient capacity to operate the connected damper. Outside air and relief air damper actuators shall be spring return normally closed. Line voltage motors shall be two-position type.

D. Transformers are required for low voltage control items. Control manufacturer shall provide transformers with adequate capacity to operate connected equipment.

E. Panels: Control cabinets shall be furnished for each major equipment component and elsewhere as indicated. Control cabinets shall be fabricated of extruded aluminum or steel. The cabinets shall have a face panel for flush mounting gauges, switches, pilot lights, etc. and sub-panel for mounting controllers, relays, etc. Controls which require manual positioning or visual indication shall be flush mounted and identified with engraved nameplates on the face panel. Controls which are required to be accessible only for maintenance and calibration are to be mounted on the sub-panel in the cabinet. Each item shall be identified by engraved nameplates.)

F. Miscellaneous relays, transformers, switches and other devices shall be provided as required for the sequence of control indicated. Relays shall be located adjacent to the controlled device such as motor or motor starter. Relays may be located within starters and equipment control panels where space is available and where approved by NEC. Relays outside of the controlled device shall be provided with NEMA enclosure suitable for location where installed.

G. Disconnect Switches shall be provided for each 120V power connection to Stand-Alone Digital Controllers, Application-Specific Digital Controllers and all other electronic devices provided under this Section.

H. Uninterruptible power supply (UPS) with power conditioning shall be provided for each Building Network Controller and Stand-Alone Digital Controller. UPS power shall be capable of providing a minimum of 15 minutes backup power.

***** SUBSTITUTE PARAGRAPH K FOR PARAGRAPHS I & J IF THE OWNER PREFERS AN OPEN PROTOCOL DDC SYSTEM.**

I. Direct Digital Control System:

1. Building Network Controllers:

a. Central Building Controllers shall be provided as required by the system architecture for network communication with, and supervision over the control system. The controller shall provide for custom programming, global management, and overriding control of the all components of the control system via a LAN or communications link. Controller shall provide seamless communication with all Stand-Alone Digital Controllers, Application Specific Digital Controllers, unitary controllers, and third party controllers where indicated. Controllers shall be provided with Ethernet card capable of 10/100/1000 megabits for connection to Owner's LAN/WAN.

2. Stand-Alone Digital Controllers:

a. Stand-Alone Digital Controllers shall be programmable controllers capable of custom programming provided for air handling units, heating water systems, chilled water systems, and other similar equipment/systems.

b. Stand-Alone Digital Controllers shall be 16-bit microcomputer based, providing a multi-tasking operating system for control functions simultaneous with all other facility management, operator interface, and system communications functions. Stand-alone digital controllers shall provide true floating point arithmetic calculations, to accommodate accumulation of large totalized valves, and shall support calculation and accumulation of values up to 10 to the thirty-eighth power. Controllers connected to the local area network shall provide communications to all connected stand-alone digital controllers. Controllers shall be tested and certified to operate in ambient temperature of -40°F to + 140°F. Stand-alone digital controllers shall provide interface for portable operator access to password controlled access to all levels of operational capability, from simple information access, to full programmability of all functions.

c. Stand-Alone Digital Controllers shall be provided with operator display and touch pad to allow for viewing of system operation and modification of operating setpoints.

d. All programming defining the functions to be performed by the stand-alone digital controller, including but not limited to application programs and point database, shall be protected from loss due to power failure for a minimum of thirty days. Systems providing non-volatile memory for these functions are preferred. Systems not providing non-volatile memory shall provide battery backup sufficient to provide protection for the specified period.

e. Each Stand-Alone Digital Controller shall be provided with a minimum of 8 spare inputs and outputs. These spare points shall be allocated as follows: 2 spare binary outputs, 2 spare binary inputs, 2 spare analog outputs, and 2 spare analog inputs.

f. Stand-Alone Digital Controller operating system software shall be multi-tasking. Multi-tasking capability shall be provided to simultaneously perform at least, but not limited to, the following functions:

1) Downloading of application program changes to the stand-alone digital controller without affecting the simultaneous operation of existing operating application programming.

2) Printing of scheduled or on-demand reports without pre-empting operator functions.

3. Application Specific Digital Controllers:

a. Application Specific Digital Controllers (ASDC) with factory programming and no time clock may be provided for equipment such as VAV units, fan coil units, unit heaters, exhaust fans, small unitary equipment, etc. provided they are capable of controlling the equipment in accordance with the Drawings and the specified sequence of operations. ASDC's shall be capable of receiving program changes and time functions via the LAN or communications link. ASDC's shall be capable of making monitored point available to the DDC.

b. DDC control, monitoring and alarm functions may be extended to remote equipment by the use of ASDC's. Use of ASDC's shall be transparent to the central DDC without effect on DDC functions or color graphic displays.

c. Each ASDC shall be microprocessor based DDC and shall perform all sequences as indicated and shall communicate with all other DDC controllers via the LAN or

communications link. Each ASDC shall also be capable of stand-alone operation and as directed by the central DDC system.

d. Each ASDC shall provide for portable operator interface either through connection to the space sensor or connection directly to the ASDC.

e. Programmable ASDC's shall be provided with 72 hour battery back-up or non-volatile EEPROM memory and self-contained clock. The clock shall be capable of time synchronization from the DDC.

4. Unitary Control Interfaces:

a. Where unitary controls of packaged equipment are capable of communicating with the specified control system, they may be integrated into the network in lieu of Stand-Alone Digital Controllers. All specified functions and monitoring points shall be provided as specified in the Drawings and/or sequence of operations. Where required control and monitoring points are not provided as part of the unitary controls, DDC control and monitoring shall be provided.

5. Portable Operator Interface (Laptop or Notebook Computer): Provide one portable operator interface for the Owner's use in on-site analysis and control of stand-alone units and network. Unit shall operate on batteries as well as AC line voltage, and shall provide minimum 14-inch WLED display with 1366 x 768 resolution. Unit shall be provided with the latest version of Windows 7 Professional™ operating system, Intel Core iX or AMD processor at 2.2 GHZ or higher, 16X DVD+/-RW optical drive, minimum 320 GB hard drive, 2 GB of DDR3 memory, Ethernet card capable of 10/100/1000 megabits, and an 802.11 b/g/n compatible wireless LAN card. Unit shall provide a full size typewriter-style keyboard, with a minimum of eight programmable function keys and thumb pad. Unit shall be provided with a data communications cable for direct connection to the stand-alone control unit or network. Interface ports shall support RJ-11, RJ-45, RS-232, RS-485, or all types as required to interface with specified controllers.

6. Centralized Host Stations:

a. The digital control system shall have capacity to support a Centralized Host Station. Centralized Host Stations shall, in conjunction with the network of stand-alone digital controllers, and additional computers or components, provide the performance requirements within this specification. The centralized host station shall include all hardware and software components to serve as a centralized facility operator station providing color graphics, facility wide access and coordination of global control strategies, and centralized documentation. The centralized host station (shall be located)(is existing) at the _____ and (includes)(shall include):

1) Five thousand point host software with dynamic color-graphics, ICON Driven.

2) Minimum 19-inch LCD high-resolution color-graphics flat panel monitor.

3) Two (2) auto answer auto dial modems, minimum 56.0 KB.

4) One (1) serial or USB printer (minimum 160 cps).

5) One (1) external USB hard drive, sized to match the size of the hard drive provided in the computer serving the Centralized Host Stations, minimum 500 GB.

6) Simultaneous support of local and remote dial up communications.

7) All require cabling.

b. The computer serving the Centralized Host Stations shall be a 32 or 64 bit computer, which shall operate under the latest version of Windows 7 Professional™. The computer shall include as a minimum, an Intel Core i5 or AMD dual or quad core 2.6 GHZ processor, 4000 megabytes of DDR3 RAM, 128 megabyte PCI-E video card, Ethernet card capable of 10/100/1000 megabits, 16X DVD+/-RW SATA optical drive, and shall operate from a minimum 500 gigabyte SATA hard disk drive. The computer shall include an optical mouse in conjunction with the color graphic terminal and a standard 101/102 keyboard. The computer shall support all peripherals as specified. In addition, the computer supplied shall be provided with all components installed as required to support peripherals including serial or USB printers, auto answer/auto dial modems (RJ-11), and Ethernet (RJ-45).

7. Web Browser Access Interface/Controller: Provide a Web Browser Access Interface/Controller to allow real time access to the DDC system from a remote location via the Internet. Device shall be capable of supporting Microsoft Edge, Google Chrome, and Mozilla Firefox web browsers and provided with a minimum of two Ethernet (RJ-45) ports for connection to the Owner's LAN/WAN and the dedicated DDC network. Secure Sockets Layer (SSL) security protocol shall be provided with a minimum of two levels of security. Privileges allowed at each level of security shall be adjustable and programmed by the Temperature Controls Subcontractor as defined by the Owner. The following functions shall be available through the web browser:

a. View operation of all systems controlled by the DDC.

b. Modify system setpoints and schedules.

c. View and acknowledge alarms.

d. Define, save, plot, and print trend data.

J. Centralized Host Station Performance Requirements:

1. Color Graphic Operator Interface: The color graphic terminal shall be driven by software allowing the operator to access any system information via a "system penetration" method. "System penetration" shall allow the operator to begin at an entire site plan color graphic display and progressively select portions of the site plan to be chosen for closer inspection or selection of a more detailed color graphic display of a desired portion of the facility. The operator shall be able in this manner to "penetrate" to any desired system information without being required to enter any commands via the keyboard.

2. Dynamic Color Graphic Displays: Color graphic floor plan displays and system schematics for each piece of mechanical equipment including air handling units, chilled water systems, hot water systems and _____ shall be provided to optimize system performance analysis and speed alarm recognition. All mark numbers for equipment, controller and sensor designations shall exactly match those indicated on the Contract Drawings unless otherwise directed by the Owner. (All software and hardware upgrades shall be provided as required to integrate color graphics of this Contract with the Owner's existing color graphics.) All Campus, Building and Floor Plan graphic conceptuals shall be approved by the Owner prior to creation of screen graphics. Names and numbers for rooms, wings, and buildings shall be in accordance

with the Owner's final numbering systems. Color graphic display shall include, but not be limited to:

a. The real-time value dynamic display of any connected point in the network of stand-alone digital controllers.

b. The alarm status condition of any desired system alarm point.

c. Any software parameter such as setpoints for control sequences, minimum position adjustments, or throttling ranges.

d. All systems having air-side economizer shall display calculated or measured return air and outside air enthalpies.

3. Appearance of color graphics shall follow the below-listed order of penetration progression:

a. Campus plan (where more than 1 building, new and existing, is controlled or monitored).

b. (Three dimensional isometric)(Plan) color view of each building showing each floor and penthouse.

c. Entire color floor plan of the building on one screen without scrolling, and showing all equipment rooms with tags of all equipment located therein, and locations of all major system space sensors.

d. Large scale color floor plan view of each equipment room showing actual locations of controlled or monitored equipment.

e. Each item of equipment with dynamic color graphic system schematic display.

f. Each system schematic display shall be "linked" to the previous graphic, and to the system parameters of each monitored and controlled point.

g. All screen graphics for systems with economizers shall show calculated values of enthalpy for outdoor air and return air.

h. All graphics shall have user definable background, line and text colors for all screens.

4. Centralized Scheduling and Modification: The color graphic terminal shall support operator access to the global scheduling screens which allow the operator to review and modify any or all controlled schedules as desired. The centralized scheduling function shall allow modification of equipment and lighting operating schedules, modification of facility holiday schedules, and when desired allow assignment of temporary schedules for designated portions of the facility or specific equipment.

5. Global Electrical Demand Limiting Control shall have the capability to allow the operator to review and modify the parameters affecting global demand control strategies. Demand control shall utilize sliding window control algorithm with provision for multiple load shed facility wide as appropriate to owner's requirements. Time of day demand limits shall be assignable to appropriate billing period time slots.

6. Energy Management Reporting shall have the capability to provide daily, weekly, monthly, and/or yearly formatted reports of facility, metered electrical consumption. Reports shall provide detail information for hourly KWH consumption, daily peak hour

of consumption, daily time of peak demand, demand setpoint in use at time of peak, daily degree days, and outside air temperature and relative humidity at time of peak. Reports shall be created to provide individual reporting as desired by the owner for multiple facility meters, multiple sites, or aggregate facility metering combining multiple meters. The centralized host station shall retain daily summary energy data for up to five years. Reports can be designated as automatically printed, or called-up for report printout demand. The centralized host station shall support auto dial polling for remote sites for individual energy reporting and histories of multiple sites and have sufficient capacity to accommodate auto polling and report accumulation of a minimum of 100 sites. Reporting parameters, formatting, and frequency shall be in accordance with the Owners preferences.

7. Optimum Start Control programs shall be self-learning and shall adapt the algorithm parameters to the optimum values for each applied zone. Optimum start/stop shall provide separate control outputs for heating, cooling, fan and ventilation control sub-systems to maximize energy efficiency. The Centralized Host Station shall provide operator access to all optimum start parameters for designated items, equipment, or scheduled systems. Trend Reports: The Centralized Host System shall support logging and historical accumulation of trended data from the entire facility, or multiple sites with capacity for acquiring trend data from a minimum of 100 sites. The system shall be capable of utilizing dedicated logging printers and provide the capacity to document printed trend data accumulated from any or all of the stand-alone digital controllers in connected on-site network, or from any number of remote sites which connect to the centralized host system dedicated logging printer via dial-up modem or Ethernet connection. The centralized host system shall provide capacity to store to disk a directory of at least 150 trend logs. Such trend logs can be accessed from the directory by the operator at any time for analysis of selected sets of the trended data, display onto the screen, or hard copy documentation.

8. Third Party Software Packages: The Centralized Host System shall provide the capacity to run specific third party software packages for word processing, spreadsheets, or database management programs.

9. Database Archiving: The Centralized Host System shall provide capability to up-load or download global control functions and programs being performed by the network of stand-alone digital controllers, and the individual database and application programming resident in each controller in the facility, or on remote sites. The up-load programs shall be retained on the centralized host system's hard disk for system backup. Programs may be modified using editor functions, and downloaded to individual units as desired.

10. Database Maintenance Reports: The centralized host system shall provide a daily report of all modifications made to any software function in the system. Report shall include the specific setpoints, schedules, sequence parameters, or limits that were modified and the time and location of the modification, and the identification of the operator making the modification.

11. Override Report: The centralized host system shall provide a daily report of all overrides issued, and/or in force on the system. Override reports shall allow tracking of operator functions and maintenance of desired operational conditions.

12. System Maintenance Report: The centralized host system shall provide a report of maintenance items on an automatic printout basis. Maintenance events shall be settable by the user based on event, elapsed run time, number of cycles or calendar day/date.

13. All operator access shall have multiple-level password protection. All setpoints for safeties shall be protected by the highest level password.

14. All help files imbedded in the software as well as all auxiliary software necessary for full access and to allow programming and other functions shall be provided and made accessible to the operator.

K. Control Panels shall be a fully electronic analog control or digital control system, providing all control functions for the equipment specified to be controlled from that panel. Each control panel shall serve one or more equipment systems. Multiple control panels serving a single piece of equipment are prohibited. Each control point shall serve a single, distinct input or output. Control functions to be performed by control panels are as described hereinafter in the sequences of operation and on the drawings. Each panel shall service one or more equipment systems.

L. All signals between the DDC control panel and the monitored or controlled devices shall be low voltage (less than 100 volts).

M. Sensing of temperature, humidity, differential pressure, and all other inputs shall be industry standard signals by one of the following types:

1. 0-20 mA

2. 4-20 mA

3. 0-5 VDC

4. 0-12 VDC

5. Resistance Signals

All inputs shall be compatible with the controllers used, and with the requirements for readout of variables.

N. On/Off Outputs: The control panel shall internally provide test points for the circuit driving the equipment contactor, for troubleshooting the low voltage circuit to the contactor. All relays or digital output modules shall provide a pilot light or LED display of this same status.

O. Modulating Outputs shall be industry standard 0-5 VDC, 0-12 VDC or Milliamp outputs of 0-20 mA or 4-20 mA, or drive open/drive closed type modulating outputs. Drive open/drive closed type controllers shall include sufficient components and control algorithms.

P. Standard Software Function Libraries: Complete libraries of control algorithms for DDC, Energy Management, and Facilities Management functions shall be resident for all stand-alone digital controllers and shall be drawn from for the creation of the application programming.

Q. Energy Management Control: The network of stand-alone controllers shall individually perform Time of Day Scheduling, Optimum Start/Stop, Enthalpy Optimization, and all Control Optimization strategies, such as Supply Air Reset, and Soft Start Ramp-up, for their connected systems of equipment. Coordination of strategies involving multiple systems of equipment shall be performed by sharing of necessary data between the stand-alone controllers on the communicating network.

R. Electric Demand Limiting Control: The stand-alone controllers shall have the capability to communicate and provide coordination for global electric demand limiting control. Demand limiting algorithm shall be resident within a selected stand-alone digital controller and shall

issue load shed commands to the network for control of specific items of equipment. Demand limiting shall be sliding window demand control with a minimum of three user definable time of day demand limit setpoints. Multiple load shed tables shall be definable, and be shed for rotational or sequential restoration as appropriate for the loads within each designated shed table. The stand-alone digital controller to which electrical consumption meters may be installed shall provide for daily, and monthly formatted reports of metered electrical consumption. Reports shall be individually named and identified with a title line definable for each report, and shall provide information as detailed as hourly KWH consumption, daily peak hour of consumption, daily time of peak demand, demand setpoint in use at time of peak, daily degree days, and outside air temperature and relative humidity at time of peak. Reports shall be created to provide individual reporting as desired by the Owner for multiple facility meters, multiple sites, or aggregate facility metering combining multiple meters. System shall have capability to designate reports for automatic print, or call-up for report printout on demand, as well as upload to selected centralized host system for historically archiving.

S. Alarm Occurrence Status: Alarm condition reports shall provide a printout listing the status of specific items associated with the equipment generating the alarm. Report shall be routed to a specific printer or combination of printers at the Centralized Host Station or the on-site programming unit. Report shall record time and status information and allow operational personnel to use this information to diagnose the alarm situation.

T. Telecommunications Support: Each building network shall be provided with the necessary equipment, programming, and connections to communicate with remote host computers through one auto dial/auto answer modem and through an Ethernet connection to the Owner's LAN/WAN.

U. Remote Access and Notification: The system shall be installed such that access to the entire facility can be accomplished through both the modem and the Owner's LAN/WAN. The modem and Ethernet connection shall each be capable of providing the following functions:

1. Access to the entire facility control system by the Contractor to provide service and diagnostic support.

2. Access by the Owner from off-site for similar purposes, and for remote operation, monitoring, and adjustment of facility functions.

3. Notification of desired exceptions and alarms to multiple remote sites scheduled as necessary for business hours, or off-hours reporting.

V. Off Hours Exception Reporting shall provide the Owner a means of specifying up to two remote sites for which off hours exceptions shall be reported. Selection of the site to be connected shall be programmed by the Temperature Controls Subcontractor as directed by the Owner, and set to change automatically per time of day and day of week.

W. Generally, the stand-alone digital controller and control panel shall be located on or near the unit, which they control as indicated on the Drawings.

X. Lightning arrestors shall be provided on all wiring, which exists or enters the building. Arrestors shall be located adjacent to the protected equipment.

Y. As a part of this contract the Temperature Control Subcontractor shall provide eight hours of classroom instruction in operation, programming and maintenance of the system to owners operating and maintenance personnel. Instructors shall be fully qualified in all aspects of the system. Training shall be scheduled as required by the owner and shall take place at an

owner-designated location. Training shall be video recorded and provided to the Owner in DVD format.

PART 3 - EXECUTION

3.01 WORK BY OTHERS:

A. All line voltage wiring (101 volts or more) shall be furnished and installed as a part of Divisions 26 and 27.

B. All low voltage wiring (100 volts or below) shall be furnished and installed as an integral part of this section of the specification in strict accordance with Divisions 26 and 27. (Refer to Divisions 26 and 27 for special requirements of separation between Control and Instrumentation wiring from Communications/Data Cabling.)

C. All dampers, valves, immersion wells and pipe pressure tappings will be installed by the Mechanical Contractor.

D. All relays, firestats, sensors, annunciators, alarms, or other electrical devices not indicated to be installed by Divisions 26 and 27, shall be installed under Division 23. Coordinate with Divisions 26 and 27 for locations as necessary.

E. BAS Contractor shall coordinate the location of all control panels with Divisions 26 and 27. All power circuits and communication network/devices necessary for the control panels shall be provided within the Contract.

3.02 GENERAL SEQUENCE REQUIREMENTS:

A. Refer to Section 23 09 93 for Sequence of Operation for HVAC Controls.

3.03 INTERFACE WITH PACKAGED UNITARY EQUIPMENT CONTROLLERS:

A. Where packaged equipment is indicated elsewhere within the Contract Documents to provide unitary control with BACNET or similar interface, the DDC shall communicate with and monitor the packaged controllers. Coordinate with available equipment protocols, BACNET MS/TP (or BACNET IP if approved by Owner). At a minimum, the DDC system shall:

1. Provide signals to the packaged controllers for occupancy and all setpoints necessary. Setpoints adjustment shall be available through the graphics interface. Occupancy scheduling shall be as indicated for equipment with DDC control.

2. Monitor all unit alarms and provide an alarm within the BAS of any alarm conditions within the unit. Alarm indications shall be specific to the type alarm occurring with the unit.

3. Monitor all points indicated within this section, all points indicated within the respective equipment specifications and all points shown on the controls schematic Drawings. Additional points shall include monitoring of actual unit percent capacity or stages of capacity where available. Where any control or data point is not provided within the equipment controls, the DDC shall provide the necessary input/output, sensor, etc. necessary for control or monitoring of that point.

4. Provide graphics displays for all packaged equipment to include: all points indicated within this section, all points indicated within the respective packaged equipment specifications, and all points shown on the controls schematic Drawings. The main graphics display for the respective unit shall include all points shown on the controls

schematic Drawings. Any data available in excess of that indicated above shall be available outside the main graphics screen.

3.04 SYSTEM MONITORING AND ALARM

A. The DDC shall provide an alarm for the following points as applicable to each unit, system, or piece of equipment. Where points occur in more than one unit or system, an alarm shall be provided for each system in which it occurs. The alarm indication shall be specific as to the parameter that has either exceeded or fallen below limits or provides indication that the system is not operating as commanded. The alarm indication shall identify the system in which the alarm occurs. Limits for alarm indication shall be coordinated with the Owner's representative and shall not be so tight as to cause nuisance alarms.

1. Economizer Fault Detection and Diagnostic (FDD) alarms
2. High/low discharge air temperature for all VAV units
3. Return air humidity
4. Discharge static pressure for all VAV units (exceeds high limit)
5. Differential static pressure across filters
6. Minimum outside airflow on VAV units (below setpoint)
7. High return or space CO2
8. VFD alarm indication
9. Current relays
10. High/low space temperature
11. Duct smoke detectors
12. Differential pressure across fans or pumps
13. Chilled water system supply water temperature
14. Chiller supply water temperatures
15. Chiller alarms
16. Condenser water supply temperature
17. Low condenser water basin temperature
18. Boiler alarm(s)
19. Heating water system supply temperature
20. VAV box low airflow condition
21. Activation of freeze protection
22. Glycol low level

23. Float switch alarms

24. Activation of generator

25. Kitchen refrigerator temperature alarm

26. Kitchen freezer temperature alarm

3.05 INSTALLATION

A. The location of all control items on the exterior of the building shall be approved by the Architect prior to installation.

B. Where the condition occurs, provide insulated sub bases for all space temperature sensors located on exterior walls.

C. All sensors located in equipment, ductwork and piping shall be installed with appropriate fittings such that devices are securely attached to coils, duct, pipe, or similar and are not free to move, rotate, or become dislodged. The use of adhesives for attachment is not permitted.

3.06 SERVICE AND GUARANTEE

A. The entire control system shall be serviced and maintained in first class condition by the control manufacturer for a period of one year after acceptance at no extra cost to the Owner.

END OF SECTION

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SECTION 230993
SEQUENCE OF OPERATIONS FOR HVAC CONTROLS

PART 1 - GENERAL

1.01 SUMMARY

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

B. Work Included:

1. Sequence of Operations for HVAC Systems

C. Related Sections:

1. Division 01 -- Commissioning

2. Section 23 00 10 – HVAC General Requirements

3. Section 23 05 00 – Common Work Results for HVAC

4. Section 23 05 53 – Identification for HVAC Piping and Equipment

5. Section 23 05 93 – Testing, Adjusting, and Balancing for HVAC

6. Section 23 09 00 – Instrumentation and Control for HVAC

7. Section 23 20 00 – HVAC Piping and Pumps

8. Section 23 30 00 – HVAC Air Distribution

9. Section 23 50 00 – Central Heating Equipment

10. Section 23 80 00 – Decentralized HVAC Equipment

1.02 GENERAL REQUIREMENTS

A. Programming shall be provided in accordance with commonly accepted industry standards and practices to ensure proper and efficient control of all equipment and systems.

B. Control sequences shall be accomplished in accordance with control drawings and the sequences specified in this section and described on the drawings. It is the intent of this section to utilize sequences included in pre-programmed controllers when such sequences provide the intended operation. Where factory programming is incapable of providing the sequence specified in the Contract Documents, a custom controller with custom programming shall be provided.

1.03 SUBMITTALS

A. Refer to Section 23 09 00, Instrumentation and Control for HVAC.

1.04 WARRANTY

A. Refer to Section 23 09 00, Instrumentation and Control for HVAC.

1.05 COMMISSIONING OF HVAC SYSTEMS:

A. Refer to Section 23 09 00, Instrumentation and Control for HVAC.

PART 2 - PRODUCTS – Not Used

PART 3 - EXECUTION

3.01 GENERAL SEQUENCE REQUIREMENTS:

A. Set points: All control setpoints shall be provided with appropriate deadbands where necessary to prevent the excessive cycling of equipment, valves, dampers, etc.

B. Failure of Digital Control System: The control system shall be installed to fail safe to the heating mode.

1. Night setback shall fail to day (occupied) mode.

2. Heating water system shall fail with boiler energized to boiler control and heating water pump on.

C. Unoccupied Period Freeze Protection: When outdoor air temperature falls below 35°F during unoccupied periods, the following sequence shall occur.

1. Heating water pumps shall be energized (pumps should be energized whenever any space requires heat).

D. Unoccupied Periods: At times when the building is unoccupied, the DDC shall control all systems to maintain an adjustable night setting for heating. Terminal units such as cabinet unit heaters and fan coil units shall cycle the fans as necessary to maintain unoccupied setpoints. Activation of the manual override on a space temperature sensor, where applicable, shall result in the following: the space temperature setpoint shall be indexed to the occupied setpoint for that space and the system serving that space shall be indexed to the occupied mode. All other spaces shall be maintained at unoccupied temperature setpoints.

E. System Start-up: Following any type of system shutdown, the DDC shall stagger the starting of all electrical loads to reduce electric peak demand.

F. System Shut-down: Ancillary systems required for freeze protection (except electric coils) shall remain operational.

G. Duty/Standby and Lead/Lag Control: All equipment indicated to be operated as duty/standby or lead/lag shall be sequenced based on run time and alternated bi-monthly or as otherwise required in accordance with the Owner’s preferred schedule. Sequencing shall occur as scheduled without the need for shutdown, if necessary. Sequencing for individual equipment shall occur so as not to impact the operation of the entire system. The DDC shall automatically energize the standby or lag device in the event of a failure in the duty or lead equipment.

H. Refer to the Electric Sequence Controls Schematics on the drawings for automatic control of fans, ancillary heating equipment, and other similar items. The following hard-wired interlocks shall be provided in addition to any others indicated on the Electric Sequence Controls Schematics:

1. Boiler firing shall be inhibited unless combustion air dampers have been opened and verified open through actuator limit switches.

2. Emergency boiler shutoff shall de-energize all boilers upon activation of the emergency break glass switch provided under Division 26.

I. All screen graphics for systems with economizers shall show calculated values of enthalpy for outdoor air and return air.

3.02 SEQUENCE OF OPERATION:

A. Refer to drawings for equipment sequences of operation.

END OF SECTION

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SECTION 232000
HVAC PIPING AND PUMPS

PART 1 - GENERAL

1.01 SUMMARY

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

B. Work Included:

1. Pipe and Pipe Fittings
2. Hydronic Pipe Specialties
3. Air Control Fittings
4. Miscellaneous Piping Specialties
5. Pumps
6. HVAC Water Treatment

C. Related Sections:

1. Division 01 -- Commissioning
2. Section 23 00 10 – HVAC General Requirements
3. Section 23 05 00 – Common Work Results for HVAC
4. Section 23 05 48 – Vibration and Seismic Controls for HVAC Equipment and Piping
5. Section 23 05 53 – Identification for HVAC Piping and Equipment
6. Section 23 05 93 – Testing, Adjusting, and Balancing for HVAC
7. Section 23 09 00 – Instrumentation and Control for HVAC
8. Section 23 50 00 – Central Heating Equipment
9. Section 23 80 00 – Decentralized HVAC Equipment

1.02 REFERENCES:

A. General: The following standards or codes form a part of this specification to the extent indicated by the reference thereto.

B. American Society for Testing and Materials (ASTM):

A53-88a Pipe, Steel, Black and Hot-dipped, Zinc-coated, Welded and Seamless

A106-88a Seamless Carbon Steel Pipe for High Temperature Service

A120-88a Pipe, Steel Black and Hot-dipped, Zinc-coated, Welded and Seamless for Ordinary Uses

A126-84 Gray Iron Castings for Valves, Flanges and Pipe Fittings

A254-88 Copper Brazed Steel Tubing

A420-88 Piping Fittings of Wrought Iron Carbon Steel and Alloy Steel for Low Temperature Service

A539-88 Electric-Resistance-Welded Coiled Steel Tubing for Gas and Fuel Oil Lines

B32-89 Solder Metal

B42-88 Seamless Copper Pipe, Standard Sizes

B75-86 Seamless Copper Tube

B88-95a Seamless Copper Water Tube

C. American Society of Mechanical Engineers (ASME):

ASME 95 Boiler and Pressure Vessel Code

B16.3 Malleable Iron Threaded Fittings

B16.4 Cast Iron Threaded Fittings

B31.9 Building Services Piping

D. International Ground Source Heat Pump Association (IGSHPA) Installation Manuals.

E. National Electrical Manufacturers Association (NEMA)

F. Underwriters Laboratories, Inc. (UL)

1.03 COMMISSIONING OF HVAC SYSTEMS:

A. The Contractor shall provide contact information to the Commissioning Agent indicated in Division 1 for all major items of Equipment.

B. Provide additional submittal copy of major equipment for Commissioning Agent specified in Division 1.

1.04 SUBMITTALS:

A. Submit shop drawings, product data and samples in accordance with Division 1 and Section 23 00 10.

B. Shop drawings, diagrams, catalog data and such other data necessary to fully describe and substantiate compliance with these specifications shall be submitted for all equipment and materials marked with notation set forth in Section 23 00 10.

C. Operation and maintenance data shall be submitted in accordance with Division 1, for all items of equipment and materials marked with notation set forth in Section 23 00 10.

PART 2 - PRODUCTS

2.01 PIPE AND FITTINGS:

A. Material Standards:

1. Steel pipe shall be manufactured in accordance with ASTM A53 and shall be so labeled.

2. Copper pipe shall be manufactured in accordance with ASTM B88 and shall be so labeled.

B. Heated Water Lines: Pipe 4" and smaller shall be type L hard drawn copper tubing or standard weight schedule 40 black steel pipe over 4" shall be standard weight black steel. Fittings for copper pipe shall be ASME B16.18 or ASME B16.22 solder type. Viega ProPress (no substitute) may be used for pipe 2" and smaller. Fittings for steel pipe shall be standard weight, threaded, black, malleable in accordance with ASME B16.3 or cast iron in accordance with ASME B16.4 except fittings over 2" size may be welding type. Flanges shall be weld neck type. All fittings shall be suitable for 125 psi water service.

C. Provide utility location tape 12 inches to 24 inches above buried piping outside the building, consisting of polyethylene plastic and metallic core or metallic-faced, acid-and alkali-resistant, polyethylene plastic warning tape manufactured specifically for warning and identification of buried utility lines. Provide tape on rolls, 3 inch minimum width, for the intended utility with warning and identification imprinted in bold black letters continuously over the entire tape length. Warning and identification to read, "CAUTION, BURIED (intended service) LINE BELOW" or similar wording.

1. Warning Tape for Metallic Piping: Acid and alkali-resistant polyethylene plastic tape. Minimum thickness of tape shall be 0.003 inch. Tape shall have a minimum strength of 1500 psi lengthwise, and 1250 psi crosswise, with a maximum 350 percent elongation.

2. Detectable Warning Tape for Non-Metallic Piping: Polyethylene plastic tape with minimum thickness of 0.004 inch. Tape shall have a minimum strength of 1500 psi lengthwise and 1250 psi crosswise. Tape shall be manufactured with integral wires, foil backing, or other means of enabling detection by a metal detector when tape is buried up to 3 feet deep. Encase metallic element of the tape in a protective jacket or provide with other means of corrosion protection.

2.02 HYDRONIC PIPE SPECIALTIES:

A. Fill valves ([S]) shall be Bell & Gossett or Watts complete with strainer and check valve. Valve shall be adjustable 10-25 and 25-60 psi and field set at 5 psi above pressure required to fill the system. Provide full size manual bypass with cutoffs around fill valve for fast fill and purging.

B. Backflow Preventer ([S]): Watts No. 909 reduced pressure type or accepted equal by Wilkins or Febco, complete with inlet and discharge shut-offs and field testing cocks, 150 psi working pressure. Provide full size of indicated line size, extend vent to nearest drain.

C. Manual air vents on 3/4" piping shall be chromium plated brass 1/8" NPT coin operated type. Provide extension tube if required to maintain access to vent operator. Manual air vents on 1" and larger branch piping and hydronic mains shall be a minimum 1/2" ball valve with hose thread adaptors. Extend vent piping as necessary to locate valves in accessible locations. Air vents and vent piping shall be suitable for 150 psi working pressure.

D. Automatic air vents ([S]) shall be Hoffman No. 79, suitable for 150 psi service and shall provide venting operation under all conditions. Exhaust port from each shall be extended with a concealed 1/4" copper tubing to floor of equipment rooms, to a drain, or to 6" above grade at building exterior.

2.03 AIR CONTROL FITTNGS [S] [O/M]:

A. All air control fittings shall be provided by the same manufacturer and are based on Bell & Gossett models.

B. Air Separator [S]: ASME rated coalescing removal type separator with medium, flanged removable head, and flanged pipe connections. Coalescing medium shall be removable stainless steel or copper. Connections shall be provided for air vent, blow down valve, and skim valve. Air separator shall be Bell and Gossett model CRS, Spirotherm VDN/VHN, or equal.

C. Boiler Fitting ([S]): ABF top outlet.

D. Tank Fitting ([S]): ATF or ATFL as applicable with combination drain and vent valve.

E. Pressurized Vertical Expansion Tanks ([S]) shall be pre-charged steel type with replaceable heavy duty butyl rubber bladder. The tank shall have a 1-1/2 in. NPT system connection, ¾ in. drain, and a .302-32 charging valve connection (standard tire valve) to facilitate the on-site charging of the tank to meet system requirements. The tank shall be constructed in accordance with Section VIII of the ASME Boiler and Pressure Vessel Code and stamped 125 PSIG working pressure. The tank shall be fitted with lifting rings and a floor mounting skirt for vertical installation.

2.04 MISCELLANEOUS PIPING SPECIALTIES:

A. Strainers shall be Y type with stainless steel basket suitable for 125 psi service. All strainers shall be provided with blowdown valves.

B. Dielectric fittings such as couplings or flanges shall be installed to isolate pipes of non-ferrous metal where connection is made to ferrous metal. Isolation shall be accomplished by use of a brass converter fitting of threaded brass or bronze couplings (not unions), or flanged joints with gaskets and bolt bushings. Materials shall withstand pressure and temperature as required. Valves of the same materials may also be used.

C. Drains shall be accessible and shall consist of 3/4" ball valves with hose thread adapters, cap and chain unless indicated otherwise.

D. Escutcheons shall be the split pattern chromium plated bronze or steel. Special height escutcheons shall be provided where extended sleeves are used. Escutcheons shall be sized to cover the entire opening.

E. Pipe sleeves shall be installed as outlined in SECTION 23 00 10 HVAC GENERAL REQUIREMENTS.

2.05 PUMPS [S] [O/M]

A. General: Pumps shall operate at not over 1750 rpm and shall be suitable for pumping 210°F water. Pump shop drawings shall include pump curves with operating head, pumping quantity, and motor horsepower clearly marked. Pump impeller shall be no larger than 80% of the range between minimum impeller and maximum impeller size for the model selected. Pump motor and couplings shall be suitable for operation with variable frequency drive (VFD) where indicated.

B. Base Mounted Units shall be Bell & Gossett Series 1510 two bearing, end suction split case, enclosed impeller, non-overloading, centrifugal type. Casing and bearing housings shall be cast iron with grease fitting. Shaft seal shall be mechanical type. Impeller, impeller guide rings, and shaft sleeve shall be bronze or stainless steel. Shaft shall be steel, turned and ground. Pump and motor bearings shall be sleeve, roller or ball type. Pump shall be direct connected through a flexible coupling to a general-purpose type electric motor. Pump and motor shall be mounted on a common cast iron or steel base. Each pump shall be furnished complete with suction diffuser constructed of cast iron with steel inlet vanes, start-up strainer, normal service strainer, and adjustable support leg. Each pump shall be set firmly and bolted and grouted in place.

2.06 HVAC WATER TREATMENT

A. Chemical feeder [S] shall consist of a one-shot feeder and a one year supply of chemicals. The feeder shall have a steel body of two-gallon capacity, with holes at top and bottom sides tapped for 3/4" pipe thread, and 3/4" pipe thread drain. The bypass feeder shall be rated at 300 psi at 200°F. The tank shall have a wide mouth, 3-1/2" opening so that chemical addition can be performed without the need of a funnel. The bypass feeder shall have a continuous threaded closure requiring 2-1/2 turns to close and seal. The cap shall be constructed of cast iron with an epoxy-coated underside to prevent corrosion and shall use a square ring gasket seal. The ring gasket shall not be glued or restrained from movement. The bypass feeder shall be provided with legs to elevate the feeder off the floor. The legs shall have holes to allow anchor bolt mounting to the floor.

PART 3 - EXECUTION

3.01 PIPING INSTALLATION:

A. General: Sleeves and sealant shall be provided where pipes pass through floors, partitions or walls as outlined in Section 23 00 10, HVAC GENERAL REQUIREMENTS. Pipe shall be cut accurately to measurements established at the job site and worked into place without springing or forcing, properly clearing all windows, doors and other openings. Pipe in finished areas shall be concealed. Excessive cutting or other weakening of the building structure to facilitate piping installation will not be permitted. Each end of each piece of pipe shall be reamed. Pipe shall be installed to permit free expansion and contraction without damage to joints or hangers. Changes in direction shall be made with fittings. Bent pipe showing kinks, wrinkles, or other malformations will not be acceptable. Bushings and all thread nipples will not be allowed.

B. All piping shall be installed with sufficient pitch to insure adequate drainage and all high points in water lines shall be provided with auto-air vents, all low points with drains. Pipe extending through the roof shall be properly flashed.

C. Bull head tee piping connections shall not be used in supply or return arrangements.

D. Piping connections to equipment shall be provided with unions or flanges. Banked water coils shall be piped in reverse return arrangement with a balancing cock in the return leg of each coil. Boilers shall not be connected into the piping systems until they have been thoroughly cleaned internally in accordance with the manufacturer's instructions and not until they can be fired under a fairly continuous load. Connections shall not be made to any equipment until the piping systems have been cleaned completely and are free of all dirt.

E. A suction diffuser shall be provided at the suction connection to each base mounted pump; maximum water pressure drop shall not exceed 2.5 feet w.g. at full pump flow. Suction diffusers shall have start-up screen.

F. Open ends of pipe lines or equipment shall be properly capped or plugged during installation to keep dirt or foreign material out of the system.

G. Escutcheons shall be provided where exposed pipes pass through finished walls or floors.

H. Miscellaneous piping terminating at floor drains or in the air shall be resiliently anchored to protect against fatigue or damage incurred as a result of vibration or abuse.

I. Provide P/T ports in the supply and return piping at all coils, heat exchangers, pumps, and where otherwise indicated on the drawings.

J. All piping to a coil or heat exchanger shall be the full size of the runout indicated with a reducer as necessary at the coil connection. This shall include all appurtenances except control valves.

K. All underground piping shall be installed minimum 3'-0" below grade and minimum 4'-0" below roadways unless otherwise indicated on the Drawings.

L. A hose bib for draining the condenser water system shall be provided downstream of the condenser water pump triple duty valve. The hose bib shall be located at the lowest point within the mechanical room. Provide other drain valves as necessary to allow complete drainage of the condenser water piping.

M. Joints:

1. Copper tubing shall be cut square, ends reamed and all filings and dust wiped from interior of pipe. Joints shall be soldered with solder drawn through the full fitting length. Excess solder shall be wiped from joint before solder hardens. Solder shall be 95/5 composition – 50/50 will not be allowed. All solder joints shall have piping surfaces sanded or brushed. Self-cleaning solder flux as a substitute for sanding or brushing is not acceptable. In lieu of soldered fittings in hydronic piping, Viega ProPress (no substitute) fittings may be used for copper pipe 2" and smaller.

2. Threaded joints shall be made with tapered threads properly cut. Joints shall be made tight with a stiff mixture of litharge and glycerin or other approved thread joint compound applied with a brush to the male threads only. Not more than three threads shall show after the joint is made up. The use of thread protectors for pipe couplings is not acceptable. Expanding self-hardening pipe dope ("expando") shall not be used.

3. Welded Joints:

a. Welded joints shall be fusion-welded by qualified welders in accordance with American National Standard B31.1.06, Chapter 5, unless otherwise required. Changes in direction of piping shall be made with welding fittings only. Mitering or notching pipe to form elbows and tees or other similar type construction will not be permitted. The contractor shall wire brush and paint welded pipe welds before insulation is applied. Saddle type welding outlets may be used for equipment take-off's from the mains.

b. All pipe welding shall be done only by competent and experienced welders. High test welding rods suitable for the material to be welded are to be used throughout. All welds shall be built up to a thickness of 1 ½ times pipe wall thickness. All tees, branches, reducers or specialties that may be required in welded piping shall be carefully laid out by welders, using templates, and the joints shall have carefully matched intersections and shall be properly spaced. Finished pass on all welds shall be a smooth continuous weld cap. Multiple "stringers" on horizontal welds will not be acceptable.

c. During welding, all piping shall be securely clamped in place so that true alignment is held throughout the welding process. Where there is apt to be distortion, proper allowance shall be made so that the sections to be joined will be in proper alignment after the weld is completed. Care shall be exercised to prevent the occurrence of protruded metal into the pipe. All welds shall be of sound metal, free from laps, cold shuts, gas pockets, oxide inclusions and similar defects.

d. Adequate protection blankets, screens, etc. shall be provided during cutting and welding to protect existing adjacent surfaces.

4. Flanges and unions shall be faced true and made square and tight. Unions shall be 125 psi service, bronze seat type. Flanges shall be ASA Standard 125 psi service with red rubber gaskets. Unions or flange joints shall be provided on each side of each valve 2-1/2" or larger and in each line immediately preceding the connection to each major piece of equipment such as a pump, boiler, and other similar items.

3.02 RELIEF VENTS:

A. All natural gas vents and relief devices shall be independently and directly piped to the outside in accordance with the local Building Code, the International Fuel Gas Code and ANSI/ASHRAE Standard 15a. Refrigerant relief devices shall include chiller rupture disks and purge piping.

3.03 CONTROL ACCESSORIES:

A. Control valves, pipe wells and pressure tappings shall be furnished under Section 23 09 00 and installed as work of this Section.

3.04 PUMPS:

A. Contractor shall verify that final installed pump-motor shaft alignment is within the acceptable tolerances as specified by the pump manufacturer. Alignment shall be verified at both hot and cold operating temperatures and after all piping has been connected.

3.05 TESTING:

A. Heating Water Piping:

1. Piping shall be tested and results approved by the Architect/Engineer prior to application of insulation.

2. Piping system shall be capped and subjected to a static water pressure of 50 psig above operating pressure (minimum 125 psig), and pressure maintained for four (4) hours with no leaks or loss in pressure. Testing with air is prohibited.

3. Test source of pressure shall be isolated from the system before conducting pressure tests.

3.06 FLUSHING:

A. All hydronic systems shall be flushed.

1. The piping system installation shall be complete & all pressure tests accepted.

2. Temporary bypasses shall be provided around coils, control valves, heat exchangers and other similar items to prevent trash from being flushed into these items.

3. In order to remove larger debris, the entire system to be filled with domestic water, vented, then drained to sanitary system.

4. A temporary circulating (if necessary) pump will be sized by mechanical contractor to provide the correct flow for flushing the entire system. Minimum velocities shall be 3 ft/s minimum for flushing.

5. System will be continuously circulated while periodically draining & adding water to maintain proper system pressure. This will continue until water clarity is acceptable as determined by the water treatment contractor. The length of time this step takes depends on the flow rate and quantity of water flushed in GPM.

6. Once water clarity is confirmed by the water treatment Contractor, chemical cleaning agents shall be introduced into the system and circulated as detailed in the chemical treatment submittal.

7. The water treatment Contractor shall provide water samples from different system locations to confirm total dissolved solids and turbidity levels are within acceptable levels.

8. All strainers shall be cleaned.

3.07 SYSTEM STARTUP:

A. When heating water systems have been tested and made tight, flush all dirt, trash, and extraneous material with cleaner as recommended by equipment manufacturers, the Owners Water Treatment Consultant, and in accordance with this Section, Section 23 80 00, and Section 23 05 93. The cleaning chemicals used shall be provided by the Contractor. The Contractor shall notify the Owner's Water Treatment Consultant 30 days prior to the boil-out/cleaning of the system.

B. The chemicals to be used by the Contractor for the specified initial treatment shall be furnished by Contractor. The Owner's Water Treatment Consultant shall be provided the opportunity to supervise the cleaning of equipment and the initial chemical fill for placing the equipment in normal service.

C. Chemical formulation shall be compatible with system materials, shall conform to DEQ regulations and shall not exceed DEQ or local effluent limits.

D. After cleaning and chemically treating the HVAC systems, the Contractor shall furnish the Owner, in writing, the following information:

1. Date of initial treatment.

2. Type of chemicals used for treatment.

3. Estimated date that further treatment or testing will be required.

END OF SECTION

SECTION 235000
CENTRAL HEATING EQUIPMENT

PART 1 - GENERAL

1.01 SUMMARY:

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

B. Work Included:

1. Heating Boilers

C. Related Sections:

1. Division 01 -- Commissioning
2. Section 23 00 10 – HVAC General Requirements
3. Section 23 05 00 – Common Work Results for HVAC
4. Section 23 05 48 – Vibration and Seismic Controls for HVAC Equipment and Piping
5. Section 23 05 53 – Identification for HVAC Piping and Equipment
6. Section 23 05 93 – Testing, Adjusting, and Balancing for HVAC
7. Section 23 07 00 – HVAC Insulation
8. Section 23 09 00 – Instrumentation and Control for HVAC
9. Section 23 20 00 – HVAC Piping and Pumps
10. Section 23 70 00 – Central HVAC Equipment
11. Section 23 80 00 – Decentralized HVAC Equipment

1.02 REFERENCES:

A. General: The following standards or codes form a part of this specification to the extent indicated by the reference thereto.

B. Air Moving and Conditioning Association, Inc. (AMCA):

Bulletin 210 Standard Test Code for Air Moving Devices

C. American Society of Mechanical Engineers (ASME):

ASME-95 Boiler and Pressure Vessel Code

D. American National Standards Institute (ANSI):

Standard B31.1 Code for Pressure Piping

E. National Fire Protection Association (NFPA):

Standard 30 Flammable and Combustible Liquids Code

F. National Electrical Manufacturers Association (NEMA)

G. Sheet Metal and Air Conditioning Contractors' Association (SMACNA)

Duct Construction Standards (Latest Edition)

H. International Fuel Gas Code

I. Underwriters Laboratories, Inc. (UL)

1.03 EQUIPMENT LABEL:

A. All mechanical equipment and appliances shall be listed and labeled by a nationally recognized testing and inspection agency approved by the authority having jurisdiction. All equipment and appliances shall be installed in accordance with the conditions of the listing. Manufacturer's installation instructions shall be available at the job site at the time of inspection.

1.04 INSPECTION CERTIFICATES:

A. All boilers and pressure vessels shall be inspected and have a certificate of inspection issued by the Virginia Department of Labor and Industry.

1.05 COMMISSIONING OF HVAC SYSTEMS:

A. The Contractor shall provide contact information to the Commissioning Agent indicated in Division 1 for all major items of Equipment.

B. Provide additional submittal copy of major equipment for Commissioning Agent specified in Division 1.

1.06 SUBMITTALS:

A. Submit shop drawings, product data and samples in accordance with Division 1 and Section 23 00 10.

B. Shop drawings, diagrams, catalog data and such other data necessary to fully describe and substantiate compliance with these specifications shall be submitted for all equipment and materials marked with notation set forth in Section 23 00 10.

C. Operation and maintenance data shall be submitted in accordance with Division1, for all items of equipment and materials marked with notation set forth in Section 23 01 00.

PART 2 - PRODUCTS

2.01 PACKAGED CONDENSING GAS-FIRED HOT WATER BOILER [S][O/M]:

A. General: Packaged gas-fired boilers shall be Fulton Endura or equal, condensing type, complete with boiler fittings and automatic controls and designed for use with natural gas. The boiler with all wiring shall be completely factory assembled as a self-contained unit. Boiler design and construction shall be in accordance with Section IV of the ASME Code for hot water heating boilers with maximum water working pressure of 160 psi.

B. The boiler shall have no minimum return water temperature requirements. The boiler shall be a firetube design. The furnace location shall be such that all furnace components are within water-backed areas. Adequate openings shall be provided for access to the water side of the boiler. Temperature and pressure gauge shall be provided with the boiler.

C. Heat Exchanger: The heat exchanger is defined as the surfaces of the pressure vessel where flue gases transfer sensible and latent heat to the hydronic fluid. The heat exchanger shall be a firetube design constructed using only stainless steel. Firetubes shall be constructed of minimum .10” thick stainless steel.

D. A zero flow or low flow condition shall not cause any harm to the pressure vessel or heat exchanger of the boiler. Flow switches, dedicated circulator pumps, or primary/secondary piping arrangements shall not be required to protect the heat exchanger or pressure vessel from thermal shock or other system related considerations. Boilers requiring the use of flow switches or primary/secondary piping arrangements are unacceptable.

E. The boiler shall vent using sealed combustion.

1. The flue (exhaust) stack shall be AL 29-4C or equivalent material UL-1738/C-UL S636 approved for Category IV condensing, positive pressure applications, or Polypropylene.

2. The air intake piping shall be Schedule 40 PVC or equivalent.

3. The boiler shall be capable of operating with an exhaust draft not exceeding -0.04” W.C. and a combined air intake and exhaust venting pressure drop not exceeding +1.50” W.C.

4. The boiler vent shop drawing shall be reviewed and approved by an authorized representative of the boiler manufacturer prior to submittal for review by the Architect/Engineer.

F. The boiler shall have a pre-mix combustion system, capable of operating at 4” W.C. incoming gas pressure while simultaneously achieving emissions performance, full modulation/turndown, and full rated input capacity.

G. The exhaust manifold shall be constructed of stainless steel, with a collection area for the ultimate disposal of flue gas condensate.

H. Blower shall be variable speed, non sparking, hardened aluminum impeller centrifugal fan to operate during each burner firing sequence and to pre-purge and post-purge the combustion chamber. Motor shall be brushless DC variable speed motor with hall effect sensor feedback; internal electronic commutation controller with built in speed control and protection features; long life, sealed, ball bearing with high temperature grease. Variable speed blower shall have PWM signal input with tachometer output.

I. The boiler control panel shall be constructed in a UL 508A approved panel shop.

J. Ignition shall be via direct spark or hot surface igniter. A UV scanner shall be utilized to ensure precise communication of flame status back to the flame programmer. Flame rods are not acceptable. Where hot surface igniters are provided, the Manufacturer shall include a minimum of one (1) spare for each boiler provided.

K. The boiler shall be capable of a minimum 5:1 firing rate turndown ratio. The boiler shall operate at no greater O2% than 7.0% over the entire turndown range in order to maximize seasonal efficiency. Boilers exceeding 7.0% O2 at any operating conditions will not be accepted.

L. The boiler shall maintain <20ppm NOx at all operating conditions.

M. Controls

1. The boiler electrical control panel shall include the following devices and features:

a. 7” color touch screen control display factory mounted on the front cabinet panel door.

1) The control display shall serve as a user interface for programming parameters, boiler control and monitoring; and shall feature a screen saver, screen disable for cleaning, contrast control, volume control for alarm features, boiler status, configuration, history and diagnostics.

b. The boiler control panel shall be constructed in a UL 508 approved panel shop.

c. 24 VAC control transformer.

d. Control relay for 120 VAC motorized isolation valve control.

e. The flame safeguard control on the boiler shall be integrated with temperature control and lead/lag sequencing modular boiler plant functionality.

f. All controls are to be cabinet, vessel or panel mounted and so located on the boiler as to provide ease of servicing the boiler without disturbing the controls. All controls shall be mounted and wired according to UL requirements.

2. Boiler Operating Controls and Features:

a. Proportional Integral Derivative (PID) temperature load control capability for up to two loops, central heat and domestic hot water.

b. Operating temperature limit for automatic start and stop.

c. Flue gas exhaust temperature monitoring.

d. Return water temperature monitoring.

e. Time of day display.

f. Customizable boiler name display.

g. Alarm history for 15 most recent alarms including equipment status at time of lockout.

h. Password protection options.

3. Sequencing Control of Modular Boiler Plants: Sequencing capabilities (lead/lag) shall be integral to the boiler controller for up to 8 boilers installed in the same hydronic loop and shall not require an external panel.

a. The boiler manufacturer shall provide a supply water header temperature sensor.

1) The sensor shall be NTC resistive 10KOhm +/- 1% at 77°F, field installed in the common supply water piping, and field wired to the master boiler.

b. One (1) boiler in the system shall be field programmed as the master and subsequent boilers will be programmed as lag units.

c. Sequence of Operation:

1) Upon call for heat and demand in the system, a boiler will be enabled at low fire and will modulate according to demand and PID settings up to the base load common value. The base load common shall be field adjustable with a default setting of 40%.

2) If the heating load exceeds the output at the base load common firing rate, the next boiler in the sequence will be enabled at low fire. Modular boilers will modulate up and down in parallel as a cohesive unit with infinite modulation points to meet heating load requirements.

3) This process continues until all available boilers are enabled, at which point they are released to modulate up to full fire if required.

4) As the load decreases, the boilers will be sequentially disabled.

5) Boiler sequence order shall be rotated on a programmable number of run hours.

6) A boiler in lockout alarm shall be automatically removed from the sequence order.

7) Lag boilers shall default to local control if the master boiler is fully powered off or removed.

8) Each individual boiler shall enable and disable a water circulation control device. The enable of the device, for example a motorized isolation valve or boiler circulator, will be simultaneous with the heat demand for that boiler. The disable of each device will be based on a programmable time delay when the heat demand is no longer present. In variable primary arrangements, the control shall hold the lead boiler isolation valve open at all times.

4. Building Automation System Interface: Hardware and software to enable building automation system (BAS) to monitor, control, and display boiler status and alarms.

a. Hardwired Contacts:

1) Monitoring: Boiler Status, Burner Demand, General Alarm, Firing Rate.

2) Control with Factory Installed Jumper: Safety Interlock for External Device, Remote Boiler Enable, Remote Lead/Lag Enable, Emergency Stop (E-Stop)

3) Remote Setpoint Signal: 4-20 mA.

b. Communication Protocol: A communication interface with BAS shall enable BAS operator to remotely enable and monitor the boiler plant from an operator workstation.

1) The boilers will communicate with each other and the Building Automation System via a daisy chain addressed Modbus network. Field wiring between nodes shall be twisted pair low voltage with shielded ground.

2) A BACnet MSTP and IP protocol communication gateway shall be provided for each boiler. The BACnet gateway shall be field installed on all boilers. Communication only through the master boiler is unacceptable, communication must be maintained in the event of a master boiler power failure. A communication point mapping list shall be provided.

N. Burner selection:

1. The burner shall be a premix low emission design with a built-in flame arrestor functionality.

O. Boiler safety controls shall include:

1. Operating Temperature Limit for automatic start and stop.

2. High Limit: A single UL 353 temperature probe shall function as a dual-element outlet temperature sensor and shall comply with CSD-1 CW-400 requirements for 2 independent temperature control devices.

a. High limit sensor shall be NTC resistive 10KOhm +/- 1% at 77°F. Sensor shall have brass material bulb with 1.181 +/- 0.015” insertion and 0.370 +/- 0.005” bulb diameter.

b. Manual reset stops burner if operating conditions rise above maximum boiler design temperature.

P. Low Water Safety Relay monitoring a probe in the boiler pressure vessel.

1. Air Safety Switch to prevent operation unless sufficient combustion air is proven.

2. Flame detector to prove combustion.

3. High condensate probe to prevent operation in the event of a blocked condensate drain.

4. Blocked exhaust monitor to prevent operation in the event of a blocked condensate drain.

Q. All controls are to be burner or panel mounted and so located on the boiler as to provide ease of servicing the boiler without disturbing the controls. All controls shall be mounted and wired according to UL requirements. Electrical power supplied shall be 120/60/1.

R. Main Fuel Train Components

1. A factory mounted main fuel train shall be supplied. The fuel train shall be fully assembled, wired, and installed on the boiler and shall comply with CSD-1 code. The fuel train components shall be enclosed within the boiler cabinet.

2. A lock up regulator upstream of the fuel train shall be furnished by the boiler manufacturer as a standard component integral to the boiler cabinet. Factory test fire of the boiler with the provided lock up regulator is required.

3. Standard CSD-1 fuel train shall comply with IRI, which has been replaced by GE GAP.

S. Boiler Fittings & Trim

1. The boiler shall be supplied with an ASME Section IV safety relief valve. The safety relief valve size shall be in accordance with ASME code requirements.

2. The boiler shall be supplied with a combination temperature and pressure gauge to be mounted on the water outlet piping of the boiler.

3. A condensate drain connection shall be available on the boiler, allowing flue gas condensate to freely drain out of the exhaust manifold of the boiler. A condensate drain trap assembly shall accompany the boiler system, with pH neutralization accommodations available upon request.

a. Condensate drain piping must be galvanized or stainless steel. Copper, carbon steel, iron, PVC, CPVC, or polypropylene pipe materials are not accepted.

4. The water supply and return connections on the boiler shall be 4” diameter NPT threaded. The water connections shall not be designed to support any external structural load from the piping system.

5. The boiler shall come with lifting eyes and fork truck accessibility for rigging.

6. Instructions for installation, operation and maintenance of the boiler shall be contained in a manual provided with each boiler.

7. A wiring diagram corresponding to the boiler configuration shall be included with each boiler.

8. Each boiler shall be installed and operated in a functioning hydronic system, inclusive of venting, as part of the manufacturing process. A factory test fire report corresponding to the boiler configuration shall be included with each boiler.

T. Emissions

1. When operating on Natural Gas, the boiler shall have CO emissions less than 50 ppm corrected to 3% O2 and NOx emissions less than 20 ppm corrected to 3% O2, over the entire turndown range.

U. Warranty

1. The boiler manufacturer will repair or replace any part of the boiler that is found to be defective in workmanship or material within eighteen (18) months of shipment from the factory or twelve (12) months from start-up, whichever comes first.

2. The boiler’s pressure vessel is warranted against failure due to thermal shock, flue gas condensate corrosion, and/or defective material or workmanship for a period of ten (10) years, non-prorated, from the date of shipment from the factory provided the boiler is installed, controlled, operated and maintained in accordance with the Installation, Operation and Maintenance Manual.

3. Waterside corrosion or scaling is not covered. The manufacturer will repair, replace, exchange or credit at their option, FOB factory, the pressure vessel as defined above, provided this equipment has been installed, operated and maintained by the buyer in accordance with the Installation, Operation and Maintenance Manual.

PART 3 - EXECUTION

3.01 GENERAL:

A. All equipment and materials, specified herein or shown on the drawings shall be installed complete, coordinated with all other work, tested and made tight and put into safe controlled operation to perform its intended function as a part of this project.

B. All rooftop equipment shall be secured to the roof framing structure.

C. Boiler and water heater vents shall be installed in accordance with the manufacturers written instructions.

D. Boiler and water heater vents shall be installed with the outlet a minimum of 3 feet above the point of roof penetration and 2'-0" higher than any roof structure within 10'-0" of the roof penetration.

END OF SECTION

SECTION 238000
DECENTRALIZED HVAC EQUIPMENT

PART 1 - GENERAL

1.01 SUMMARY:

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

B. Work Included:

1. Miscellaneous Appurtenances

C. Related Sections:

1. Division 01 -- Commissioning
2. Section 23 00 10 – HVAC General Requirements
3. Section 23 05 00 – Common Work Results for HVAC
4. Section 23 05 48 – Vibration and Seismic Controls for HVAC Piping and Equipment
5. Section 23 05 53 – Identification for HVAC Piping and Equipment
6. Section 23 05 93 – Testing, Adjusting, and Balancing for HVAC
7. Section 23 09 00 – Instrumentation and Control for HVAC
8. Section 23 20 00 – HVAC Piping and Pumps
9. Section 23 50 00 – Central Heating Equipment

1.02 REFERENCES:

A. General: The following standards or codes form a part of this specification to the extent indicated by the reference thereto.

B. Air Moving and Conditioning Association, Inc. (AMCA):

Bulletin 210	Standard Test Code for Air Moving Devices

C. Air Conditioning and Refrigeration Institute (ARI):

Standard 210	Standard for Unitary Air Conditioning Equipment
Standard 240	Standard for Unitary Heat Pump
Standard 310	Standard for Packaged Terminal Air Conditioners
Standard 410	Standard for Forced Circulation Air Cooling and Heating Coils
Standard 440	Standard for Room Fan Coil Air Conditioners

D. American National Standards Institute (ANSI):

Standard B31.1	Code for Pressure Piping

E. American Society of Heating, Refrigeration and Air Conditioning Engineers (ANSI/ASHRAE):

Standard 15	Safety Code for Mechanical Refrigeration

F. National Fire Protection Association (NFPA):

Standard 90A	Air Conditioning and Ventilating Systems of other than Residence Type

G. National Electrical Manufacturers Association (NEMA)

H. Sheet Metal and Air Conditioning Contractors' Association (SMACNA)

Duct Construction Standards (Latest Edition)

I. Underwriters Laboratories, Inc. (UL)

1.03 EQUIPMENT LABEL:

A. All mechanical equipment and appliances shall be listed and labeled by a nationally recognized testing and inspection agency approved by the authority having jurisdiction. All equipment and appliances shall be installed in accordance with the conditions of the listing. Manufacturer's installation instructions shall be available at the job site at the time of inspection.

1.04 COMMISSIONING OF HVAC SYSTEMS:

A. The Contractor shall provide contact information to the Commissioning Agent indicated in Division 1 for all major items of Equipment.

B. Provide additional submittal copy of major equipment for Commissioning Agent specified in Division 1.

1.05 SUBMITTALS:

A. Submit shop drawings, product data and samples in accordance with Division 1 and Section 23 00 10.

B. Shop drawings, diagrams, catalog data and such other data necessary to fully describe and substantiate compliance with these specifications shall be submitted for all equipment and materials marked with notation set forth in Section 23 00 10.

C. Operation and maintenance data shall be submitted in accordance with Division1, for all items of equipment and materials marked with notation set forth in Section 23 01 00.

PART 2 - PRODUCTS

2.01 MISCELLANEOUS APPURTENANCES [S] [O/M]:

A. Miscellaneous electric appurtenances such as transformers, solenoid valves, electric relays, selector switches, on-off switches, pilot lights and other similar items required by the electric sequence control diagrams and not shown to be provided by the Electrical Contractor shall be provided as part of the Mechanical Contract.

1. Solenoid valves shall be Asco or Alco of coil rating and size to accomplish the indicated requirement.

2. On-Off switches shall be toggle type, 20 amp. contract rating complete with engraved cover plate where required.

3. Selector switches shall be manual selector type with the indicated poles and contacts and engraved cover plate. Contact rating shall be a minimum of 20 amps.

4. Relays shall be G.E., Square D, or Cutler-Hammer 20 amp rating with sufficient contacts for the sequence indicated.

B. Time clock [S] [O/M] shall be Paragon Model 7218 or Tork Model W220, seven-day model with 10 hour minimum reserve time feature. Reserve time spring shall rewind itself after power source is restored.

C. Thermostats [S] [O/M] shall be provided as indicated below. The use of thermostats containing mercury is not allowed.

1. Programmable Thermostats (s):

a. Programmable thermostats shall be Honeywell T7300A thermostat and a Q7300 subbase, or approved equal for conventional heating operation. The thermostat shall contain a keyboard for entering the times and temperatures along with a liquid crystal display for reading information. The thermostat shall contain a microprocessor that performs the calculations to control the system.

b. The T7300A thermostat shall contain a three hour override button, enabling programmed temperatures to be overridden from unoccupied mode to occupied mode.

c. The T7300A thermostat with Q7300 subbase shall provide a system that will control with system or fan switching and seven-day flexible programming with two occupied and two unoccupied periods per day for each of the seven days of the week. The system shall have individual setpoints for occupied heat and cool, and unoccupied heat and cool. System shall have auxiliary relay output for occupied/unoccupied control of auxiliary fans and dampers. System shall have capability to provide contact closures for two stages of output for heating and two stages of output for cooling.

2. Exhaust fan thermostats shall be Johnson Controls T22 with auto-off fan switch. The thermostat shall be rated for 6 amps. at 120 volts.

3. Heavy duty heating thermostats shall be Johnson Controls T22 rated for 16 amps. at 120 volts.

4. Outdoor thermostats shall be Johnson Controls A19 Series.

5. Firestats shall be UL approved, Johnson Controls A25 manual reset type with an adjustable temperature setting. Set at 125°F.

6. Thermostat guards shall be rectangular (wire, plastic, cast aluminum) with baseplate (except wire type) and all required accessories for wall mounting. Guards shall have ample openings to allow fast sensing of room air conditions. Guards and baseplate shall be selected and sized to suit type of thermostat and mounting where installed.

D. Blowdown separator [S] [O/M] shall be Johnston Boiler Company, or accepted equal, complete with after cooler, drain and vent fittings and ASME stamped for 150 psi service.

PART 3 - EXECUTION

3.01 GENERAL:

A. All equipment and materials, specified herein or shown on the drawings shall be installed complete, coordinated with all other work, tested and made tight and put into safe controlled operation to perform its intended function as a part of this project.

B. All rooftop equipment shall be secured to the roof framing structure.

END OF SECTION

SECTION 260500
COMMON WORK RESULTS FOR ELECTRICAL

PART 1 - GENERAL

1.01 RELATED DOCUMENTS:

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

1.02 WORK INCLUDED:

A. Every item of labor, material, devices and appurtenances for installing a complete Electrical System and other related systems included in Division 26 of the Specifications.

B. Section 26 05 00 – Common Work Results For Electrical

C. Section 26 05 19 – Low-Voltage Electrical Power Conductors and Cables

D. Section 26 05 26 – Grounding And Bonding For Electrical Systems

E. Section 26 05 33 – Raceway And Boxes For Electrical Systems

F. Section 26 05 53 – Identification For Electrical Systems

G. Section 26 28 13 – Fuses

H. Section 26 28 16 – Enclosed Switches And Circuit Breakers

I. Section 26 29 00 – Low-Voltage Controllers

1.03 RELATED WORK:

A. General: See all other portions of these Contract Documents and apply to those portions of work, relating to Electrical Work, the same as if repeated herein in its entirety. The Division 26 Electrical Trade shall allow for wiring and controlling all equipment requiring electrical connections as described therein even though not shown on the electrical drawings. The Division 26 Electrical Trade shall provide and install all conduits, standard boxes and grounding for Divisions 27 and 28 Trades. Divisions 27 and 28 Trades shall provide all special boxes, cabinets and enclosures to Division 26 Electrical Contractor for installation. The Division 26 Electrical Contractor shall coordinate with Divisions 27 and 28 Trades for sizes and locations of conduits, boxes, cabinets and enclosures required by Divisions 27 and 28 Trades. The Division 26 Electrical Trade shall provide and install all conduits, standard boxes, cable trays, and grounding for Division 27 & 28 Trades.

1.04 WORK NOT INCLUDED:

A. Certain electrical equipment will be provided in-place as specified under other Divisions of these Contract Documents and other pieces of equipment such as operating controls, etc., will be provided f.o.b. (freight on board) premises, which shall be mounted and connected to electrically under Division 26.

1.05 DRAWINGS:

A. Where conduit, equipment, devices and other electrical appurtenances are shown on the drawings, the general arrangement of such items on the electrical drawings shall be followed as

closely as actual building construction and the work of other trades will permit. Because of the small scale of the electrical drawings, it is not feasible to indicate all offsets, fittings and accessories which may be required. The Contractor shall investigate the construction conditions affecting the work and provide fittings and accessories as required to meet actual conditions.

1.06 QUALITY ASSURANCE:

A. Equipment and material used in the project shall be new and undamaged. The electrical installation shall fit into the space allotted and shall allow adequate, acceptable, clearances for entry, servicing, safety, and maintenance. The Contractor shall coordinate the work to ensure that the equipment may be moved into place without altering building components or other installations. All Electrical work shall be performed by a Commonwealth of Virginia Class-A licensed Electrical Contractor whose technicians, mechanics, or tradesmen shall be skilled in the trade involved. All electrical work shall be performed under the direct supervision of an electrician with a locally recognized and accepted master license.

B. Equipment and material in existing installations may be reused where specifically indicated on the drawings.

1.07 REFERENCES:

A. The complete installation and all materials and equipment under Division 26 shall conform to the Virginia Uniform Statewide Building Code, current issue, including all applicable portions of the National Electrical Code (NEC) and all other governing codes and regulations.

B. All equipment used shall bear the Underwriters Laboratory (U.L.) label for the intended application, or other organizations label if acceptable to the Authority having jurisdiction and concern with product evaluation.

C. In addition, the following codes, standards, and regulations shall apply to the complete installation and all materials and equipment. These are referred to by their accompanying abbreviations.

D. National Electrical Code (NFPA No. 70) 2017 NEC

E. National Electrical Manufacturers Association NEMA

F. Underwriters Laboratories, Inc. UL

G. All Systems' Installation Certification Compliance Documents for Installing Trades

H. The above standards are intended as a minimum and shall be exceeded if required by the Contract Documents. In the event information contained in the Contract Documents conflicts with one of the above mentioned codes, the codes shall take precedence.

1.08 PERMITS, LICENSES, TAXES AND INSPECTION CERTIFICATES:

A. All bonds, licenses, and electrical connection fees, inspection fees, and taxes required for the execution of the work shall be obtained and paid for by the Contractor. The contractor is advised that since this project is on State property, Building Codes and Zoning Ordinances of local political sub-divisions do not legally apply. Building permits required by the locality consistent with the Governors memorandum of September 11, 1973, will be obtained and paid for by the Owner.

1.09 REGULATIONS AND STANDARDS:

A. The completed installation and all materials and equipment shall conform to local ordinances and codes, other regulations and standards listed herein or in related sections. These are intended as a minimum and shall be exceeded if required by the specifications or Drawings. In the event of a conflict between the codes, standards, or regulations, and information contained in the Contract Documents, the applicable code, standard, or regulation shall take precedence.

1.10 SUBMITTALS:

A. Submit shop drawings, product data and samples in accordance with Division 1 for all items as specified in related sections of these specifications. One (1) electronic (PDF) copy of the submittal shall be submitted. One (1) electronic (PDF) copy of the submittal will be returned to the Contractor. If additional copies are required they will be the responsibility of the Contractor. Where drawings are submitted, the Contractor shall submit a minimum of two (2) sets of full scale prints. One (1) copy will be marked and returned to the Contractor, and the Contractor shall be responsible for all additional copies required for his use. All submittal data shall be correctly identified to show project name, and the exact model, style or size of item being submitted. Improperly identified submittals will not be reviewed by the Engineer. Each item submitted for review shall bear the Subcontractor's stamp which states that they have reviewed the submission, that it is complete, and that in their opinion it meets the contract requirements. Contractor's stamp shall identify the paragraph and page number for which the submittal is being made. Any submission which has not been reviewed and stamped by the Electrical Trade will not be reviewed by the Engineer. No reviews prior to award of Contract will be considered or accepted.

B. Shop drawings, samples, diagrams, catalog data and such other data necessary to fully describe and substantiate compliance with these contract documents shall be submitted as follows:

1. All the equipment and materials where submissions are specifically required by other Divisions of these Contract Documents.

2. All the equipment and materials that are indicated with an [S] behind the product title. This shall include submission of the specified products equipment and materials.

3. All the equipment and materials that are acceptable equal substitution.

4. If submission is NOT required for the SPECIFIED products "shop drawings and product data" under 1. and 2. above, the Contractor shall NOT submit a shop drawing for the SPECIFIED products.

5. Samples, in good working order, shall be submitted in accordance with Division 1, complete with all installation and service drawings and instructions. All samples will be returned at the submitter’s expense unless otherwise indicated. Samples may be subject to destructive testing by the Architect/Engineer.

C. Operation and Maintenance manual(s) shall be submitted in accordance with Division 1 and shall include a complete product index, a copy of all accepted shop drawings, installation and maintenance data, sequence of controls, parts lists, and the name, address and telephone number of supplier or nearest representative. All electrical devices, equipment and systems marked [O/M] in these specifications shall be included and all other such electrical items which will require servicing before the duration of its useful life has been reached. The manual(s) shall be presented to the Engineer for review and transmitted to the Owner before the final payment is recommended.

D. Equivalents: Manufacturers, trade names and model numbers indicated herein and on drawings shall be interpreted as establishing a standard of quality and shall not be construed as limiting competition. Unless definitely stated otherwise and upon complying with Division 1, the Contractor may use any article of equal appearance which, in his judgment is equal to that specified and is accepted by the Engineer. Where three or more manufacturers are named in the specifications for any item, the Contractor should use one of the manufacturers. No others shall be reviewed or accepted. Manufacturers listed first in these specifications and on drawings were used as a basis of design. It will be the responsibility of the Contractor to verify all connections, physical sizes and capacities of all other manufacturer's items, both items named herein, or items proposed. If the equipment necessitates changes in power distribution, conduit, wiring, lighting, ductwork, piping, or any other building systems from that indicated on the drawings, the Contractor shall be responsible for all additional costs included and notify other trades of the changes. Where such changes are required, detail drawings indicating all required changes shall be submitted for review at the same time the manufacturers drawings are submitted for approval. See Division 1 for substitutions.

E. Guarantee: Electrical equipment, materials and labor required by these specifications and accompanying drawings shall be guaranteed to be free from defective materials or workmanship, including lamps, for a period of one year after final acceptance of the project except extended warranties as specified elsewhere in these documents on specific items of equipment will be furnished by the Trade providing the equipment. Defects in material or workmanship occurring during this period shall be corrected with new material and equipment or additional labor at no cost to the Owner. Manufacturer's certificates of warranty shall be transmitted to the Owner before final payment is recommended.

1.11 WARRANTIES:

A. The Contractor shall warrant for a period of one year all work provided under the Contract to include, but not necessarily limited to, all systems, equipment, materials, and workmanship. This shall not be construed to limit any extended warranty periods of longer than one year for specific items or systems specified elsewhere in the Contract Documents.

B. The warranty period shall commence on the date of acceptance by the Owner and shall cover all parts and labor as required to fulfill the warranty at no cost to the Owner.

C. Refer to Division 1 for additional warranty requirements.

D. Information on all warranties shall be included in the O&M Manuals specified herein to be provided to the Owner.

1.12 COORDINATION OF WORK:

A. General: The contract documents indicate the extent and general arrangement of the electrical systems. The Contractor shall be responsible for the coordination and proper relation of the electrical work to the building structure and to the work of other trades. No additional compensation or extension of completion time will be granted for extra work caused by the lack of coordination.

B. Cooperation: The Contractor shall provide dimensions and locations of all openings, shafts and similar items to the proper trades and install work as required so as not to interfere with, or delay, the building construction.

C. Locations of lines and equipment shall be determined from actual field measurements. The outlines of the building shown on the electrical drawings are intended only as a guide to indicate relative locations of the electrical work. Refer to architectural and structural drawings for building construction details. If conflicts prevent installation of electrical work at the locations

indicated, minor deviations shall be made subject to acceptance by the Engineer, and without additional compensation.

D. Cutting and Patching: Unless stated otherwise, the Electrical Trade shall do all cutting necessary for the installation of his work. All work should be installed sufficiently in advance of new construction in order to permit installation of supports, sleeves, and similar items without cutting. Cutting which will in any way affect the building structure shall not be performed without permission of the Architect-Engineer. The Electrical Trade is responsible for patching where he does cutting. Patching shall be done to the satisfaction of the Architect-Engineer.

E. Roughing-In: Receptacles, switches, and other similar items shall align vertically or horizontally with each other, hose bibbs, thermostats, the building structure and features thereof when it appears obvious and logical that they should. All mounting heights shall be within the limits of Commonwealth of Virginia USBC and ADAAG.

F. Damage to Other Work: The Electrical Trade is responsible for damage to other work caused by his work or workmen. Repairing of damaged work shall be done by the Trade who installed the work, and as directed by the Architect-Engineer; the cost of which shall be paid for by the Electrical Trade.

1.13 ASBESTOS:

A. Asbestos Free Materials: The intention of these drawings and specifications is that there be no asbestos containing materials installed on this project. To the best of the Architects' and Engineers' knowledge, none of the material or equipment specified herein or shown on the drawings contains asbestos. The Contractor shall make every effort to prevent any asbestos materials from being installed in or used on the construction of the project. At the completion of the project, the Contractor shall certify by letter that to the best of his knowledge, no asbestos containing materials were used for or in the construction of this project.

B. Existing Materials:

1. Discovery: If during the construction of this project, work involving friable asbestos is suspected, or encountered, all work in this area shall be discontinued and the Owner or the Owner’s representative, shall be notified immediately and the Owner with his own forces or by separate contract shall be responsible for complete investigation, removal, and disposition of the friable asbestos hazard in accordance with applicable laws and regulations. If the Contractor claims that delay or additional cost is involved because of such action by the Owner, he shall make such claim as provided elsewhere in the contract documents.

2. Removal: All work involving the removal of friable asbestos will be done under a separate contract.

PART 2 - PRODUCTS

2.01 MANUFACTURERS AND MATERIALS:

A. General: Manufacturers and materials shall be as specified in subsequent sections of these specifications and as noted on the drawings. Similar types of equipment shall be the products of the same manufacturer unless specified otherwise.

2.02 SLEEVES AND INSERTS:

A. General: Sleeves and inserts shall be provided and correctly located in the structure, as required for the work.

B. Inserts shall be steel and of proper size for loads encountered.

2.03 ACCESS DOORS:

A. Provide for all junction boxes or any item requiring access. Doors shall be of sufficient size and so located that the concealed items may be serviced or completely removed and replaced. Doors required for work shall be furnished as a part of this Division to the General Contractor for installation. Doors in acoustic tile ceilings shall be furnished in multiples of tile sizes. Doors are not required in exposed grid type ceilings where tiles are removable. Doors shall be metal access doors with cam lock, style to match ceiling or wall construction. Doors occurring in rated construction shall be fire rated U.L. labeled access doors correlated to preserve the integrity of the rated construction. Doors shall be prime finish steel except those in toilets, shower rooms, locker rooms, kitchens and other similar areas shall be aluminum with natural anodized finish. Doors shall match the access doors in Division 23 and meet the acceptance of the Architect.

PART 3 - EXECUTION

3.01 INSTALLATION:

A. General: Materials and equipment shall be installed in accordance with manufacturer's instructions to conform to the details and application as specified in subsequent sections of these specifications and indicated on the drawings.

B. Supports: Provide necessary supports for all equipment and appurtenances as required; this includes, but is not limited to, frames or supports for items such as switchboards, panelboards, lighting fixtures, disconnect switches, junction boxes, conduit, motor starters, outlet boxes, and other similar items requiring supports. Floor mounted equipment in Equipment Rooms shall be set on 4-inch high concrete foundation pads unless shown otherwise. All concrete pads shall have 1” chamfered corners and edges. Foundation drawings, bolt setting information and foundation bolts shall be furnished by the subcontractors furnishing the equipment that is required to have concrete foundations. Concrete for foundations shall be provided by the Electrical Trade and in accordance with Division 03 - Concrete Work, unless noted otherwise.

C. Sleeves: Provide sleeves for all conduits passing through concrete or masonry walls, partitions, concrete slabs or beams installed during construction of the wall, partition, slab or beam. Sleeves placed horizontally in walls or in any position in beams shall be standard weight ASTM A53 steel pipe of length equal to the thickness of the wall or beam. Those placed vertically in non-waterproof floors shall be 20 gauge galvanized sheet steel of length equal to the thickness of the slab, flared and nailed to the form, or fastened to reinforcing fabric and filled with sand during pouring to prevent deformation. Sleeves occurring in floors of rooms where hose bibbs or floor drains provided under Division 21 occur, and in pipe spaces, shall be standard weight steel pipe projecting 1/2" above finished floor except in Equipment Rooms they shall project four (4) inches above finished floor. Sleeves in floors with waterproof membrane shall be provided with flanges or flashing rings and shall be clamped or flashed into the membrane. All sleeves shall be of sufficient diameter to allow installation of conduit except sleeves on lines subject to movement, which shall clear the conduit at least one inch all around. Conduits through exterior walls, or floors, below grade shall have seals specified in Section 26 05 43 between the conduit and wall sleeve. Sleeve shall have anchor and water stop plate. The entire assembly shall be tightened and adjusted to make watertight. Sleeves for insulated wiring and conduit, penetrating fire (and smoke) rated partitions, walls and floors shall have seals as specified in Section 26 05 43 and shall be sealed in accordance with the terms of U.L. Listed Through-Penetration Firestop Systems (XHEZ) as published in the U.L. Fire Resistance Directory. Penetrations shall exactly conform to details of the Firestop System indicated for the type of partition, wall and floor construction encountered. All penetrations through nonfireresistance rated floor assemblies and through the ceiling membrane of nonfireresistance rated roof assemblies shall be fireblocked with tightly packed mineral-wool insulation secured in place. All

penetrations through equipment room walls and other areas of noise or heat generation shall be tightly sealed with mineral fiber rope. All penetrations through draftstop partitions shall be sealed to maintain the integrity of the partition. All firestopping of sleeves for electrical work shall be provided under Division 26.

D. Temporary Requirements: Openings in equipment shall be kept capped at all times until connection is made to the system. The ends of all conduits and equipment openings shall be kept capped properly with approved devices. Approved devices are items such as specially molded plastic caps and sheet metal caps.

E. Access Doors: Provide access doors for all concealed electric equipment, pull boxes, junction boxes or any item requiring access. Doors shall be of sufficient size and so located that the concealed items may be serviced or completely removed and replaced. Doors required for Electrical work shall be furnished by the Electrical Trade, to the Contractor for installation. Doors in acoustic tile ceilings shall be furnished in multiples of tile sizes. Doors are not required in exposed grid type ceilings where tiles are removable.

F. Painting: All work under this Division shall be painted in accordance with Section 26 05 53, Identification for Electrical Systems. Division 26 shall also paint and identify all conduits and boxes for Divisions 27 & 28 as described in Section 26 05 53.

3.02 EXISTING WORK AND DEMOLITION:

A. Electrical Demolition: Remove all existing electrical conduits, wiring, junction boxes, outlets, lighting fixtures, wiring devices, unused panelboards, etc., indicated for demolition. Additional amounts of demolition may be required to accommodate desired renovations and new construction. Not all demolition may be shown on the drawings. All existing electrical equipment not indicated for demolition shall remain in place.

B. Equipment and Fixtures Removed: The Owner will select and retain such existing electrical equipment and materials which are indicated to be removed and not reused, as he desires. All other existing equipment and materials indicated to be removed, and not reused shall become the property of the Contractor, who shall remove them from the premises within the time frame specified under other Divisions of this Contract Document.

C. Equipment and Fixtures Existing to Remain: All existing exterior lighting fixtures, and other electrical equipment and materials to remain shall be disconnected and be rewired. All electrical equipment and materials shall be protected from damage during demolition. Install new phase, neutral and grounding conductors, if grounding conductor is not already present, in each feeder and branch circuit to be reworked, from the panelboard to the outlet. (This shall include exterior lighting, pond fountain system, ground sprinkler system and various shop like equipment.)

D. Power Interruption: Attention is called to the fact that the existing facilities around the building shall remain in operation throughout the construction period. The building main data room shall remain powered throughout the project with temporary generator power and normal power throughout the project until connected to new permanent power and generator power. All necessary temporary arrangements shall be made as required to keep all electrical circuits in continuous operation during this period except for scheduled outages for circuit change-overs. The outage shall be kept to the minimum and carefully scheduled to suit the Owner. The outages shall not affect other facilities on site.

E. Miscellaneous: In all altered portions of the buildings, the Electrical Trade shall remove all existing electrical work. All existing work or areas that are not altered shall be reconnected as required. Where indicated changes to non-electrical facilities require minor electrical changes, these changes shall be accomplished even if not specifically indicated. Only a portion of the

existing work is shown on the drawings. Contractors submitting proposals shall visit the site to determine the scope of work under this heading as no additional compensation will be granted because of existing conditions even though the existing conditions may not be indicated on the drawings. Demolition shall not begin until the work schedule is approved by the Owner. The work shall be scheduled to prevent any disruption to the normal operations of the buildings main data room and other facilities on campus.

3.03 FIELD QUALITY CONTROL:

A. System Readings: Certain system voltage and current readings shall be taken, the values recorded and submitted in triplicate to the Engineer. Two complete sets of readings are required, one under no load and one under maximum available load. The current and voltage shall be recorded on each phase (plus voltage between all phases) at main panelboard and at each branch circuit panelboard. Additional spot readings shall be made if required. Resistance of grounding system shall be tested and recorded. Forms for submitting this report may be obtained from the Engineer's office. A sample form is bound herewith.

B. Equipment Readings: Voltage and amperage readings on each phase of each motor circuit and each resistance heater circuit installed under this contract shall be measured, the values recorded, and submitted in triplicate to the Engineer. Also record motor nameplate data, actual motor heater protective device ratings and all other data necessary for selection of heater device.

3.04 MANUFACTURER'S ASSISTANCE:

A. Qualified technical representatives of manufacturers shall be available to visit the project and provide required assistance for any problems or trouble areas of any systems, material or equipment used in the project. Manufacturer's engineering assistance shall also be available for above problems or trouble areas. The Contractor shall purchase all materials, equipment or systems with these services included in the purchase price or otherwise be prepared to have the above service provided when needed or requested by the Engineer without additional compensation. Where one manufacturer's equipment constitutes the majority of the components or devices to make a system, the manufacturer's technically qualified representative shall inspect and accept the completed installation whether or not especially requested by the Engineer.

3.05 INSTRUCTION OF OWNER'S REPRESENTATIVE:

A. The Electrical Trade shall instruct the representative of the Owner in the proper operation and maintenance of all elements of the Electrical systems. Competent representatives of the Contractor shall spend such time as necessary to fully prepare the Owner to operate and maintain the Electrical systems.

3.06 CONSTRUCTION STATUS REPORT:

A. Each item of discrepancies noted on Construction Status Report prepared by the Engineer shall be answered in detail in writing by the Contractor before payment can be recommended.

3.07 SCHEDULE OF ABBREVIATIONS:

Electrical Abbreviations:

A	-	AMP
ABV	-	ABOVE
AC	-	AIR CONDITIONING OR ARMOR CLAD
ACB	-	AIR CIRCUIT BREAKER
ACI	-	AMERICAN CONCRETE INSTITUTE
ACS	-	ABOVE COUNTER SPLASHBACK
ADAAG	-	AMERICANS WITH DISABILITIES ACT
AEIC	-	ASSOC OF EDISON ILLUMINATING CO'S.
AFF	-	ABOVE FINISHED FLOOR
ANSI	-	AMERICAN NATIONAL STANDARDS INSTITUTE
ASME	-	AMERICAN SOCIETY OF MECHANICAL ENG.
ASTM	-	AMERICAN SOCIETY FOR TESTING AND MATERIALS
ATS	-	AUTOMATIC TRANSFER SWITCH
AUTO	-	AUTOMATIC
AUX	-	AUXILIARY
BALL	-	BUILDING ACOUSTICS AND LIGHTING LABS
BAT	-	BATTERY
BIL	-	BASIC INSULATION LEVEL
BOCA	-	BUILDING OFFICIALS AND CODE ADMIN.
BRK	-	BREAKER
CAP	-	CAPACITORS
CABO/MEC	-	COUNCIL OF AMER. BLDG. OFFICIALS MDL
CB	-	CIRCUIT BREAKER (CRT BRK)
CBM	-	CERTIFIED BALLAST MANUFACTURERS
CCCT	-	CROSS CURRENT COMPENSATION TRANSFORMER
CF	-	COIL FAN
CMU	-	CONCRETE MASONRY UNIT
CND	-	CONDUIT (COND)
CNDCT	-	CONDUCTOR
COMB	-	COMBINATION
CONC	-	CONCRETE
CONTR	-	CONTRACTOR
CPT	-	NEUTRAL GROUNDING TRANSFORMER
CRT	-	CIRCUIT
CS	-	CORNER SECTION
CT	-	CURRENT TRANSFORMER
CUH	-	CABINET UNIT HEATER
CW	-	COLD WATER
DB	-	DOORBELL
DF	-	DRINKING FOUNTAIN
DH	-	DOOR HOLDER
DISC SW	-	DISCONNECT SWITCH (D.S.)
DO	-	DRAW OUT
DP	-	DOUBLE POLE
DT	-	DOUBLE THROW
DW	-	DISHWASHER
E	-	EXISTING (EXST)
EA	-	EACH
EC	-	ELECTRIC CONVECTOR
EEI	-	EDISON ELECT. INST.
EGC	-	EQUIPMENT GROUNDING CONDUCTOR
EIA	-	ELECTRONIC INDUSTRIES ASSOC.
ELEC	-	ELECTRIC
EMER	-	EMERGENCY (EM)
EMT	-	ELECTRICAL METALLIC TUBING
EN	-	EXISTING OUTLET WITH A NEW DEVICE AND WIRING
ENG	-	ENGINE
EO	-	EXISTING OUTLET
EQUIP	-	EQUIPMENT
EP	-	EXPLOSION-PROOF
EP SW	-	ELECTRO- PNEUMATIC SWITCH
ER	-	EXISTING RELOCATED
ERL	-	ENVIRONMENTAL RESEARCH LABS
ESC	-	ELECTRIC SEQUENCE CONTROLS
ETL	-	ELECTRICAL TESTING LAB
EWC	-	ELECTRIC WATER COOLER
EXP	-	EXPANSION
FA	-	FIRE ALARM
FIN FL	-	FINISHED FLOOR
FIXT	-	FIXTURE
FL	-	FLOOR
FLA	-	FULL LOAD AMPS
FLUOR	-	FLUORESCENT
FS	-	FILLER SECTION
FU	-	FUSE
GBM	-	GROUND BUS MODULE
GEC	-	GROUNDING ELECTRODE CONDUCTOR
GEN	-	GENERATOR
GF	-	GROUND FAULT
GND	-	GROUND
GRS	-	GALVANIZED RIGID STEEL CONDUIT
HOA	-	HAND-OFF-AUTOMATIC
HP	-	HORSEPOWER
HPS	-	HIGH PRESSURE SODIUM
HV	-	HIGH VOLTAGE
HW	-	HOT WATER
HZ	-	HERTZ
IB	-	IN BASEBOARD
IBS	-	IN BASE OF SHELVES
ICEA	-	INSULATED CABLE ENGINEERS ASSOCIATION
ICL	-	IN COUNTER LIP
ICS	-	IN COUNTER SPLASHBACK
IEEE	-	INSTITUTE OF ELECTRICAL AND ELECTRONICS ENG'S
IGC	-	ISOLATED GROUNDING CONDUCTOR
IMC	-	INTERMEDIATE METAL CONDUIT
INCAND	-	INCANDESCENT
INTLK	-	INTERLOCK
ITL	-	INDEPENDENT TESTING LABORATORIES
JB	-	JUNCTION BOX
KV	-	KILOVOLTS
KVA	-	KILOVOLTS-AMPS
KVARS	-	KILOVAR
KW	-	KILOWATT
LA	-	LIGHTNING ARRESTOR
LV	-	LOW VOLTAGE
MAX	-	MAXIMUM
MC	-	METAL CLAD
MDH	-	MAGNETIC DOOR HOLDER
MECH	-	MECHANICAL
MFG	-	MANUFACTURER
MIN	-	MINIMUM
MH	-	MANHOLE
MO	-	MOTOR OPERATED
MOD	-	MOTOR OPERATED DAMPER
MP	-	MAIN PANEL
MP SW	-	MOTOR PROTECTIVE SWITCH
MS	-	MOTOR STARTER
MTD	-	MOUNTED
MTS	-	MANUAL TRANSFER SWITCH
MW	-	MEGAWATTS
NC	-	NORMALLY CLOSED
NCS	-	NURSES CALL SYSTEM
ND	-	NEW DEVICE IN EXISTING OUTLET
NEC	-	NATIONAL ELECTRIC CODE
NEMA	-	NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION
NESC	-	NATIONAL ELECTRICAL SAFETY CODE
NFPA	-	NATIONAL FIRE PROTECTION ASSOC
NIC	-	NOT IN CONTRACT
NEUT	-	NEUTRAL
NO	-	NORMALLY OPEN
OCB	-	OIL CIRCUIT BREAKER
OPR	-	OPERATED
OS	-	OIL SWITCH
OSHA	-	OCCUPATIONAL SAFETY & HEALTH ACT
P	-	POLE
PA	-	PUBLIC ADDRESS
PB	-	PULLBOX
PC	-	PHOTOCELL (PEC)
PD	-	PLUG DUCT
PE	-	PNEUMATIC ELECTRIC
PM	-	PLUG MOLD
PNL	-	PANEL
PS	-	PLUG STRIP
PT	-	POTENTIAL TRANSFORMER
PW	-	PART WINDING (MOTOR STARTER)
PWR	-	POWER
R	-	REMOVE
RR	-	REMOVE & REINSTALL
R&C	-	REMOVE DEVICE & CAP OUTLET
REC	-	RECEPTACLE
RHC	-	RE-HEAT COIL
RLY	-	RELAY
SEC	-	SECONDARY
SGA	-	SURGICAL GAS ALARM
S/N	-	SOLID NEUTRAL
S/O	-	SPACE ONLY
SP	-	SINGLE POLE
ST	-	SINGLE THROW
SURF	-	SURFACE
SUSP	-	SUSPENDED
SW	-	SWITCH
SYNCH	-	SYNCHRONIZE
TC	-	TIME CLOCK
TEL	-	TELEPHONE
TIA	-	TELE- COMMUNICATIONS INDUSTRY ASSOC
TRANS	-	TRANSFORMER (XFMR)
TYP	-	TYPICAL
UCL	-	UNDER COUNTER LIP
UFAS	-	UNIFORM FEDERAL ACCESSIBILITY STANDARDS
UH	-	UNIT HEATER
UL	-	UNDERWRITERS LAB
UV	-	UNIT VENTILATOR
V	-	VOLT
VDOT	-	VIRGINIA DEPARTMENT OF TRANSPORTATION
W	-	WATTS
WH	-	WALL HEATER
WM	-	WIRE MOLD
WP	-	WEATHERPROOF
Y	-	WYE
ι	-	PHASE

END OF SECTION

ELECTRICAL TEST DATA REPORT

ASCENT ENGINEERING GROUP, INC.
5228 VALLEYPOINTE PARKWAY, SUITE 4
ROANOKE, VA 24019

PROJECT: _____
_____
_____
_____

Electrical Contractor: _____
Date tests were made: _____ Date Submitted: _____

Current Characteristics: _____Volts _____ Phase _____ Wires

Type voltmeter used: _____ When calibrated:_____
Type ammeter used: _____ When calibrated:_____

Service ground - Resistance in ohms _____
Resistance test must be made with hand crank, magneto type, megger.

PANEL	VOLTAGE - NO LOAD		VOLTAGE - MAX. LOAD		MAX. LOAD AMPERAGE			
	PH TO PHASE	PHASE TO GND	PHASE TO PHASE	PH - GND	PH A	PH B	PH C	NEUT

PROJECT:

CONTRACTORS:

GEN.:

MECH.:

ELEC.:

DATE:

MOTOR OVERLOAD PROTECTION

REQUIRED ON ALL PHASES
(SEE N.E.C. SECT. 430 FOR
MAX. PERCENT ALLOWABLE)

NOTES:

1. IDENTIFY EACH MOTOR THUS: CWP-1, H&V-1, F-1, ETC. SAME AS SHOWN ON DWGS.
2. SMALL MOTORS MAY BE RATED THUS: HP, WATTS OR FLA.
3. ALL DATA BY ELECTRICAL CONTRACTOR.
4. SERVICE FACTOR -- IF NOT AVAILABLE ENTER DEGREE C. RISE.
5. MOTOR CONTROLLER TYPE -- FVNR, RVPW, 2-SPD/1W, 2-SPD/2W, Y/Δ, MANUAL, ETC.
6. MOTOR PROTECTION -- INCLUDE COPIES OF HEATER TABLES WITH THIS REPORT.

EQUIP. MARK (1)	MOTOR DATA						MOTOR CONTROLLER		N.E.C.	MOTOR PROTECTION (6)		
	HP (2)	VOLTS	PHASE	N'PLATE AMPS	SERVICE FACTOR (4)	RUN AMPS*	TYPE (5)	NEMA SIZE	MAX. % ALLOWED	MIN. & MAX. AMPS	HEATER NO.	MFGR.

*AS MEASURED WITH AMMETER AT SITE.

SECTION 260519
LOW VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 - GENERAL:

1.01 RELATED DOCUMENTS:

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

1.02 WORK INCLUDED:

A. Wires and Cables, Under 600 Volts.

B. Connectors and Lugs, Under 600 Volts

C. Wiring torqueing results

1.03 RELATED WORK:

A. Division 23 – Mechanical

B. Section 26 05 26 – Grounding And Bonding For Electrical Systems

C. Section 26 05 33 – Raceway And Boxes For Electrical Systems

D. Section 26 05 53 – Identification For Electrical Systems

1.04 REFERENCES:

A. All wire, cables, connectors and lugs shall be U.L. listed for the application intended, and meet NEMA applicable standards.

B. All wiring methods shall meet with NFPA applicable codes.

C. NETA testing stardards.

1.05 CONDUCTOR CODING (208Y/120 and 480Y/277 Volt)

A. Color Code Conductors of 208Y/120-volt system power and lighting conductors as follows:

Neutral	White
Ground	Green
Phase A	Black
Phase B	Red
Phase C	Blue

B. Color Code Conductors of 480Y/277-volt system* power and lighting conductors as follows:

Neutral	Grey
Ground	Green
Phase A	Brown
Phase B	Orange
Phase C	Yellow

* Owner’s NEC compliant color code may be substituted for the above 480Y/277 code.

C. No. 12 and No. 10 conductors shall have continuous insulation color(s). Color code conductors larger than No. 10 which do not have continuous insulation color by application of at least two laps of colored tape on each conductor at all points of access. Tape shall be "Scotch," “Highland,” or “Timflex” vinyl plastic electrical tape No. 35, or accepted equal. The 480Y/277 volt conductors shall be marked with an appropriately wide tape of the above base color and an adjacent narrow tape of yellow. Wrap-around "Brady" markers or shrinkable PVC sleeving with hot-stamped lettering may be used and shall state the appropriate conductor identification. Label "480Y/277-Volt" on all phase conductors of the 480Y/277-volt system.

D. Number code all control and instrumentation wiring at all points of access.

1.06 CONDUCTOR SIZES:

A. All conductor sizes (AWG) are based on copper. (See Section 2.02A.1 for provisions to utilize aluminum building wiring.

1.07 SUBMITTALS:

A. Submit shop drawings and product data in accordance with Section 26 05 00.

PART 2 - PRODUCTS

2.01 MANUFACTURERS:

A. All wires and cables shall be as manufactured by General Cable, Capital Wire & Cable, Carol Cable, American Insulated Wire, Southwire, Senator, Rome, Cerro Wire and Cable, Circle Wire & Cable.

B. All connectors and lugs shall be as manufactured by T & B, Buchanan, 3M, Burndy, or accepted equal.

2.02 MATERIALS AND TYPE:

A. Wiring, Power and Control:

1. General:

a. Conductors shall be **soft annealed copper** unless otherwise indicated.

b. Feeder conductors, indicated to be size #1/0 and larger, may be aluminum in lieu of copper. Where substitution of aluminum is made, the Contractor shall take responsibility for resizing all conductors and conduits for the affected circuits in accordance with each individual overcurrent device, equipment buss rating and the NEC. In no case shall an aluminum feeder conductor, or set of conductors, have a smaller ampacity than the circuit size based on copper.

c. All conductors #8 AWG or larger shall be stranded (except in surface raceway SR, all conductors shall be stranded).

d. All power wiring shall be #12 AWG minimum unless otherwise indicated.

e. All control wiring shall be #14 AWG minimum for NEC Class I and #16 AWG minimum for NEC Class II, **extra fine stranding.**

f. All insulation shall be rated for 600 volts unless otherwise indicated.

2. Building Wiring: Conductors shall be type "THWN" or "THHN" unless otherwise indicated. "THHN" shall not be used in damp or wet locations.

3. Underground Wiring (Refer to Part-3 for limitations):

   a. #12 AWG through #6 AWG: Conductors shall be type UF copper cable with heat and moisture-resistant insulation, suitable for branch-circuit wiring. The cable shall have an insulated equipment grounding conductor. The overall covering shall be flame-retardant; moisture, fungus, and corrosion resistant; and shall be limited to use within the pole standard.

   b. #12 AWG through 500 kcmil (MCM) AWG: Conductors shall be type RHH/USE/RHW stranded copper with Durasheath cross-linked polyethylene, thermosetting XLPE that is heat, fungus and moisture resistant.

   c. #12 AWG through 500 kcmil (MCM) AWG: Conductors shall be type XHHW-2 stranded copper cable with cross-linked polyethylene, thermosetting XLPE that is chemical and oil resistant, and suitable for wet or dry locations.

4. Flexible Metal Conduit (Liquidtight) Connections and Motor Starter Enclosures: Power and line voltage control wiring Type MTW stranded copper unless otherwise indicated for all motor connections, HVAC equipment, transformers, all other equipment subject to movement and vibration, and motor starter enclosures.

5. Flexible Cable:

   a. Shall be hard service cord, type "SO" with equipment ground conductor in addition to normal current carrying conductors, and "safety-yellow" jacket.

   b. Connectors shall be Crouse-Hinds series CG, Appleton, Kellems, O.Z./Gedney, Raco, or T & B, complete with locknut, sealing gasket, gland nut and tapered neoprene bushing.

   c. In hazardous areas, connectors shall be Crouse-Hinds CGBS.

B. Motor Connections:

1. Connection lugs shall be Thomas and Betts, Series 54200.

2. Insulation shall be motor stub splice insulators, Thomas and Betts, Series MSC, or Raychem MCK.

C. Connectors and Lugs, 600 Volts and Under:

1. Material: Copper, or suitable copper alloy, for all current carrying parts and all parts coming in contact with conductors.

2. Connectors and Lugs, No. 8 and Larger Conductors: Compression type T & B "Color-Keyed", or accepted equal by Burndy or Kearney. Mechanical compression lugs furnished with equipment are acceptable. Provide insulating covers or heat shrinkable insulators where required.

3. Connectors, No. 10 and Smaller Conductors: Permanently indented self-insulated pressure connectors T & B, Buchanan, or accepted equal. Snap-on insulating caps are acceptable insulation. "Scotch-loks" by the 3M Company, "Wing-Nut" by Ideal, "Legrands" by Pass & Seymour (P&S) are acceptable wing type wire connectors.

4. Lugs, No. 10 and Smaller Conductors: Permanently indented or compression type by Buchanan, Burndy, T & B, or accepted equal. Washer head screw terminals without lugs are acceptable on neutral bars, circuit breakers, wiring devices and other equipment, unless otherwise indicated. Mechanical compression lugs furnished with equipment are acceptable.

5. Exterior Splices: Compression type T & B "Color-Keyed", complete with T & B Shrink-Kon series HS heat shrinkable insulators, or accepted equal by Burndy or Kearney.

6. Connectors and Lugs, Aluminum: All connectors, lugs and fittings shall be UL listed for use with aluminum alloys, and aluminum to copper alloys where encountered.

PART 3 - EXECUTION

3.01 INSTALLATION:

A. Clean out raceway system before pulling wire.

B. Thoroughly inspect all existing raceway systems for burrs, deformation, rust, water, and other hazards. Inform Architect/Engineer in writing of any raceway conditions that would be detrimental to wiring, or not in compliance with Codes or practices. All existing raceways shall meet the requirements of Section 26 05 33.

C. Utilize an approved compound as required to facilitate pulling wires and cables, unless otherwise indicated.

D. 600 Volts and Under Wiring Methods:

1. Conductor Ties:

a. Inside each enclosure, other than outlet and junction boxes, conductors shall be bundled and trained utilizing T & B "Ty-Rap", 3M Brand Cable Ties, Tyton Cable Ties, or accepted equal, ties. All Switchboards, Panelboards, Motor Starters, Disconnects, etc. require at least one (1) conductor tie for each circuit entering and each circuit leaving the Switchboard, Panelboard, Motor Starter and Disconnect.

2. Conductor Sizes:

a. Line Voltage Power Wiring: No. 12 AWG minimum. Circuits and feeders larger than 20 amp. to have conductors sized for equal or greater ampacity than their protective device ratings unless otherwise indicated. All wires for 20 amp. circuits shall be #10 on runs 100 feet to 250 feet, #8 on runs 251 feet to 500 feet and #6 on runs 501 feet and above.

b. Control Wiring:

1) 120 Volt: If not carrying motor current, No. 14 AWG unless otherwise indicated, or required by load or distance encountered.

3. Terminal Strips: Where equipment does not have terminal strips, provide terminal strips to terminate and splice control, power limited and communication cables. Indicate wire numbers on strip with indelible pen.

4. Conductor Identification:

a. Wire Markers:

1) Identify lighting and receptacle branch circuit wiring by panelboard name and circuit number at all accesses.

2) Identify motor branch circuit wiring by circuit number and phase at all accesses.

3) Identify feeders by name of equipment from which they originate, circuit number, and phase.

4) Identify all control wiring with a unique number for each wire.

b. Color Code: Color code conductors to designate neutral conductor, ground conductor and phase conductors as described in Part 1 of this Section.

5. Splices:

a. Feeders: Feeder conductors installed between electrical distribution equipment (i.e., switchboards, transformers, and panelboards) shall be free from splices, no exceptions. Any feeder conductor splices proposed by the Contractor shall be approved in advance by the Engineer; otherwise, they are not permitted.

b. No splices shall be made in any conductor beyond the exterior walls of the Building, except in exterior pullboxes, and where approved by the Engineer.

6. Motor Connections: Shall use connection lugs with motor stub splice insulators.

7. Each applicable system shall have a separate conduit system unless the applicable system's manufacturer, Codes and Regulations permit other systems conductors to be installed in the same conduit.

8. Provide insulation resistance testing of all 3 phase feeder cables. Provide a feeder testing chart with each feeder listing and testing results.

9. All wiring terminations shall be properly torqued and recorded in table form with conduction feeder name of circuit with torqueing results. Indicate both ends of the conductor or feeder termination and torqueing results.

END OF SECTION

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SECTION 260526
GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS:

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

1.02 WORK INCLUDED:

A. Equipment Grounding Conductor (EGC)

1.03 RELATED WORK:

A. Section 26 05 19 – Low-Voltage Electrical Power Conductors and Cables

B. Section 26 05 23 – Control Voltage Electrical Power Cables

C. Section 26 05 33 – Raceway and Boxes for Electrical Systems

1.04 REFERENCES:

A. NFPA 70 (NEC), Article 250

1.05 DESCRIPTION:

A. An insulated equipment grounding conductor, color coded per section 26 05 19, and the NEC, shall be provided for each alternating current circuit without exception.

1.06 TESTS:

A. The equipment grounding conductor shall be tested for continuity and proper bonding to metallic equipment enclosures, outlet boxes, wiring devices and similar items.

PART 2 - PRODUCTS

2.01 MANUFACTURERS:

A. Ground Clamps: Thomas & Betts “GUV,” O. Z. Gedney “CG” series or Blackburn “GUV” series, as required by water pipe size and/or grounding electrode conductor size.

PART 3 - EXECUTION

3.01 INSTALLATION:

A. Equipment Grounding Conductor (EGC):

1. Provide a separate insulated grounding conductor, color-coded as per Section 26 05 19, enclosed in the same raceway with the phase conductors for all alternating current circuits, even though not necessarily shown on the drawings.

2. The equipment grounding conductor shall be secured to the equipment enclosure at the source of power and at the apparatus being served by the alternating current supply.

3. The minimum size for the grounding conductor shall be as specified in Table 250.122 of N.E.C.

B. Provide test results for grounding system tests. Also provide open grounding test and results.

END OF SECTION

SECTION 260533
RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL:

1.01 RELATED DOCUMENTS:

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

1.02 WORK INCLUDED:

A. Rigid Conduit (Heavy Wall, Intermediate Metal Conduit, Electrical Metallic Tubing and Rigid Non-Metallic Conduit)

B. Fittings for Conduits,.

C. Pull Boxes

D. Junction Boxes

1.03 RELATED WORK:

A. Section 26 05 53 – Identification For Electrical Systems

1.04 SUBMITTALS:

A. Submit shop drawings and product data in accordance with Section 26 05 00.

PART 2 - PRODUCTS

2.01 MANUFACTURERS:

A. Rigid Heavy Wall Conduit (GRS): Essex, Allied Tubing, Republic, Steelduct, Triangle, L.T.V., Wheatland, or accepted equal.

B. Intermediate Metal Conduit (I.M.C.): L.T.V., Berger Industries, Inc., Allied Tubing, or accepted equal.

C. Fittings (All fittings to be same materials as specified for conduit):

1. Rigid Heavy Wall and Intermediate Metal Conduit Fittings: O.Z., T & B, Efcor, Berger Industries, or accepted equal.

2. Electrical Metallic Tubing Fittings: T & B, Raco, Steel City, O.Z./Gedney, Berger Industries, Inc. or accepted equal.

3. Conduit "L's": Crouse Hinds, Killark, O.Z./Gedney, Shamrock Conduit Products, or accepted equal.

4. Cable Supports: O.Z. type M, or accepted equal.

5. Insulated Throat Metallic Bushings: O.Z./Gedney Type B or BLG, T & B nylon insulated metallic, or acceptable equal by Efcor. Provide grounding lug type where required.

D. Pull and Junction Boxes: General Metals, Electromate Mfg. Corp., Hoffman, or accepted equal.

E. Outlet Boxes: Appleton, Raco, Steel City, or accepted equal.

F. Outlet Box Brackets: E-Z Mount Bracket Co., Inc., Vinton, Virginia 24179 (703-345-3000), or accepted equal by Caddy, Raco.

2.02 MATERIALS AND USE:

A. Rigid Heavy Wall Conduits (GRS): Of mild steel tube, electro or hot-dipped galvanized and U.L. labeled.

B. Intermediate Metal Conduit (I.M.C.): Of mild steel tube in sizes 3/4" to 4", hot-dipped galvanized or electro-galvanized and U.L. labeled. Refer to limitations under Part 3 - EXECUTION.

C. Electrical Metallic Tubing (EMT): Of mild steel tube in sizes 3/4" to 4" hot-dipped galvanized or electro-galvanized and U.L. labeled. Refer to exceptions under Part-3.

D. Fittings:

1. For Rigid and Intermediate Conduit: Couplings to be galvanized or sheradized steel. Double galvanized steel locknuts shall be used where required by code. Single locknut and bushing may be used elsewhere. Insulated throat metallic bushings to be installed on all rigid conduit terminations where such bushings are required by NEC to protect the wires from abrasion. Use ground lug type where required.

2. For E.M.T.: Steel set screw connectors, permanently indented or gland compression type. **Do not use cast metal type.**

3. Conduit "L's": Galvanized steel, threaded, "LB" or "LBD".

4. Cable Supports: To be installed for the support of all conductors and cables as per NEC Article 300-19.

5. Fire Resistance Rated Wall and Smoke Partition Seals:

a. Provide fire-seals for each conduit or cable passing through fire rated walls and floors where the floor, wall or smoke partition has a rating up to three (3) hours in accordance with Manufacturer's application data. All penetration systems shall have been tested per ASTM B14-88 fire test and UL listed for "Through-Penetration Fire Stop System".

b. Provide UL approved thru-wall fittings for passage of power-limited cabling where cable tray, path of cable hooks, or other major cable pulling route intersects fire wall. The system shall expand rapidly where exposed to fire or high temperature to provide the required firestopping. The fittings shall be complete with built-in firestopping material and through-wall penetration. Each penetration shall be equivalent size of a 4” conduit sleeve or greater and shall remain fully accessible to add or remove cables without disturbing the firestopping material. The fittings shall have been UL-tested and meet the requirements of ASTM E814 UL1479 and shall be rated for 4 hours. Fittings shall be UL approved for use in air plenums.

E. All boxes to be sheradized or galvanized (after fabrication) sheet steel (except floor boxes) code gauge boxes.

F. The minimum size of all boxes shall conform to the requirements of the National Electrical Code, unless noted to be larger on the drawings, and shall have adequate braces and supports.

G. Pull and Junction Boxes: All boxes shall have screw-on or hinged covers. All flush mounted boxes shall have 3/4" overlapping covers with flush-head cover retaining screws and covers in finished areas shall be prime coated with paint.

H. Outlet Boxes:

1. All boxes shall have ears turned in. Multiple gang boxes must be one piece type (not built-up). Provide 3/8" (or larger if required) fixture stud in all fixture boxes. Provide appropriate covers as required, including 3/4" deep plaster ring covers where plaster may be encountered. Provide vapor proof outlet boxes for vapor proof fixtures. Provide size and type of boxes as required by location and N.E.C., except where exposed masonry occurs, use one piece "tile boxes". All boxes shall be 4" square boxes with "tile rings" unless noted otherwise or where larger sizes are required. All outlet boxes requiring hangers shall be hung with metal hangers.

2. **All exposed boxes below ceiling level shall be cast type FS or FD.**

I. Stud Wall Outlet Box Brackets: Provide #E-Z 1-4, #E-Z 4-1116 or #E-Z 23-1 outlet box brackets with extension brackets or acceptable equal.

J. Outlet Box Bar Hangers: Provide adjustable or solid bar metal hangers by Appleton Electric Manufacturing or accepted equal.

PART 3 - EXECUTION

3.01 INSTALLATION:

A. Provide raceway systems to achieve required distribution, switching and circuit control. All wires for all systems shall be installed in rigid metal raceways and terminated in boxes or cabinets, unless otherwise specified herein as partial conduit or non-conduit installation. Allow for making connections to all outlets, motors, etc., indicated and check plans to insure that all outlets, etc., have a designated circuit. Notify the Engineer of any discrepancies found.

B. Conduit runs are not shown on the drawings, unless specifically noted or indicated otherwise.

C. **Cap** raceway systems during course of construction and thoroughly clean inside before installation of conductors.

D. No rigid raceway for line voltage wiring shall be smaller than 3/4", except for flexible conduit, unless specifically indicated otherwise. The Electrical Trade shall size all other raceways based on the N.E.C. and verify the sizes shown on the drawings, increasing same if required by local authorities and/or codes.

E. All conduit feeding from one building area to another shall remain within the confines of the building, unless shown or noted otherwise on the drawings.

F. Field made conduit bends shall be made with an acceptable bending machine or conduit bender.

G. Rigid Metal Heavywall Conduit (GRS):

1. All joints shall be properly threaded and made tight in standard conduit couplings.

2. All thread conduits or nipples are not acceptable.

3. All conduit cuts shall be square, made with a hacksaw or approved cutting machine, and reamed after threading and before installation to remove burrs.

4. All threads, both field-cut and factory-cut, not otherwise protected, shall be painted after installation with two coats of asphaltum paint if concealed and two coats of primer base paint if installed in an exposed location.

5. GRS shall be used in service entrance raceways where exposed.

6. Clamps to be malleable two (2) hole galvanized iron and hangers to be rod type steel.

H. Where conduits are exposed to occupants, up to 8'-0" feet above the floor, the conduits shall be snug to the wall and secured with two (2) hole clamps (utilizing specified detention type fasteners).

I. Intermediate Metal Conduit (IMC):

1. Applicable specifications for installation of rigid metal conduit applies to IMC.

2. IMC can be substituted for GRS per the NEC.

J. Electrical Metallic Tubing (EMT):

1. Applicable specifications for installation of rigid metal conduit applies to E.M.T.

2. E.M.T. shall **not** be used underground, cast in concrete, exposed on exterior of buildings, and exposed interior locations below 8'-0" (above finished floor).

3. E.M.T. may be routed down exposed interior walls to top of panelboards, motor starters, disconnect switches, light switches, etc.

4. E.M.T. is permitted in electrical and mechanical equipment rooms, per detail on drawings.

K. Supports: Provide metallic supports as required for the proper installation of the raceway or conduit systems and all other equipment installed under this contract. **Wire shall not be used to support or tie down any conduit system.**

L. Empty Conduits: Pull #12 stranded gauge galvanized fishing wires or stranded nylon line through all empty conduits for all systems. These wires or lines to remain in the conduits.

M. Exposed Masonry: Where wall finish is exposed masonry, raceways shall be so placed in wall that the masonry unit can be neatly set around it with minimum cutting and without injury to the exposed masonry face.

N. Pull and Junction Boxes: Provide all necessary pull and junction boxes where indicated or required by National Electrical Code. Certain pull and junction boxes may be shown on the drawings for specific design reasons but is not to preclude the fact that additional boxes will be required to conform to codes and good practice.

O. Outlet Boxes:

1. General: All outlet boxes shall be set flush or set to meet the N.E.C. requirements; otherwise box extensions shall be installed. Mounting heights of all outlets shall be as indicated on the drawings, specified herein, or as permitted on the job. Support all boxes to maintain alignment and rigidity. Clean boxes of all foreign matter prior to installation of

wiring and/or devices. Adjacent outlet boxes shall be aligned horizontally at the same height, or vertically in the same line, as required.

2. Wall Outlets:

   a. Where the outlet boxes are shown back-to-back in the walls of 6" or less in thickness, the boxes shall be offset horizontally. Through-the-wall outlet boxes shall not be permitted. Outlet boxes, indicated to be installed side-by-side in the same wall, shall be located 6" apart. All boxes shall be rigidly secured in the wall.

   b. Steel Outlet boxes in fire walls and fire separation assemblies shall be installed in accordance with Virginia USBC 704.1.1 and 714.1.6.1 respectively. Therefore outlet box openings cannot exceed 16 square inches per outlet with 100 square inches limit per 100 square feet of wall area. Where outlet boxes are shown in opposite sides of the wall or assembly, the boxes shall be separated by a horizontal distance of not less than 24 inches.

3. Exposed Masonry: The outlet boxes shall be placed in the wall to allow the masonry unit to be neatly set around the box, with the minimum of cutting and without injury to the exposed masonry face. The dimensioned heights of the outlets in the exposed masonry walls are intended to mean to the nearest masonry joint.

P. Conduit Termination: All rigid heavy wall metal conduits (G.R.S, I.M.C. and E.M.T.) and rigid non-metallic conduits (P.V.C.) shall terminate with locknut and bushing in all boxes, cabinets, panels, etc. Where a grounding means is not provided in the box, cabinet, panel, etc. provide a locknut and grounding bushing.

END OF SECTION

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SECTION 260553
IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL:

1.01 RELATED DOCUMENTS:

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

1.02 WORK INCLUDED:

A. Prepare and paint Division 26 equipment supports and miscellaneous materials located in Equipment Rooms, Mechanical Rooms, and other utility areas housing mechanical and/or electrical equipment.

B. Identification of conduits, junction boxes, pull boxes, panelboards, disconnect switches, and Division 26 system enclosures.

1.03 WORK NOT INCLUDED:

A. Painting of factory finished Division 26 Equipment such as Panelboards, etc.

1.04 RELATED WORK:

A. Section 26 05 00 – Common Work Results For Electrical

B. Section 26 05 33 – Raceway And Boxes For Electrical Systems

C. Section 26 22 00 – Low-Voltage Transformers

D. Section 26 28 16 – Enclosed Switches And Circuit Breakers

E. Section 26 29 00 – Low-Voltage Controllers

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS:

A. Except as otherwise specified, materials shall be the products of the following manufacturers:

1. Sherwin-Williams

2. Pratt and Lambert

3. Devoe

4. Benjamin Moore

2.02 MATERIALS:

A. Deliver all paints and materials to the project site in their original containers with all labels intact and legible at the time of use.

B. Sherwin-Williams Industrial Maintenance Coatings System 4000 products are listed below to establish color and a standard of quality.

1. All Hangers and Supports: One coat Series 54 Gloss Black Alkyd Enamel.

2. Uninsulated diesel engine exhaust and other similar hot surfaces shall be painted with two coats of No. B59S8 Heat Resistant Aluminum.

3. Exterior of belt guards and other protective guards shall be finished with two coats of Series 54 Alkyd Gloss Enamel No. SW4084 safety yellow color. Interior of and all items covered by belt guards and other protective guards shall be finished with two coats of No. SW4083 safety orange color.

4. Factory Finished Equipment finishes shall be cleaned and properly touched up with equipment manufacturers touch-up paint unless finish is severely damaged or of unacceptable quality. In the latter case, the entire finish shall be restored in accordance with painted procedures herein specified.

PART 3 - EXECUTION

3.01 WORKMANSHIP:

A. The work shall be accomplished by qualified mechanics skilled in the painting trade. Painting of equipment and other materials shall not commence until all testing is complete and systems are ready for operation. Materials shall be evenly spread, and smoothly flowed on without runs or sags. Each coat shall be thoroughly dry before application of succeeding coats.

3.02 PROTECTION OF WORK:

A. The painters shall protect all adjacent surfaces with drop covers during the process of painting. Upon completion, paint spots, if any, shall be removed from all surfaces not intended to be painted.

3.03 PREPARATION OF SURFACE:

A. Surfaces to be painted shall be completely dry before applying paint. Metal surfaces shall be cleaned with mineral spirits before applying materials. Rust and scale shall be removed by wire brushing or sanding. Galvanized surfaces shall be chemically treated with crystalline zinc phosphate in strict accordance with the manufacturer=s recommendations. Surfaces shall not be painted when the temperature is, or is likely to be, near the freezing point, nor when they are exposed to hot sun.

3.04 IDENTIFICATION OF PIPES AND EQUIPMENT:

A. After **all** painting is completed, operating and control parts of the equipment and systems such as switchgear, panelboards, telephone cabinets, system cabinets, disconnect switches, motor starters and control cabinets shall be properly identified with laminated engraved plastic nameplates fastened with sheet metal screws, bolts or permanent adhesive. Pressure sensitive tape is **not** acceptable. Identification symbols or designations shall be the same as shown on the contract documents.

B. Boxes; Concealed and Surface Mounted: Each junction box, pullbox or similar enclosure shall be **neatly** identified by stencil marking which shall indicate service contained, and circuit numbers. Stencil letters shall be upper case (Capital) not less than one-half inch high and painted with Series 54 black gloss enamel.

C. Power Circuits: Label all power circuits on equipment, devices, receptacles and switches. Label circuits inside receptacle outlets boxes, switching device outlets boxes and on faceplates for receptacle and switches.

D. Label all equipment (motors, disconnects, starters, VFDs, MP switch, panelboards, transformers, ATS switches, mechanical equipment, etc.) with serving circuit number and serving panelboard. Labels shall be a phenolic labels (black with white letters for normal power and red with white letters for generator power).

E. Label all panelboards with serving circuit number and serving panelboard. Labels shall be a phenolic labels (black with white letters for normal power and red with white letters for generator power).

F. Conduit:

1. Color bands shall be painted on each conduit where exposed or accessible. Bands shall be six inches wide and shall be placed along the conduit run immediately preceding the passage of the conduit through walls, ceiling or floor, and at each equipment connection or junction box. Where sub-bands are specified, they shall be two inches wide and centered in the color band. Adjacent to each color band, the abbreviation of the name of the service contained in the conduit shall be **neatly** stenciled. Stencil letters shall be one-half inch high upper case, applied with Series 54 black gloss enamel. Color bands shall be Series 54 Alkyd Gloss Enamel of colors listed below.

2. In lieu of painted color bands, the Contractor may use pressure sensitive tape a minimum of 2" wide. Each color band will require wraps as necessary to provide the full 6" wide band with or without the 2" sub-band.

3. In lieu of stenciled names of the pipe service, the Contractor may use vinyl "snap around" markers as manufactured by Seton, Bunting, Brady and Thomas & Betts (T&B).

4. Color Banding:

System	Abbrev./Color	Color Band	Color Sub-Bands
120/208 Volts (Normal)	208V/Black	Black	Yellow
277/480 Volts (Normal)	480V/Black	Black	Orange

G. The main panelboard, generator control panel, and other similar systems shall have an engraved informational laminated nameplate with the installing trade's name, telephone number and address for the Owner to obtain preventive maintenance, service or parts. The nameplate shall include the job order number, shop number or other identification which will identify the related equipment.

If the above address and telephone number is a branch office, the main office or manufacturers address and telephone number shall be included.

END OF SECTION

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SECTION 262813
FUSES

PART 1 - GENERAL

1.01 RELATED DOCUMENTS:

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

1.02 WORK INCLUDED:

A. Fuses [S]

1.03 RELATED WORK:

A. Section 26 28 16 – Enclosed Switches And Circuit Breakers

1.04 SUBMITTALS:

A. Submit product data in accordance with Section 26 05 00.

1. Product Data: Submit application, technical, and installation data.

PART 2 - PRODUCTS [O/M]

2.01 MANUFACTURERS:

A. All Fuses shall be as manufactured by Cooper Industries, GEC Alsthon, Littlefuse, Gould-Shawmut (Nippon Mining). [S] [O/M]

2.02 MATERIALS AND TYPE:

A. Motor and Panelboard Fuses: Rejection type **C** class RK-1, dual element, time-delay, current limiting, cartridge type, by 300™ Low-Peak Yellow™ by Bussman, LoIp© by CEFCo, Power-Pro® by Littlefuse, "AMP-TRAP 2000" by Gould-Shawmut (Nippon Mining), with a minimum interrupting rating of 200,000 amperes rms symmetrical.

B. For applications 601 amps and higher, utilize time-delay, current limiting, silver linked **UL** class **"L"** fuses by 300™ Low-Peak™ Bussman, Short Check® by CEFCo, Power-Pro© by Littlefuse, A4BQ "AMP-TRAP 2000" by Gould-Shawmut (Nippon Mining) with a minimum interrupting rating of 200,000 amperes rms symmetrical.

PART 3 - EXECUTION

3.01 INSTALLATION:

A. Fuses for motor circuits shall be sized in accordance with the fuse manufacturer's sizing chart for **"motor running overload protection"**, unless otherwise required for a specific motor. All other fuses for other than motor circuits shall be of size and type as required by the connected equipment manufacturer's written instructions unless otherwise indicated. Labels indicating size and type of replacement fuses shall be glued to inside of door on all fusible switches, fusible motor starters and panels.

3.02 SPARE FUSES:

A. 600 Amp Fuses and Smaller: Furnish spare fuses not to exceed 10% of each rating with a minimum of three (3) per rating.

END OF SECTION

SECTION 262816
ENCLOSED SWITCHES AND CIRCUIT BREAKERS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS:

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

1.02 WORK INCLUDED:

A. Disconnect Switches

1.03 RELATED WORK:

A. Section 26 05 53 – Identification For Electrical Systems

B. Section 26 20 00 – Low-Voltage Electrical Distribution

C. Section 26 28 13 – Fuses

1.04 REFERENCES:

A. All disconnect switches and circuit breakers shall meet and comply with applicable sections of U.L., N.E.C. and NEMA.

1.05 SUBMITTALS:

A. Submit shop drawings and product data in accordance with Section 26 05 00.

1. Shop Drawings for Disconnect Switches shall include:

a. Scale drawing of enclosure and internal components.

b. Roughing-in requirements.

2. Circuit Breaker shop drawings shall include:

a. Frame type and ampere rating.

b. Trip amperage.

c. Interrupting rating in RMS symmetrical amps.

d. Accessories.

3. Product Data: Submit application, technical, and installation data.

B. Submit Operation and Maintenance Manuals in accordance with Section 26 05 00.

PART 2 - PRODUCTS [O/M]

2.01 MANUFACTURERS:

A. All disconnect switches shall be Square D (Group Schneider) Class 3110 Heavy Duty Visible-Blades® safety switches, General Electric Spec-Setter© Heavy Duty Type TH (to 600A), and Type TC (800A & 1200) safety switches [S][O/M], Cutler-Hammer/Eaton Heavy Duty Type DH series safety switches, and Siemens Vacu-Break VBII™ Heavy Duty safety switches.

B. All circuit breakers shall be as manufactured by Square D or acceptable equal by Cutler-Hammer/Eaton, General Electric (GE) or Siemens.

2.02 MATERIALS AND TYPE:

A. Disconnect Switches [S] [O/M]: Rated for voltage encountered, poles and amperage as required. Heavy Duty, NEMA enclosures, fusible for rejection type class R fuses only, solid neutral assembly, equipment grounding kit, unless otherwise indicated. Refer to NEMA type under PART 3 - EXECUTION.

B. Molded Case Circuit Breakers (MCCB) [S] [O/M]:

1. Ratings and special features shall be as scheduled.

2. Trips shall be thermal magnetic with inverse time delay and instantaneous time-current characteristics.

3. 225 ampere frame and larger MCCB shall have permanent non-interchangeable trips, factory-calibrated at 40 degrees C, and adjustable magnetic feature set by a single adjustment. Interchangeable trips will be considered as an alternative.

4. Industrial grade MCCB shall be provided except that commercial grade MCCB (quick-lag "Q-Line") may be used for MCCB 100 amperes and below where other indicated criteria are met.

5. Ambient compensating MCCB shall be provided for outdoor applications or where indicated on drawings.

6. MCCB shall not be used for switching lights unless they are specifically rated for switching duty.

7. U.L. listed HACR type circuit breakers shall be provided for use with air conditioning, heating and refrigeration equipment having motor group combinations and marked for use with HACR type circuit breakers.

8. Circuit breakers shall have removable lugs. Lugs shall be UL listed for copper and aluminum conductors. Breakers shall be UL listed for installation of mechanical screw-type lugs and compression type lugs.

9. Current limiting circuit breakers shall meet UL 489 requirements, NEMA Standard AB3-2013 and Federal Specifications W-C-375B/GEN.

C. Fuses: Provide specified fuses, sizes as required.

PART 3 - EXECUTION

3.01 INSTALLATION:

A. Provide disconnect switches for all motors and appliances for the project where required by the National Electrical Code; and rated for the voltage encountered complete with required poles, amperage rating and all accessories. Not all disconnect switches required by NFPA-70 are necessarily indicated on the drawings.

B. Provide rain-tight NEMA-3R, NEMA-4, NEMA-4X, explosion-proof or other NEMA enclosures for switches where required by NEC and environmental conditions.

C. Coordinate voltage of shunt trips with connected systems.

3.02 FIELD QUALITY CONTROL:

A. Technical Assistance: The electrical gear manufacturer's representative shall generally provide installation supervision of this equipment if requested by the contractor.

END OF SECTION

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SECTION 262900
LOW-VOLTAGE CONTROLLERS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS:

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

1.02 WORK INCLUDED:

A. Motor Protective Switches

B. Magnetic Starters, including across-the-line starters and reduced-voltage starters.

C. Variable Frequency Drives (VFD's), Installation of Division 23 VFD's

D. Control Accessories

1.03 RELATED WORK:

A. General: The Contractor shall consult all other sections of these Contract Documents specifications containing any type of equipment requiring electrical connections and allow for wiring and controlling all equipment as described therein even though not shown on the electrical drawings. See mechanical drawings for exact locations and names of Mechanical Equipment and Controls. (Division 23)

B. Division 23 - Mechanical

C. Section 26 28 13 - Fuses

1.04 SUBMITTALS:

A. Submit shop drawings and product data in accordance with Section 26 05 00.

1. Shop Drawings shall include:

a. Scale drawing enclosure and internal components.

b. Internal wiring schematic.

c. Roughing-in requirements.

2. Product Data: Submit application, technical, and installation data.

B. Submit Operation and Maintenance Manuals in accordance with Section 26 05 00.

PART 2 - PRODUCTS

2.01 MANUFACTURERS:

A. All motor starters shall be as manufactured by Square D, Furnas, Cutler-Hammer/Eaton, G.E., Siemens, or Allen Bradley. All controllers and accessories to be by the same manufacturer.

B. Phase Protection Relays shall be by Diversified Electronics, Inc. (Available from Wesco, Johnson Control and others) or acceptable equal.

C. Interposing (Interface) Relays: Square-D or Potter-Brumfield.

2.02 MATERIALS AND TYPE:

A. Motor Protective Switches [S] [O/M]: Marked 'MP' on drawings. Manual type with overload relay for each phase, with poles as required and separately wired neon or L.E.D. pilot light. M.P. switch and pilot shall be mounted on one (1) multi-gang plate.

1. Magnetic Starters [S] [O/M]: Where M.S. is marked on the drawings, provide an across-the-line combination starter complete with the following:

2. Disconnect Switch: Fusible disconnect switch for rejection type Class RK-1 fuses only, unless non-fusible is indicated.

3. Overload Relays [S] [O/M]:

a. NEMA Size 00 to 4 Contactor: Factory calibrated, directly heated, **NEMA-10**, block design, three (3) pole, bi-metallic overload relay, and ambient temperature compensation.

b. Current sensing solid state overload relays are not acceptable due to the non-automatic reset for unbalanced phase currents.

4. Indicating Lights: L.E.D. indicating lights for "power available" (green) and "run" (red). **Incandescent indicating light modules are not acceptable**, except with LED conversion lamps.

5. Control Voltage: Control circuits and holding coils shall be 120 volts. Provide individual transformers of required size where higher voltages are encountered. Protect control circuit in accordance with N.E.C.

B. **Heaters** [S] [O/M]: Install thermal overload heater elements in all switches and starters on the job whether or not the switches and starters are furnished by this subcontractor. Assume responsibility for proper application of motor running protection for all motors in accordance with the manufacturer's recommendations and the nameplate rating of the motors actually installed. All phases to have overload protection. (Not required on solid state overload relay.)

C. **Control Stations** [S]: Standard duty with maintained contact, start-stop buttons and red neon or L.E.D. indicating light, unless otherwise indicated. All start-stop buttons, hand-off-automatic switches, pilots, etc., mounted in covers of motor starters as required, unless noted otherwise.

D. **Enclosures** [S]: All motor starters and VFD=s shall have NEMA-1 **oversized** enclosures except motor starters in damp, wet or exterior (outdoors) locations shall have NEMA-3R oversized enclosures. Motor starters in kitchens and food preparation areas shall have NEMA-4X oversized enclosures.

E. **Phase Protection Relay (PLP)** [S] [O/M]: Provide Diversified Electronics, Inc., or accepted equal phase sequence and unbalance monitor, SLD Series, to monitor phase unbalance, under-voltage, phase sequence and regeneration. Monitor shall have adjustable phase unbalance, under-voltage and time delay (to break).

F. **Interposing (Interface) Relays** [S]: Square D #8501 RS 14 V20 (120 volt) relay(s) with #8501 NR45 socket, 5 amp contacts, control coil burden is 3.5 VA in rush and 1.2 VA sealed mounted in the **oversized** motor starter enclosure (bucket).

PART 3 - EXECUTION

3.01 INSTALLATION:

A. Motors: All motors and motor-driven equipment will be provided in place by another Trade, ready for connection by the Electrical Trade with control equipment provided by the Trade who provides the equipment unless specifically indicated otherwise. Motor branch circuits, etc., are designed for motor sizes as shown on the drawings. The motors and motor-driven equipment actually installed may vary from these sizes. The Electrical Trade shall verify actual sizes and notify the Engineer of any required changes.

B. Provide all required motor starters and motor protective switches, rated for the voltage encountered, complete with required poles, amperage rating and all accessories, unless indicated otherwise. Required motor starters may not be indicated on the electrical drawings. Refer to mechanical (and other divisions) equipment drawings and specifications for additional starter requirements, and provide starters as required. Provide all H.O.A. switches, L.E.D. pilots, auxiliary contacts, etc. in starters and M.P. Switches as required by Electric Sequence Control Diagrams. Provide all other control devices as called for by drawings and specifications. Provide "power available" and "run" L.E.D. indicating lights for all motor starters. The "power available" L.E.D. indicating lights are not necessarily indicated in the Electric Sequence Control Diagrams.

C. Variable Frequency Drives (VFD=s) (Furnished by Division 23):

1. The qualified manufacturer's technical representative shall supervise the contractor's installation, testing, and start-up of all the drives furnished under Division 23. A maximum total of one (1) supervision day (8 hours) shall be provided by the manufacturer's representative.

2. Division 26 shall provide assistance to Division 23 for system start-up. The VFD system start-up shall include a checkout of vibration at various frequencies through field observation and manufacturer’s data on the driven equipment. Frequency deadbands shall be set-up for each point of equipment vibration.

D. Responsibility: The Mechanical Trade is responsible for the proper operation of the mechanical systems. The Electrical Trade is responsible for all electrical work in connection therewith.

E. Provide a motor protective switch in the cabinet of wall mounted unit heaters or fan coil units; and on one side of ceiling mounted units unless indicated otherwise. Position the switch to prevent the radiation from affecting the overload protection.

F. Motor Operated Dampers (MOD’s): Division 26 shall interconnect all line voltage MOD’s with Division 23 air-handling units and fans with proper voltage and ampacity wiring for sequence of operation as required by the Mechanical Drawings. Provide a 120 volt – 20 amp circuit from the next available spare breaker in the closest mechanical or receptacle circuit panel where a circuit is not specifically indicated on the drawings. MOD’s may be connected as part of the motor control circuit, verify with the Division 23 Electric Sequence Control Diagrams.

G. Phase Loss Protection Relays shall be provided for the following three (3) phase equipment:

a. All three (3) phase equipment as indicated to have "PLP" contacts on the Division 23 Electric Sequence Control Drawings. Select the monitor (relay) for the line voltage encountered.

b. All three (3) phase (walk-in) refrigerators and (walk-in) freezers as instructed by Kitchen Equipment Installing Trade.

c. All three (3) phase motors 10hp and larger.

d. All Division 23 Variable Speed Drives.

Phase loss protection relays shall be installed in the Division 26 motor starter **oversized** enclosures.

H. All motor starters shall be provided with sound isolation mounting when mounted adjacent to an occupied space such as corridor, office, classroom, auditorium, gym or similar space.

I. Install all motor protective switches adjacent to the panelboard serving the switch unless indicated otherwise on the drawing or Division 23 Electric Sequence Controls. Each switch shall be installed in an individual outlet box, arranged in vertical or horizontal rows. Provide recessed outlet boxes if the adjacent panel is recessed. Provide **cast type** single gang boxes if the adjacent panel is surface mounted.

J. Certain multi-speed fractional horsepower motors are indicated on the Division 23 Electric Sequence Drawings to have built-in overload protection in the motor in lieu of motor protective switches.

K. Provide interposing (interface) relays for the Division 23 microprocessor based building control system module relay output (and Section 28 31 00 Fire Detection and Alarm) if the system's output relay contact is overburdened.

L. All wiring within the motor starter (control) enclosure and to the motor shall be Type MTW stranded copper per Section 26 05 19 and Section 26 05 23.

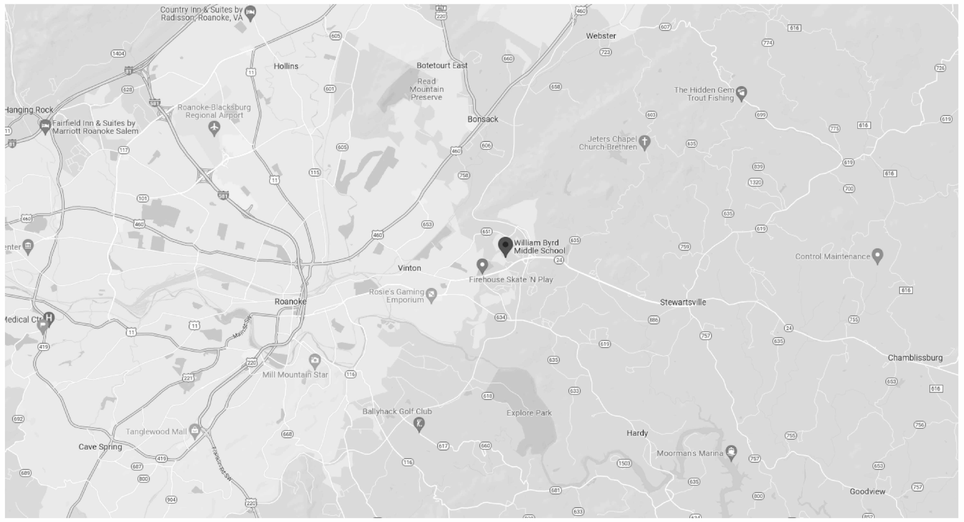
M. Division 23 will furnish power factor correction capacitors with their motors over five (5) horsepower unless otherwise indicated. Division 26 shall install and connect these capacitors to cycle with the motors. The capacitors shall be connected on the motor side of the overcurrent protective device at the motor starter. The overcurrent device shall be adjusted to reflect the reduced line current. Size capacitor conductors per NEC Article 460.

END OF SECTION

WILLIAM BYRD MS - BOILER REPLACEMENT

ROANOKE COUNTY PUBLIC SCHOOLS

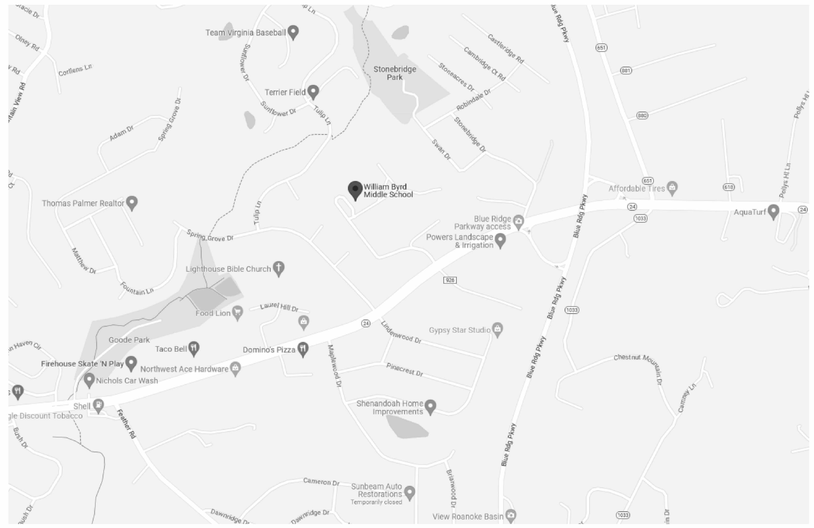
2910 E Washington Ave, Vinton, VA
24179



VICINITY MAP

MAP BY GOOGLE MAPS

DRAWING LIST	
SHEET NUMBER	SHEET NAME
ME001	MECHANICAL & ELECTRICAL CONTROLS, LEGENDS, DETAILS, SCHEDULES & NOTES
ME101	MECHANICAL & ELECTRICAL DEMOLITION PLAN
ME201	MECHANICAL & ELECTRICAL NEW WORK PLAN
P001	PLUMBING LEGEND, SCHEDULES, NOTES & DETAILS
P101	PLUMBING FLOOR PLAN - DEMOLITION
P201	PLUMBING FLOOR PLAN - DOMESTIC WATER AND GAS



LOCATION MAP

MAP BY GOOGLE MAPS

ASCENT
ENGINEERING GROUP

5228 VALLEYPOINTE PKWY, SUITE 4
ROANOKE, VIRGINIA 24019
(540) 265-4444

AEG COMM # 23070

04/26/2023

MECHANICAL SEQUENCES AND CONTROLS

CONTROL LEGEND

HOLDING COILS — COMBINATION FUSIBLE MOTOR STARTER RELAY
MOTOR
MOTOR PROTECTIVE SWITCH
DISCONNECT SWITCH (FUSED)
DISCONNECT
PILOT LIGHT
T'STAT OR RELAY
SET POINT-CLOSE BELOW 65°F — 65°F
SET POINT-CLOSE ABOVE 65°F — 65°F
ELECTRICAL WIRING, ABOVE 100 VOLT — PW
TWIST SHIELDED PAIR, 24 VOLT
DDC SENSOR (GENERIC)

AIRFLOW MEASURING STATION	AF	FREEZE PROTECTION FIRESTAT	FP FS
ANALOG INPUT	AI	FIRE ALARM SYSTEM	F.A.
ANALOG OUTPUT	AO	GAS HEATER	GH
CARBON DIOXIDE SENSOR	CO2	HEATING COIL	HC
CONTROL RELAY	CR	HOT GAS REHEAT COIL	HG
COOLING COIL	CC	HUMIDITY SENSOR	HE
CURRENT RELAY	CTR	PHASE LOSS PROTECTION	PLP
DIGITAL INPUT	DI	START-STOP	S/S
DIGITAL OUTPUT	DO	SMOKE DETECTOR	SD
DIRECT DIGITAL CONTROL PANEL	DDC	TEMP SENSOR	TE
DIRECT EXPANSION COIL	DX		
ELECTRIC COIL	EHC		
FAN RELAY	FR		

ALL ITEMS SHOWN ON CONTROL DIAGRAMS AND WIRING 100 VOLTS OR LESS SHALL BE INCLUDED AS A PART OF SECTION 230900 EXCEPT POWER WIRING OVER 100 VOLTS, ITEMS MARKED ▲ OR ITEMS SPECIFIED TO BE FURNISHED WITH EQUIPMENT. WIRING OVER 100 VOLTS AND ITEMS MARKED ▲ SHALL BE FURNISHED AS A PART OF DIVISION 26. ALL OVERLOADS, HOA SWITCHES, AUXILIARY CONTACTS AND PILOT LIGHTS SHALL BE INTEGRAL WITH THE MOTOR STARTERS UNLESS SHOWN OTHERWISE.

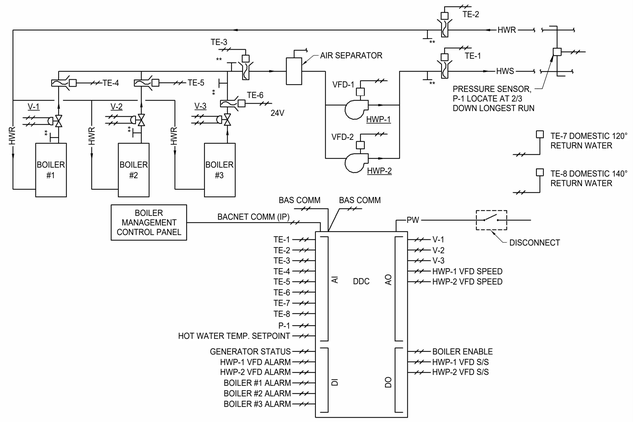
ALL WIRING SHOWN ON ELECTRIC SEQUENCE CONTROLS SHALL BE OVER 100 VOLTS UNLESS NOTED OTHERWISE. RELAYS FROM THE CONTROL SYSTEM SHALL BE LOCATED ADJACENT TO THE CONTROLLED DEVICE (MOTOR OR MOTOR STARTER), AND MAY BELOCATED WITHIN STARTER HOUSINGS WHERE SPACE IS AVAILABLE AND WHERE APPROVED BY NEC.

ALL SEQUENCES OF OPERATION, FLOW DIAGRAMS, AND POINTS LIST ARE COMPLEMENTARY. ALL CONTROL STRATEGIES SHALL BE SATISFIED EVEN IF SOME OF THE REQUIRED CONTROL POINTS, ALARM, OR SOFTWARE HAVE BEEN INADVERTENTLY LEFT OFF OF THE POINTS LIST OR FLOW DIAGRAM. SIMILARLY, CONTROL POINTS, ALARM, AND SOFTWARE STRATEGIES INDICATED ON THE POINTS LIST SHALL BE PROVIDED EVEN IF A WRITTEN SEQUENCE OR FLOW DIAGRAM DEVICE HAS BEEN INADVERTENTLY OMITTED.

CONTROL ITEMS MARKED THUS "VENTILATION-ON-OFF" SHALL HAVE PLATE ENGRAVED WITH THE WORDING CONTAINED WITHIN THE QUOTE "..." MARKS PLUS EQUIPMENT IDENTIFICATION.

*QTY AS REQUIRED/INDICATED ON PLANS.

**P/T PORT PROVIDED BY DIV. 23. INSTALLED BY DIV. 23. INSTALL WITHIN 6" OF ASSOCIATED SENSOR.



HEATING WATER SYSTEM

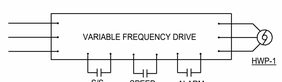
BOILERS SHALL BE CONNECTED TO CONTROL SYSTEM BACNET INTERFACE.

SEQUENCE OF OPERATION:

A. AT A PREDETERMINED OUTSIDE AIR TEMPERATURE, OR ON A CALL OR HEATING, OR ON A CALL FOR DEHUMIDIFICATION, THE DDC SHALL ENERGIZE THE BUILDING HEATING WATER PUMP, HWP-1 OR HWP-2, BASED ON RUN HOURS AND ENABLE THE BOILER SYSTEM THROUGH THE BOILER ON-BOARD CONTROLS. WHEN THE BUILDING HEATING WATER PUMP IS ENERGIZED, THE DDC SHALL SLOWLY RAMP UP THE SPEED THROUGH ITS VFD AND CONTROL TO MAINTAIN A CONSTANT DIFFERENTIAL PRESSURE AS SENSED BY P-1 LOCATED 2/3 DOWNSTREAM OF LONGEST PIPE RUN. THE DDC SHALL PROVIDE AN OUTSIDE AIR SIGNAL THROUGH THE BACNET LINK FOR HEATING WATER TEMPERATURE RESET, ACCORDING TO THE FOLLOWING SCHEDULE.

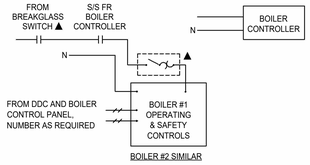
OUTSIDE AIR TEMP., °F	HWS TEMP., °F
25 AND BELOW	180
35	170
45	160
55	150
65	140
75 AND ABOVE	130

B. AT ANY TIME THE LEAD BOILER IS UNABLE TO MAINTAIN SUPPLY WATER TEMPERATURE FOR 45 MINUTES, AS SENSED BY TE-3, THE DDC SHALL ENERGIZE THE SECOND BOILER. TE-2 SENSES HEATING WATER RETURN TEMPERATURE. TE-4 AND TE-5 SENSE INDIVIDUAL BOILER SUPPLY TEMPERATURE. CURRENT RELAYS, CTR-1 AND CTR-2, SHALL VERIFY PUMP STATUS FOR HWP-1 AND HWP-2 RESPECTIVELY. THE DDC SHALL ENERGIZE THE STANDBY DUTY PUMP UPON FAILURE OF THE DUTY PUMP AND ALARM THE DDC. AT ANY TIME THE HEATING WATER PUMP(S) ARE DE-ENERGIZED, THE BOILER(S) SHALL BE DE-ENERGIZED. MINIMUM BOILER-OFF TIME SHALL BE ONE (1) HOUR. THE BOILER SAFETY CONTROL STATUS SHALL BE TRANSMITTED TO THE DDC FOR ALARM PURPOSES.
C. SYSTEM MONITORING: IN ADDITION TO ALL POINTS LISTED ABOVE, THE DDC SHALL MONITOR SYSTEM SUPPLY WATER TEMPERATURE; BOILER SUPPLY WATER TEMPERATURES; RETURN WATER TEMPERATURE; BOILER SUPPLY HEADER TEMPERATURE; DOMESTIC 120° RETURN WATER TEMPERATURE; DOMESTIC 140° RETURN WATER TEMPERATURE; VFD ALARMS; BOILER ALARMS.
D. MINIMUM FLOW CONTROL: AT ANY TIME THE PUMPS ARE ENERGIZED, AT LEAST ONE BOILER ISOLATION VALVE SHALL BE OPEN.
E. PUMP RUN TIMES: MINIMUM PUMP"ON" TIME SHALL BE 20 MINUTES (ADJUSTABLE). MINIMUM PUMP"OFF" TIME SHALL BE 20 MINUTES (ADJUSTABLE).
F. THE BOILER CONTROLLER SHALL SEQUENCE THE BOILERS IN A PARALLEL ARRANGEMENT.
G. THE BOILER CONTROLLER SHALL OPEN AND CLOSE ASSOCIATED ISOLATION VALVE WITH FIRING OF EACH BOILER.



PUMPS

HWP-2 SIMILAR



BOILER #2 SIMILAR

BOILERS

PUMPS - BELL & GOSSETT											
MARK	MAX. CAP., GPM	MIN. CAP., GPM	HEAD, FT. H2O	HP	MAX. BHP	MODEL	SERIES	SYSTEM / AREA SERVED	MCA, A	MOCP, A	VOLTAGE, V
HWP-1	641	133	92	20	17.7	4EB	e-1510	BUILDING HOT WATER DISTRIBUTION	24	30	480
HWP-2	641	133	92	20	17.7	4EB	e-1510	BUILDING HOT WATER DISTRIBUTION	24	30	480

HOT WATER BOILERS - FULTON										
MARK	MODEL NO.	INPUT CAPACITY, MBH	OUTPUT CAPACITY, MBH	FUEL USAGE, CFH	WATER VOLUME, GAL	MIN. GAS PRESSURE IN. W.C.	MINIMUM AHRI THERMAL EFF., %	MINIMUM TURNDOWN	MCA, A	MOCP, A	VOLTAGE, V
B-1	EDR-2000	2000.0	1874.0	1961	187	4	93.7	15:1	25	35	120
B-2	EDR-2000	2000.0	1874.0	1961	187	4	93.7	15:1	25	35	120
B-3	EDR-2000	2000.0	1874.0	1961	187	4	93.7	15:1	25	35	120

COALESCING AIR REMOVAL SEPARATOR - BELL & GOSSETT		
MARK	MAX FLOW, GPM	MODEL
AS-1	641	CRS-8F

EXPANSION TANKS - BELL & GOSSETT						
MARK	CAPACITY, GAL.	ACCEPTANCE VOL., GAL.	MODEL	DIMENSIONS, IN. D/A x HEIGHT	QUANTITY	WET WEIGHT, LBS.
ET-1	17.5	0.65	B1200	DIAPHRAGM	1	3320

BUILDING LOAD SUMMARY			
TOTAL HEATING REQUIREMENTS			
TRANSMISSION HEAT LOSS	=	1,650	MBH
VENTILATION AIR	=	3,290	MBH
TOTAL	=	4,940	MBH
HEATING INSTALLED			
COMBINED NEW BOILER CAPACITY	=	6,000	MBH
EXISTING GAS HEATERS	=	750	MBH
TOTAL INSTALLED CAPACITY	=	6,750	MBH

PHASING NOTES:

GENERAL: THIS IS AN OCCUPIED BUILDING DURING THE SCHOOL SEASON. THE CONTRACTOR SHALL HAVE ACCESS TO THE BUILDING IN A LIMITED, NON-INTRUSIVE MANNER FROM NOTICE TO PROCEED UNTIL STUDENTS RETURN TO THE BUILDING FOR THE 2023-2024 SCHOOL SEASON. OTHER ACCESS MAY BE OBTAINED AS APPROVED IN ADVANCE BY THE OWNER. OPENING THE BUILDING ENVELOPE FOR REMOVAL OF THE DEMOLISHED EQUIPMENT AND INSERTION OF NEW EQUIPMENT SHALL HAVE RESTRICTED ACCESS TO PROTECT THE STUDENTS, PUBLIC, BUILDING COMPONENTS, AND RCPS PERSONNEL IN A MANNER APPROVED BY THE OWNER. WORK IN MECHANICAL ROOM MAY BE ACCOMPLISHED AT ANY TIME APPROVED BY THE OWNER WITHIN THE PROJECT TIMELINE, BUT SHALL NOT AFFECT NORMAL HEATING, COOLING, OR VENTILATION OF THE BUILDING DURING OCCUP[IED PERIODS.

CONTRACTOR SHALL MAINTAIN SEPARATION OF WORK AREA AT ALL TIMES FROM THE REST OF THE BUILDING.

OWNER SHALL BE GIVEN TWO WEEKS NOTICE TO MOVE ANY EQUIPMENT AND STORAGE OUT OF THE AREAS OF WORK. OWNER'S MATERIALS WILL NOT BE RELOCATED BACK INTO COMPLETED AREAS UNTIL PUNCH LIST WORK HAS BEEN COMPLETED.

CONTRACTOR SHALL COORDINATE DELIVERIES, SUBCONTRACTOR PARKING AND OTHER SIMILAR ACTIVITIES THAT MAY OTHERWISE IMPEDE THE OWNER'S USE OF THE SCHOOL.

CONTRACTOR SHALL MAINTAIN ALL UTILITIES TO THE BUILDING THROUGHOUT CONSTRUCTION. SHUT DOWNS SHALL BE SCHEDULED WITH THE OWNER 72 HOURS IN ADVANCE.

IMPORTANT DATES:
FINAL TEACHER WORK DAY - 05/26/2023
TEACHERS RETURN - 08/01/2023
STUDENTS RETURN - 08/09/2023

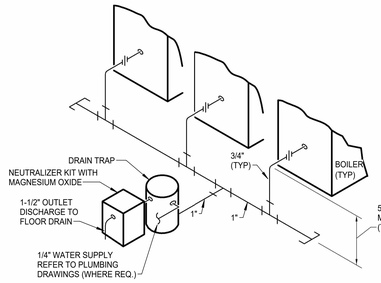
DATES LISTED ABOVE ARE BASED ON THE BEST AVAILABLE INFORMATION AT THE TIME OF BIDDING. THROUGH SCHEDULE CHANGES OR UNFORSEEN EVENTS, THESE DATES MAY BE ADJUSTED BY THE SCHOOL SYSTEM.

GENERAL EQUIPMENT NOTES:

1. BOILER LEAVING WATER TEMPERATURE SHALL BE 180°F.
2. ALL PUMPS SHALL BE SUITABLE FOR USE WITH A VARIABLE FREQUENCY DRIVE.
3. ALL PUMP MOTORS SHALL BE 1750 RPM.

COORDINATION NOTES:

ALL DUCTWORK AND PIPES SHALL BE COORDINATED WITH ALL OTHER DUCTS, PIPIES, LIGHTS, STRUCTURAL SYSTEMS, CEILING SUPPORTS AND FRAMING PRIOR TO INSTALLATION. MINOR OFFSETS AND TRANSITIONS SHALL BE PROVIDED AS REQUIRED. WHERE TRANSITIONS ARE REQUIRED, CROSS SECTIONAL AREA OF DUCT SHALL NOT BE REDUCED. MEASUREMENTS FOR VERTICAL CLEARANCES OF BOILER EXHAUST AND OA INTAKES SHALL BE TAKEN AT THE JOB SITE BEFORE FABRICATION OF ANY DUCT.



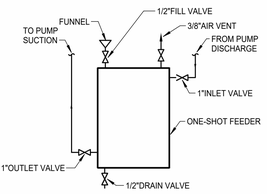
NOTES:

1. PIPING MATERIAL SHALL BE AS RECOMMENDED BY MANUFACTURER.
2. PIPING SHALL BE PITCHED DOWNWARD TO TRAP.

BOILER CONDENSATE PIPING DETAIL

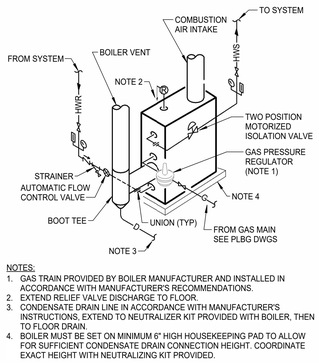
SCHEMATIC

SYSTEM	AFF TOP OF OUTLET UNLESS NOTED	ELECTRICAL SYMBOLS	
		SYMBOL	DESCRIPTION
BOXES AND WIRING			ELECTRIC MOTOR
			CONDUIT ABOVE CEILING OF AREA WHERE SHOWN
	5'-0"	VFD	VARIABLE FREQUENCY DRIVE, BY DIVISION 23.
	5'-0"	MP	MOTOR PROTECTIVE SWITCH W/PILOT AND HEATER(S)
		JB	JUNCTION BOX
	AS NOTED		125V, 3W, 20A, 2P, 1∅ DUPLEX RECEPTACLE, WALL, HEAVY DUTY COMMERCIAL — 5362 TYPE — NEMA 5-20R
DEMOLITION			MOTOR TO BE REMOVED
		VFD	VARIABLE FREQUENCY DRIVE (VFD) TO BE REMOVED
		MS	MOTOR STARTER TO BE REMOVED
		MP	MOTOR PROTECTIVE SWITCH TO BE REMOVED
		VFD E	VARIABLE FREQUENCY DRIVE TO REMAIN
		E	SURFACE MOUNTED PANELBOARD TO REMAIN



CHEMICAL FEEDER DETAIL

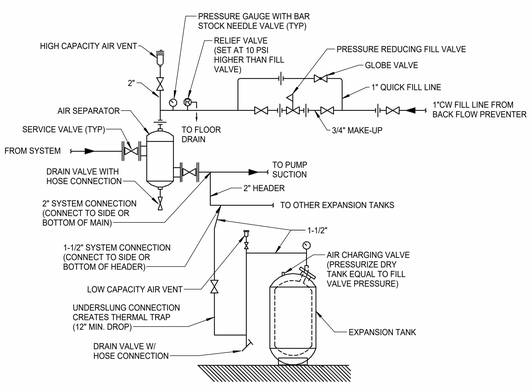
SCHEMATIC



NOTES:
1. GAS TRAIN PROVIDED BY BOILER MANUFACTURER AND INSTALLED IN ACCORDANCE WITH MANUFACTURER'S RECOMMENDATIONS.
2. EXTEND RELIEF VALVE DISCHARGE TO FLOOR.
3. CONDENSATE DRAIN LINE IN ACCORDANCE WITH MANUFACTURER'S INSTRUCTIONS, EXTEND TO NEUTRALIZER KIT PROVIDED WITH BOILER, THEN TO FLOOR DRAIN.
4. BOILER MUST BE SET ON MINIMUM 6" HIGH HOUSEKEEPING PAD TO ALLOW FOR SUFFICIENT CONDENSATE DRAIN CONNECTION HEIGHT. COORDINATE EXACT HEIGHT WITH NEUTRALIZING KIT PROVIDED.

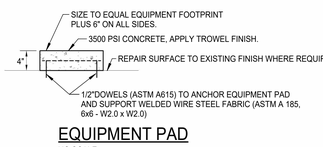
BOILER CONNECTIONS

SCHEMATIC



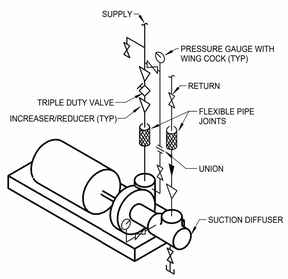
EXPANSION TANK DETAIL

SCHEMATIC



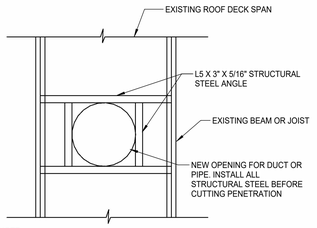
EQUIPMENT PAD

NO SCALE



PUMP CONNECTIONS

NO SCALE



NOTE:
1. SHIM DECK AS REQUIRED FOR FULL SUPPORT AND TO PREVENT FLEXING OF ROOF DECK.
2. FULLY WELD ALL STEEL ANGLE JUNCTIONS.

STRUCTURAL DECK SUPPORT AT ROOF PENETRATION DETAIL

NO SCALE

LEGEND

HEATING WATER SUPPLY	HWS
HEATING WATER RETURN	HWR
CONDENSATE DRAIN	D
COLD WATER	CW
GAS	G
BOILER BLOW-OFF	BBO
VENT	V
SERVICE VALVE	
BALANCING COCK	
STRAINER	
CHECK VALVE	
RELIEF VALVE	
GLOBE VALVE	
CONTROL VALVE	
GAUGE	
THERMOMETER	
DRIP STATION	DS
FILL VALVE	
REDUCING VALVE	RV
DIRECTION OF SLOPE DOWN	
DIRECTION OF FLOW	
ANCHOR	
PIPE GUIDE	
ACOUSTIC LINED DUCT (DOUBLE LINE)	
ACOUSTIC DUCT/EQUIPMENT LAGGING	
DUCT TRANSITION	
WATERTIGHT DUCT	
FABRIC DUCT	
CONNECT TO EXISTING	
EXTENT OF DEMOLITION	
NEW WORK	
EXISTING WORK TO REMAIN	
EXISTING WORK TO BE REMOVED	

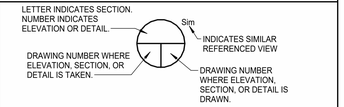
STANDARD ABBREVIATIONS

ø	DIAMETER	HP	HORSEPOWER
x/x	FLAT OVAL	HR	HOUR
ABV	ABOVE	HZ	HERTZ
AFF	ABOVE FINISHED FLOOR	IN	INCH(ES)
APD	AIR PRESSURE DROP	KW	KILOWATTS
ARRGMT	ARRANGEMENT	LAT	LEAVING AIR TEMPERATURE
AUTO	AUTOMATIC	LBS	POUNDS
AAV	AUTOMATIC AIR VENT	LVD	LOW VOLTAGE MOTOR OPERATED DAMPER
AUX	AUXILIARY	LWT	LEAVING WATER TEMPERATURE
BEL	BELOW	MAV	MANUAL AIR VENT
BTU	BRITISH THERMAL UNIT	MAX	MAXIMUM
BTUH	BTU PER HOUR	MBH	THOUSAND BTU PER HOUR
CAP	CAPACITY	MECH	MECHANICAL
CFM	CUBIC FEET PER MINUTE	MFG	MANUFACTURER
CMU	CONCRETE MASONRY UNIT	MIN	MINIMUM
CO	CLEANOUT	MOD	MOTOR OPERATED DAMPER (LINE VOLTAGE)
CONC	CONCRETE	MP SW	MOTOR PROTECTIVE SWITCH
CONN	CONNECT	MTD	MOUNTED
CONT	CONTINUATION	MVD	MANUAL VOLUME DAMPER
CR	CONTROL RELAY	NC	NORMALLY CLOSED
CRD	CEILING RADIATION DAMPER	NIC	NOT IN CONTRACT
CTR	CURRENT RELAY	NO	NORMALLY OPEN
CW	COLD WATER	NTS	NOT TO SCALE
DB	DRY BULB	OA	OUTSIDE AIR
dB	DECIBEL	OAT	OUTSIDE AIR TEMPERATURE
DDC	DIRECT DIGITAL CONTROL	OBD	OPPOSED BLADE DAMPER
DIM	DIMENSIONS	OCC	OCCUPANCY or OCCUPIED
DISC	DISCONNECT SWITCH	PD	PRESSURE DROP
DP	DOUBLE POLE	PLP	PHASE LOSS PROTECTION
DN	DOWN	RA	RETURN AIR
EXST	EXISTING	RECT	RECTANGULAR
EA	EACH	SDR	DUCT SMOKE DETECTOR
EAT	ENTERING AIR TEMPERATURE	SDPR	SMOKE DAMPER
ELEC	ELECTRIC	SS	STAINLESS STEEL
EQUIP	EQUIPMENT	S/S	START-STOP
ENT	ENTERING	SUSP	SUSPENDED
EWT	ENTERING WATER TEMP	SW	SWITCH
ESP	EXTERNAL STATIC PRESSURE	TEMP	TEMPERATURE
EXST	EXISTING	TYP	TYPICAL
°F	FAHRENHEIT	V	VOLT
FA	FIRE ALARM	VERT	VERTICAL
FDPR	FIRE DAMPER	W	WATTS
FSDPR	COMBINATION FIRE/SMOKE DAMPER	WB	WET BULB
FIN FL	FINISHED FLOOR	WC	WATER COLUMN
FL	FLOOR	WG	WATER GAUGE
FLA	FULL LOAD AMPS	WS	WATER STOP
FP	FREEZE PROTECTION	WT	WEIGHT
FR	FROM or FAN RELAY	w/	WITH
FS	FIRESTAT		
FT	FEET		
GAL	GALLONS		
GPM	GALLONS PER MINUTE		
H20	WATER COLUMN or WATER GAUGE		
HOA	HAND-OFF-AUTOMATIC		

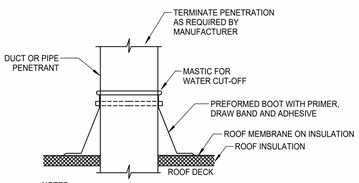
COORDINATION NOTE

ALL DUCTWORK AND PIPES SHALL BE COORDINATED WITH OTHER DUCTS, PIPES, LIGHTS, STRUCTURAL SYSTEM, CEILING SUPPORTS AND FRAMING BEFORE INSTALLATION. MINOR DUCT OFFSETS AND TRANSITIONS SHALL BE PROVIDED AS REQUIRED. WHERE TRANSITIONS ARE REQUIRED, CROSS SECTIONAL AREA OF DUCT SHALL NOT BE REDUCED. MEASUREMENTS FOR VERTICAL CLEARANCES OF DUCTWORK SHALL BE TAKEN AT THE JOB SITE BEFORE FABRICATION OF ANY DUCTWORK.

IDENTIFICATION KEY



SECTION, ELEVATION, OR DETAIL SYMBOL



NOTES:
1. SUPPLEMENTAL WIND BRACING MAY BE REQUIRED ON TALLER PENETRATIONS.
2. ROOF MAUFACTUER'S INSTRUCTIONS FOR MAINTAINING WARRANTY SHALL SUPERCEED DETAIL REQUIREMENTS.

ROOF PENETRATION DETAIL

NO SCALE

ASCENT
ENGINEERING GROUP
5228 VALLEYPOINTE PKWY, SUITE 4
ROANOKE, VIRGINIA 24019
(540) 265-4444

COMMONWEALTH OF VIRGINIA — Boyd G. Headley III — BOYD G. HEADLEY III — Lic No.021922 — 04/26/2023 — PROFESSIONAL ENGINEER

COMMONWEALTH OF VIRGINIA — Randall O. Spencer — RANDALL O. SPENCER — Lic No.029321 — 04/26/2023 — PROFESSIONAL ENGINEER

ROANOKE COUNTY PUBLIC SCHOOLS

WILLIAM BYRD MS - BOILER REPLACEMENT

2910 E Washington Ave, Vinton, VA 24179

PROJECT NUMBER: 23070
ISSUE DATE: 04/26/2023
DESIGNER: JDC
CHECKED BY: BGH

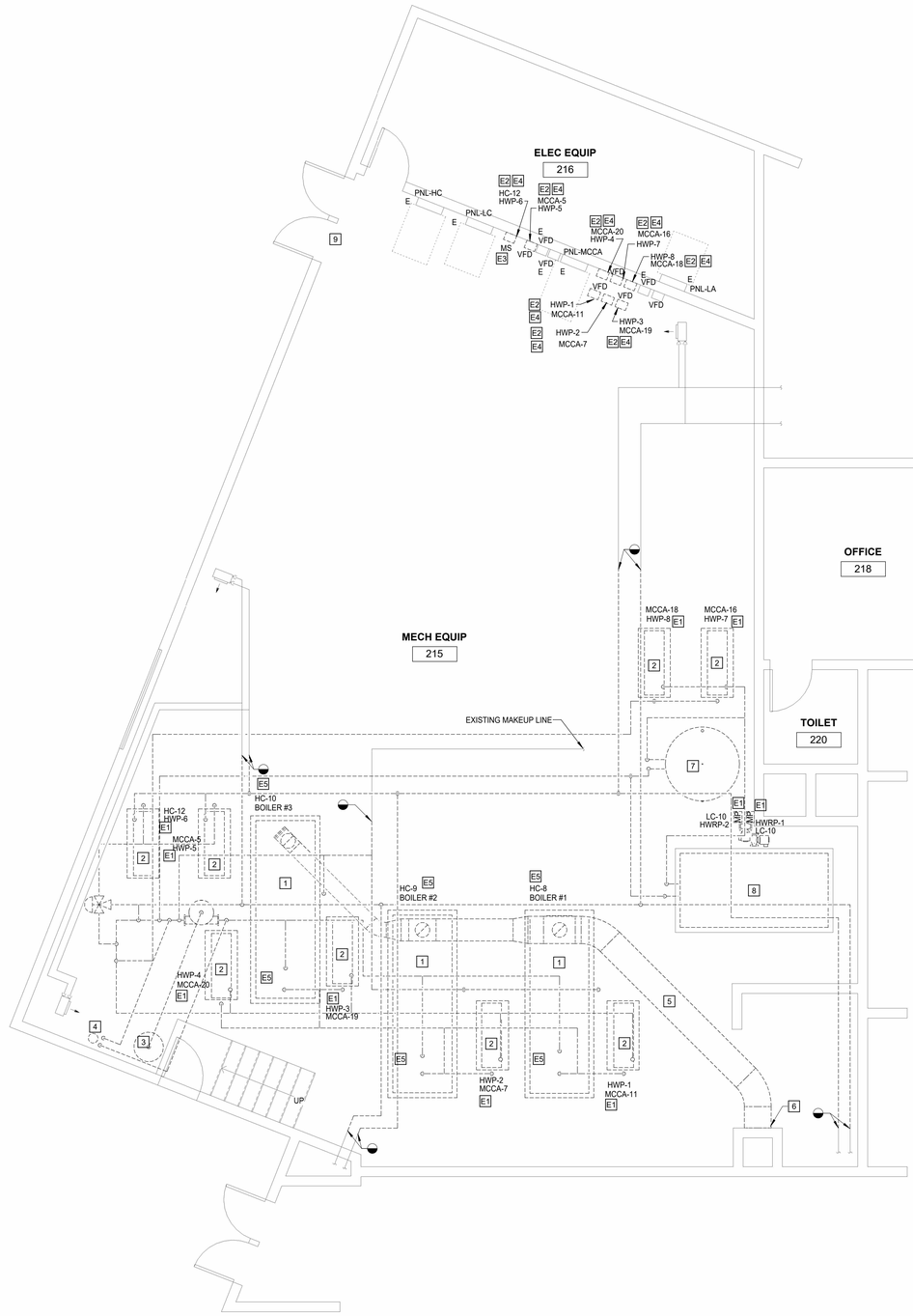
REVISIONS:

No.	DATE	DESCRIPTION

100% CONSTRUCTION DOCUMENTS

SHEET TITLE:
MECHANICAL & ELECTRICAL CONTROLS, LEGENDS, DETAILS, SCHEDULES & NOTES

SHEET NUMBER:
ME001



1 ME101 MECHANICAL DEMOLITION PLAN
SCALE: 1/4" = 1'-0"

GENERAL DEMOLITION NOTES:

1. WHERE EXISTING PIPES AND DUCTS ARE REMOVED FROM EXISTING SYSTEMS AND THE RUNOUT IS NOT REUSED, THE RUNOUT SHALL BE CAPPED AT THE TAKEOFF FROM THE MAIN TO PRESERVE THE INTEGRITY OF THE SYSTEM AS A WHOLE. ALL INSULATION SHALL BE PATCHED TO MATCH EXISTING.

SHEET NOTES:

1 DEMOLISH EXISTING BOILER, CONTROLS, AND PIPING RUNOUT TO EXTENT INDICATED. DEMOLISH EXISTING EQUIPMENT/HOUSEKEEPING PAD.

2 DEMOLISH EXISTING PUMP, CONTROLS, AND PIPING RUNOUT TO EXTENT INDICATED. DEMOLISH EXISTING EQUIPMENT/HOUSEKEEPING PAD.

3 DEMOLISH EXISTING EXPANSION TANK AND PIPING TO EXTENT INDICATED.

4 REMOVE EXISTING HOT WATER SYSTEM CHEMICAL FEEDER AND PIPING TO EXTENT INDICATED. PREPARE ASSOCIATED PIPING FOR CONNECTION TO NEW FEEDER.

5 DEMOLISH EXISTING BOILER EXHAUST FLUE.

6 PATCH FLUE PENETRATION AIR TIGHT TO MATCH EXISTING.

7 DEMOLISH EXISTING WATER HEATER, CONTROLS, AND PIPING TO EXTENT INDICATED. REFER TO PLUMBING PLANS FOR FURTHER REQUIREMENTS.

8 DEMOLISH EXISTING WATER STORAGE TANK, CONTROLS, AND PIPING TO EXTENT INDICATED. REFER TO PLUMBING PLANS FOR FURTHER REQUIREMENTS.

9 CONTRACTOR SHALL REMOVE EXISTING EQUIPMENT THROUGH EXISTING DOUBLE DOOR. CENTER MULLION MAY BE REMOVED AND REINSTALLED FOR EASE OF PASSAGE THROUGH THE DOORS.

GENERAL ELECTRICAL DEMOLITION NOTES:

1. POWER CIRCUITS BEING REMOVED FROM SERVICE SHALL BE SPARED AND MARKED AS SPARE IN RESPECTIVE PANELBOARDS (HC, MCCA, AND LC). PANELBOARD INDEX CARDS SHALL BE REPLACED WITH NEW CARDS INDICATING EXISTING CIRCUITS AND REVISED CIRCUITS.
2. ALL POWER CIRCUITS TO BE REMOVED SHALL HAVE ALL ELECTRICAL CONDUCTORS REMOVED AND CONDUITS CUT OFF AT FLOOR AND SEALED TO MATCH SURROUNDING FLOOR AND FINISH (CONCRETE).
3. ALL MOTOR STARTERS (MS) AND VARIABLE FREQUENCY DRIVES MARKED FOR REMOVAL (DASHED LINES) SHALL BE REMOVED AND TURNED OVER TO THE OWNER. IF OWNER DOES NOT WANT THEM, CONTRACTOR SHALL DISPOSE OF THEM.

ELECTRICAL DEMOLITION SHEET NOTES:

E1 DISCONNECT ELECTRICAL CIRCUIT FROM PUMP AND REMOVE WIRING BACK TO SERVING CONTROLLER AND PANELBOARD BREAKER. ALL EXPOSED CONDUITS SHALL BE REMOVED. ALL CONDUITS UNDER FLOOR SHALL BE CUT OFF AT FLOOR AND PATCH TO MATCH SURROUNDING FLOOR SURFACE.

E2 SPARE BREAKERS IN RESPECTIVE PANELBOARDS. TURN SPARE BREAKERS TO THE OFF POSITION.

E3 DISCONNECT AND REMOVE WALL MOUNTED MOTOR STARTER.

E4 DISCONNECT AND REMOVE WALL MOUNTED VARIABLE FREQUENCY DRIVE.

E5 DISCONNECT ELECTRICAL CIRCUIT FROM BOILER AND ASSOCIATED BOILER PUMP. REMOVE WIRING BACK TO SERVING PANELBOARD BREAKER. ALL EXPOSED CONDUITS SHALL BE REMOVED. ALL CONDUITS UNDER FLOOR SHALL BE CUT OFF AT FLOOR AND PATCH TO MATCH SURROUNDING FLOOR SURFACE.

E6 REMOVE MOTOR PROTECTIVE SWITCH (MP) FOR HOT WATER RECIRCULATION PUMPS (RWRP-1, 2). SPARE CIRCUIT AT PANELBOARD FOR REUSE. STOW WIRING ABOVE AREA FOR REUSE.

GRAPHIC SCALE

SCALE: 1/4" = 1'-0"

4' 2' 0 4' 8'

THESE DRAWINGS ARE BASED ON HISTORICAL DRAWINGS OF THE EXISTING BUILDING. CONTRACTOR SHALL VERIFY ALL CONDITIONS PRIOR TO FABRICATION OF SYSTEM. MODIFICATIONS SHALL BE MADE ONLY AFTER APPROVAL BY THE ENGINEER.

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ROANOKE COUNTY PUBLIC SCHOOLS

WILLIAM BYRD MS - BOILER REPLACEMENT

2910 E Washington Ave, Vinton, VA 24179

PROJECT NUMBER:
23070
ISSUE DATE:
04/26/2023
DESIGNER:
JDC
CHECKED BY:
BGH

REVISIONS:

No.	DATE	DESCRIPTION

100% CONSTRUCTION DOCUMENTS

SHEET TITLE:
MECHANICAL & ELECTRICAL DEMOLITION PLAN

SHEET NUMBER:
ME101

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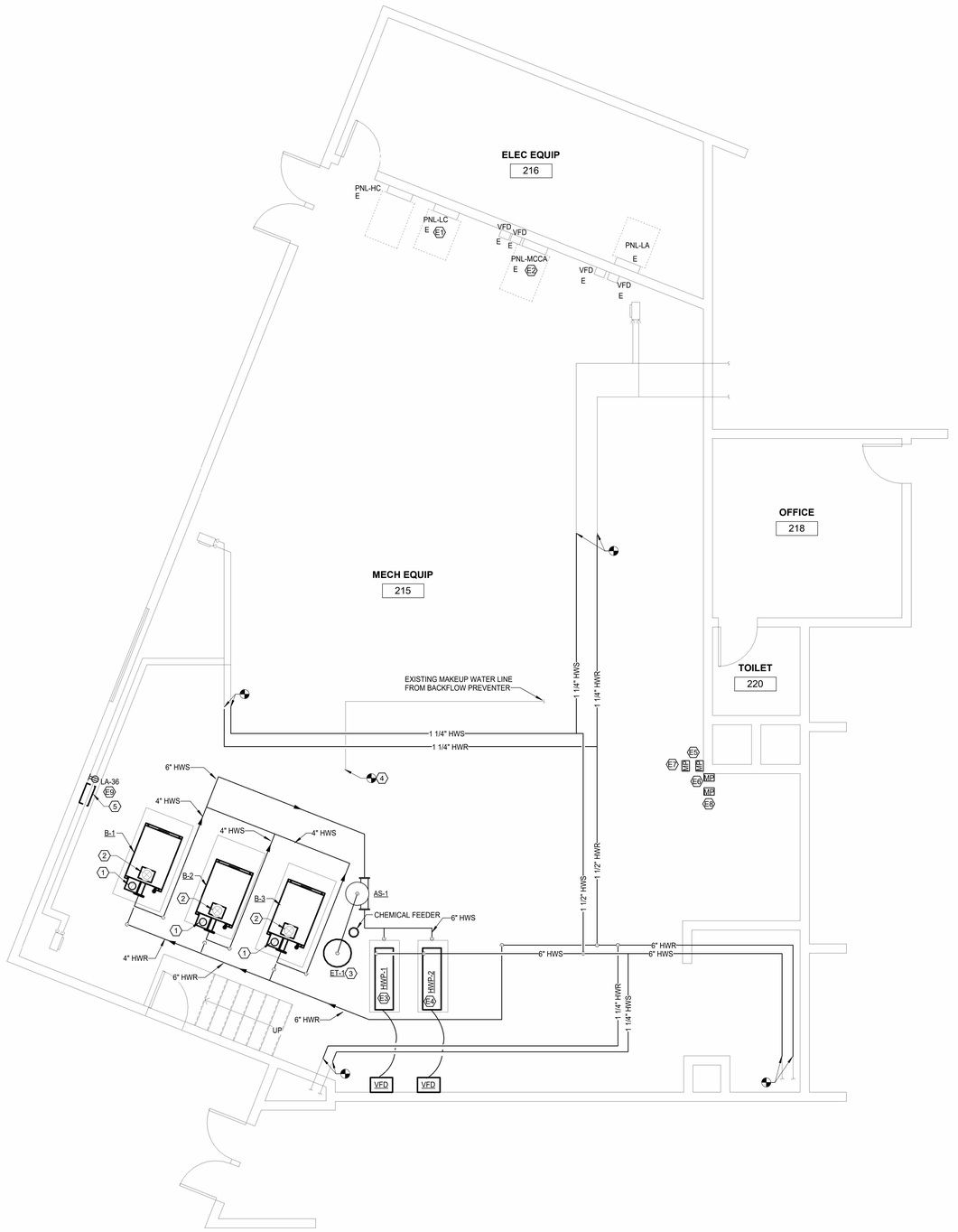
Autodesk Docs://23070 William Byrd MS Boiler Replacement/23070 MEP Central R23.rvt



1 ME201 MECHANICAL NEW WORK PLANS
SCALE: 1/4" = 1'-0"

GENERAL CONSTRUCTION NOTES:

1. ALL PENETRATIONS THROUGH WALLS SHALL BE SEALED.
2. REFER TO DIVISION 23 SPECIFICATIONS FOR TEMPORARY HEATING AND COOLING REQUIREMENTS.
3. SET ALL FLOOR MOUNTED EQUIPMENT ON CONCRETE PADS.

SHEET NOTES:

1. BOILER EXHAUST FLUE THRU ROOF. SIZE AND CAP AS REQUIRED BY MANUFACTURER. SLOPE AND MINIMUM HEIGHT OF VENTS SHALL BE IN ACCORDANCE WITH MANUFACTURER'S REQUIREMENTS.
2. BOILER OA INTAKE THRU ROOF. SIZE AND TERMINATE AS REQUIRED BY MANUFACTURER. MINIMUM HEIGHT OF OPENING AND SPACING FROM EXHAUST SHALL BE IN ACCORDANCE WITH MANUFACTURER'S REQUIREMENTS.
3. EXPANSION TANK ON FLOOR WITH CONCRETE PAD.
4. REFER TO EXPANSION TANK DETAIL FOR CONNECTION TO NEW EQUIPMENT.
5. BOILER COMMUNICATIONS CABINET PROVIDED WITH 120V AC OUTLET FOR COMMUNICATION SWITCH AND ACCESSORIES.

GENERAL ELECTRICAL NOTES:

1. ALL CONDUITS FOR NEW CIRCUITS SHALL BE FROM OVERHEAD AND NOT UNDER FLOOR.
2. LABEL ALL VARIABLE FREQUENCY DRIVES AND MOTOR PROTECTIVE SWITCHES WITH EQUIPMENT NAME SERVING AND PANELBOARD CIRCUIT BREAKER NUMBER SERVING EQUIPMENT.
3. PANELBOARD INDEX CARDS SHALL BE REPLACED WITH NEW CARDS INDICATING EXISTING CIRCUITS, REVISED CIRCUITS, AND NEW CIRCUITS.

ELECTRICAL SHEET NOTES:

E1. PROVIDE FOUR (4) 120V-1ø-20 AMP CIRCUIT BREAKERS OF MATCHING FRAME AND SIZE IN PANELBOARD LC IN POSITIONS 39, 40, 41, AND 42. CIRCUITS TO BE USED TO SERVE PLUMBING CIRCULATION PUMPS AND HOT WATER TANK CONTROLLERS.

E2. REMOVE TWO (2) 480V-3ø-20 AMP CIRCUIT BREAKERS IN PANELBOARD MCCA IN POSITIONS 5 AND 11. PROVIDE TWO (2) 480V-3ø-35 AMP BREAKERS OF MATCHING FRAME AND SIZE IN POSITIONS 5 AND 11. CIRCUITS TO BE USED TO SERVE HOT WATER PUMPS HWP-1 AND 2 AND DIVISION 23 VARIABLE FREQUENCY DRIVES.

E3. CONNECT CIRCUIT MCCA-11 TO PUMP HWP-1 WITH 3-#8 AND 1-#8 EGC IN 1" CONDUIT. ROUTE CONDUIT OVERHEAD, COLOR BAND CONDUIT, AND LABEL VOLTAGE.

E4. CONNECT CIRCUIT MCCA-5 TO PUMP HWP-2 WITH 3-#8 AND 1-#8 EGC IN 1" CONDUIT. ROUTE CONDUIT OVERHEAD, COLOR BAND CONDUIT, AND LABEL VOLTAGE.

E5. CONNECT CIRCUIT LC-39 TO HOT WATER RECIRCULATION PUMP 1 WITH 2-#12 AND 1-#12 EGC IN 3/4" CONDUIT. ROUTE CONDUIT OVERHEAD, COLOR BAND CONDUIT, AND LABEL VOLTAGE.

E6. CONNECT CIRCUIT LC-40 TO HOT WATER RECIRCULATION PUMP 2 WITH 2-#12 AND 1-#12 EGC IN 3/4" CONDUIT. ROUTE CONDUIT OVERHEAD, COLOR BAND CONDUIT, AND LABEL VOLTAGE.

E7. CONNECT CIRCUIT LC-41 TO HOT WATER TANK CONTROLLER 1 WITH 2-#12 AND 1-#12 EGC IN 3/4" CONDUIT. ROUTE CONDUIT OVERHEAD, COLOR BAND CONDUIT, AND LABEL VOLTAGE.

E8. CONNECT CIRCUIT LC-42 TO HOT WATER TANK CONTROLLER 2 WITH 2-#12 AND 1-#12 EGC IN 3/4" CONDUIT. ROUTE CONDUIT OVERHEAD, COLOR BAND CONDUIT, AND LABEL VOLTAGE.

E9. PROVIDE A 120V-1ø-20 AMP CIRCUIT BREAKER OF MATCHING FRAME AND SIZE IN EXISTING PANELBOARD LA IN SPACE ONLY POSITION 36. EXISTING PANEL LA IS LOCATED IN THE MAIN ELECTRICAL ROOM NEXT TO THE MECHANICAL ROOM. CONNECT CIRCUIT LA-36 TO BOILER COMMUNICATION CABINET MOUNTED ON WALL WITH 2-#12 AND 1-#12 EGC IN 3/4" CONDUIT. ROUTE CONDUIT OVERHEAD, COLOR BAND CONDUIT, AND LABEL VOLTAGE. LOCATE NEW 5-20 RECEPTACLE (HEAVY DUTY COMMERCAIL GRADE) JUST ABOVE BOILER COM CABINET.

GRAPHIC SCALE
SCALE: 1/4" = 1'-0"
4' 2' 0 4' 8'

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SHEET TITLE:
MECHANICAL & ELECTRICAL NEW WORK PLAN

SHEET NUMBER:
ME201

GAS-FIRED DOMESTIC WATER HEATERS

MARK	LOCATION	BASIS OF DESIGN	ASME CONSTR. (Y/N)	TEMPERATURE SETTING, °F	RECOVERY AT 100°F RISE (GPH)	WATER CONNECTION	GAS CONNECTION	INTAKE & EXHAUST CONNECTION	FUEL DATA				ELECTRICA DATA	
									TYPE	INPUT, MBH	OUTPUT, MBH	GAS PRESSURE, in. W.C.	VOLTAGE, V	PHASE
GWH-1	215 - MECH EQUIP	LOCHINVAR AWN286PM	Y	140	332	2"	3/4"	4" / 4"	NATURAL	286	273.6	7-10	120	1
GWH-2	215 - MECH EQUIP	LOCHINVAR AWN286PM	Y	140	332	2"	3/4"	4" / 4"	NATURAL	286	273.6	7-10	120	1

TEMPERING VALVE SCHEDULE

MARK	DESCRIPTION	INSTALLATION LOCATION	BASIS OF DESIGN	ASSE NO.	INLET CONNECTION	OUTLET CONNECTION	MAX PRESSURE DROP, PSI	AT FLOW RATE, GPM	MINIMUM FLOW RATE	TEMPERATURE SETTING, °F
TVM-1	MAIN TEMPERING VALVE MANIFOLD	MECH EQUIP 215	LEONARD TM-2020B-LF-DT	1017	2"	2"	10	113	1.0	120

DOMESTIC WATER THERMAL EXPANSION TANKS

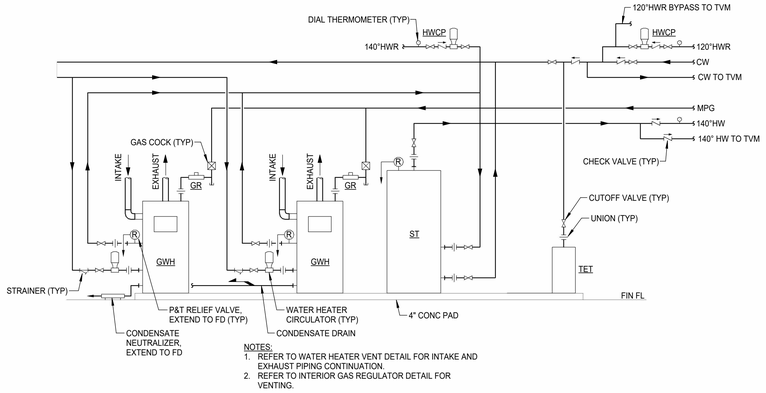
MARK	SYSTEM SERVED	MODEL	TANK TYPE	TANK VOLUME, GAL.	MAX ACCEPTANCE, GAL.	SYSTEM CONNECTION	PRECHARGED CAPACITY	STANDARD WORKING PRESSURE, PSIG	STANDARD OPERATING TEMPERATURE, °F
TET-1	GWH-1 & GWH-2	AMTROL ST-42V-C	DIAPHRAGM	17.5	0.65	3/4"	50	150	200

DOMESTIC HOT WATER CIRCULATING PUMPS

MARK	SYSTEM	BASIS OF DESIGN	TYPE	CAPACITY, GPM	PUMP HEAD, FT H20	CONNECTION SIZE	MOTOR DATA	
							VOLTAGE, V	PHASE
HWCP-1	120° DOMESTIC HW SYSTEM	B&G ECOCIRC 55-45	IN-LINE	10	13	1"	120	1
HWCP-2	140° DOMESTIC HW SYSTEM	B&G ECOCIRC 20-35	IN-LINE	1	9	3/4"	120	1

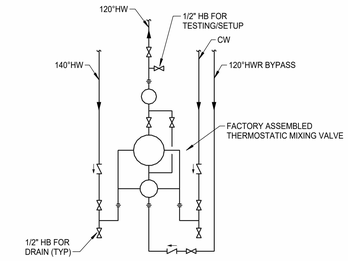
DOMESTIC HOT WATER STORAGE TANKS

MARK	SYSTEM	BASIS OF DESIGN	TANK TYPE	STORAGE CAPACITY, GAL.	QUANTITY
ST-1	DOMESTIC HOT WATER	LOCHINVAR RGA0318	GLASS LINED	318	1



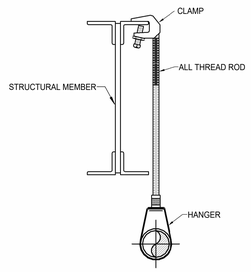
NOTES:
1. REFER TO WATER HEATER VENT DETAIL FOR INTAKE AND EXHAUST PIPING CONTINUATION.
2. REFER TO INTERIOR GAS REGULATOR DETAIL FOR VENTING.

CONNECTIONS TO GAS-FIRED WATER HEATERS
NO SCALE



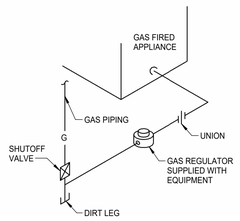
NOTES:
1. MOUNT MANIFOLD ON WALL 4'-0" AFF, FROM CENTERLINE OF MIXING VALVE.
2. INSTALL PER MANUFACTURER'S PRINTED INSTRUCTIONS.

TEMPERING VALVE MANIFOLD DETAIL (TVM-1)
NO SCALE

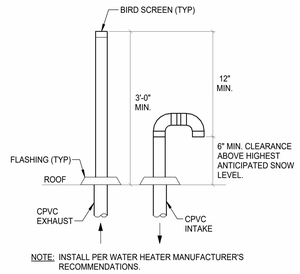


NOTE: HANGER AND HANGER INSTALLATION SHALL BE IN ACCORDANCE WITH NFPA-13 SECTION 9.1.

TYPICAL PIPE HANGER DETAIL
NO SCALE



TYPICAL GAS CONNECTION
SCHEMATIC



NOTE: INSTALL PER WATER HEATER MANUFACTURER'S RECOMMENDATIONS.

WATER HEATER VENT DETAIL
NO SCALE

PLUMBING GENERAL NOTES

1. INSTALLATION AND MATERIALS SHALL COMPLY WITH THE VIRGINIA UNIFORM STATEWIDE BUILDING CODE AND THE INTERNATIONAL PLUMBING CODE.
2. THE DESIGN IS BASED ON MANUFACTURERS AND MODELS INDICATED, AND IS INTENDED TO SHOW THE GENERAL SIZE, CONFIGURATION, LOCATION, CONNECTIONS AND/OR SUPPORT FOR EQUIPMENT OR SYSTEMS SPECIFIED WITH RELATION TO THE OTHER BUILDINGS/SYSTEMS. SEE SPECIFICATIONS SECTIONS FOR TECHNICAL REQUIREMENTS.

PLUMBING INSTALLATION

1. CONTRACTOR SHALL FIELD VERIFY LOCATION OF ALL EXISTING PIPING, ETC. BEFORE ANY NEW PIPING IS INSTALLED.
2. PLUMBING PIPING ABOVE FINISHED FLOOR SHALL BE RUN AS HIGH AS POSSIBLE, BELOW AND AVOIDING DUCTWORK AS APPLICABLE FOR ACCESSIBILITY AND MAINTENANCE.
3. PROVIDE APPROVED VACUUM BREAKERS FOR ALL WATER SUPPLIES WITH HOSE CONNECTIONS.
4. ALL CUTOFF VALVES, SHOCK ABSORBERS, ETC. SHALL BE ACCESSIBLE THROUGH AN ACCESS DOOR OR THROUGH LAY-IN CEILING. PROVIDE ACCESS DOOR WHERE REQUIRED.
5. MAKE PROPER HOT & COLD WATER, HOT WATER RETURN, WASTE, VENT, GAS, ETC. PIPING CONNECTIONS TO ALL FIXTURES AND EQUIPMENT EVEN THOUGH ALL BRANCH MAINS, ELBOWS AND CONNECTIONS ARE NOT SHOWN.

PLUMBING COORDINATION

1. CONTRACTOR SHALL COORDINATE WORK WITH ALL OTHER TRADES PRIOR TO FABRICATION OR INSTALLATION OF ANY NEW PIPING OR EQUIPMENT. IT IS THE RESPONSIBILITY OF THE CONTRACTOR TO REVIEW THE WORK OF OTHER TRADES (INCLUDING, BUT NOT LIMITED TO, STRUCTURAL, ARCHITECTURAL, FIRE SUPPRESSION, FIRE ALARM, MECHANICAL AND ELECTRICAL) AS IT AFFECTS THE PLUMBING WORK, AND AS THE PLUMBING CONTRACTOR'S WORK AFFECTS OTHER TRADES TO ENSURE THAT THE CONSTRUCTION DOCUMENTS ARE CLOSELY FOLLOWED. WHERE DISCREPANCIES ARISE, THEY SHALL BE REFERRED TO THE A/E PRIOR TO PROCEEDING FURTHER.
2. COORDINATE ALL FLOOR DRAIN AND OPEN SIGHT DRAIN LOCATIONS WITH MECHANICAL EQUIPMENT AND HOUSEKEEPING PADS IN MECHANICAL SPACES.

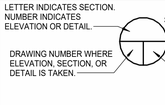
PLUMBING LEGEND SYMBOLS AND ABBREVIATIONS

TYPICAL PIPING RISER	TEE OR ELBOW FROM TOP OF MAIN	
TYPICAL PIPING BRANCH RISER	TOP OF MAIN	
	BOTTOM OF MAIN	
	SIDE OF MAIN	
	IN PLAN	
	DIAGRAMMATIC	
EXISTING TO REMAIN		
EXISTING TO BE DEMOLISHED		
COLD WATER		CW
HOT WATER		HW
HOT WATER RETURN		HWR
LOW PRESSURE NATURAL GAS		LPG
MEDIUM PRESSURE NATURAL GAS		MPG
DIRECTION OF SLOPE DOWN		
DIRECTION OF FLOW		
CUTOFF VALVE (IN PLAN)		
CUTOFF VALVE (IN VERTICAL)		CV
GATE VALVE		
CHECK VALVE		
BALANCING VALVE		
GAS COCK		
BACKFLOW PREVENTER		BFP
TEMPERING VALVE		
CLEAN-OUT		CO
SHOCK ABSORBER		SA
STRAINER		
EXTENT OF DEMOLITION		
CONNECT TO EXISTING		

ABV	- ABOVE	HWCP	- HOT WATER CIRCULATION PUMP
BEL	- BELOW	HWR	- HOT WATER RETURN
BFF	- BELOW FINISHED FLOOR	INV	- INVERT
BFP	- BACKFLOW PREVENTER	LPG	- LOW PRESSURE GAS
CFH	- CUBIC FEET PER HOUR	MPG	- MEDIUM PRESSURE GAS
CI	- CAST IRON	OSD	- OPEN SITE DRAIN
CLG	- CEILING	PVC	- POLYVINYL CHLORIDE
CO	- CLEAN-OUT	P&T	- PRESSURE & TEMPERATURE RELIEF VALVE
CONC	- CONCRETE	SAN	- SANITARY
CV	- CUTOFF VALVE	SF	- SQUARE FEET
CW	- COLD WATER	ST	- STORAGE TANK
DFU	- DRAINAGE FIXTURE UNIT	TET	- THERMAL EXPANSION TANK
DN	- DOWN	TP	- TRAP PRIMER
E	- EXISTING TO REMAIN	TV	- TEMPERING VALVE
ELEV	- ELEVATION	TW	- TEMPERED WATER
EXIST	- EXISTING	UNO	- UNLESS NOTED OTHERWISE
FD	- FLOOR DRAIN	V	- VENT
FL	- FLOOR	VB	- VACUUM BREAKER
G	- GAS	VTR	- VENT-THRU-ROOF
GR	- GAS REGULATOR	W	- WASTE
GWH	- GAS WATER HEATER	WCO	- WALL CLEAN-OUT
HB	- HOSE BIBB		
HW	- HOT WATER		

IDENTIFICATION KEY

LETTER INDICATES SECTION.
NUMBER INDICATES ELEVATION OR DETAIL.



SECTION, ELEVATION, OR DETAIL SYMBOL

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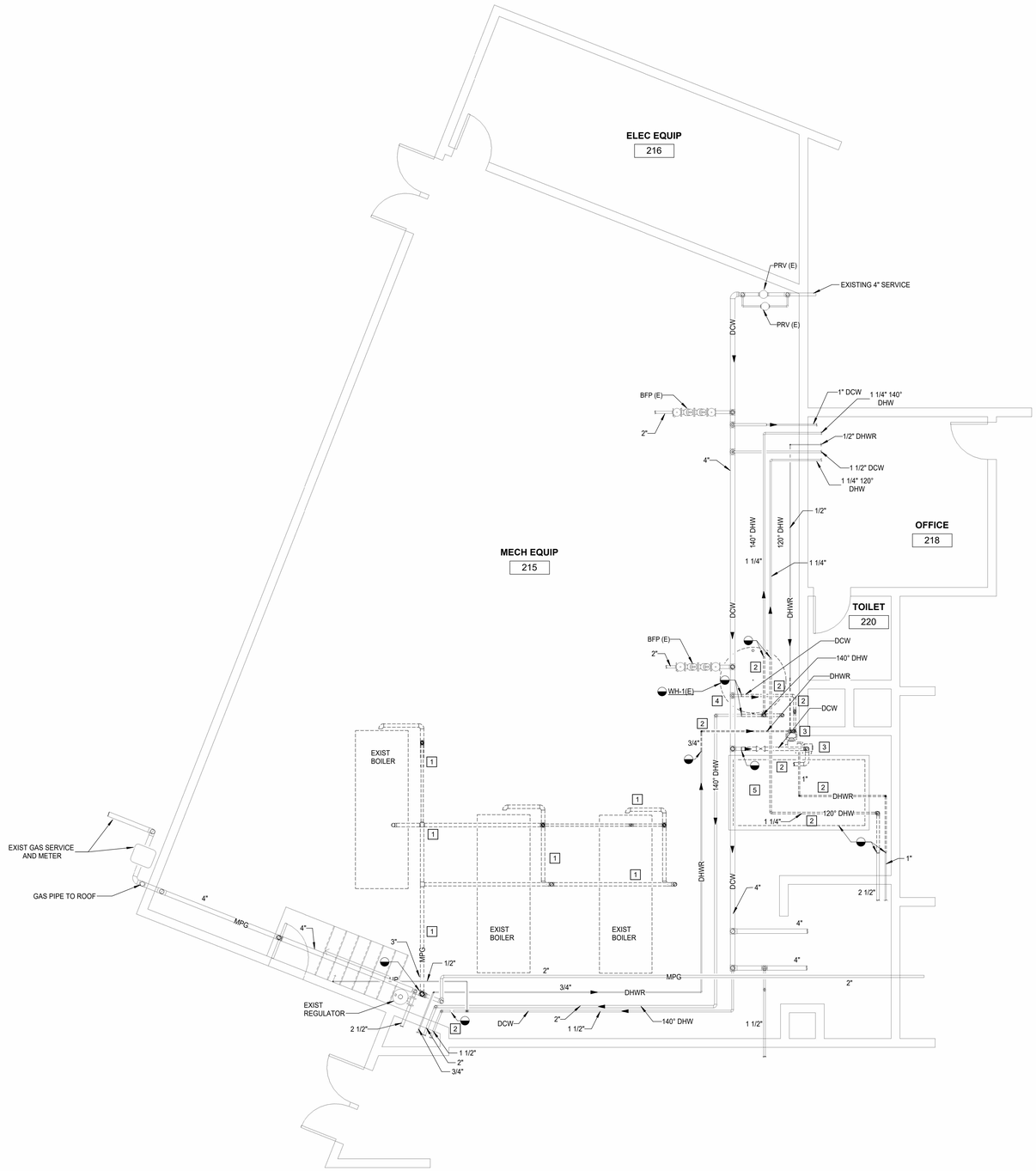
100% CONSTRUCTION DOCUMENTS

SHEET TITLE:
PLUMBING LEGEND, SCHEDULES, NOTES & DETAILS

SHEET NUMBER:
P001

DEMOLITION NOTES

1. REMOVE EXISTING GAS PIPING AS SHOWN, TO POINTS OF CONNECTION.
2. REMOVE EXISTING WATER PIPING AS SHOWN TO POINTS OF CONNECTION.
3. REMOVE EXISTING DOMESTIC WATER CIRCULATION PUMP.
4. REMOVE EXISING VERTICAL HEAT EXCHANGER AND TANK.
5. REMOVE EXISTING HORIZONTAL HEAT EXCHANGER AND TANK.



1 FLOOR PLAN - DEMOLITION
1/4" = 1'-0"

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SHEET TITLE:
PLUMBING FLOOR PLAN - DEMOLITION

GRAPHIC SCALE
SCALE: 1/4" = 1'-0"
4' 2' 0 4' 8'

SHEET NUMBER:
P101

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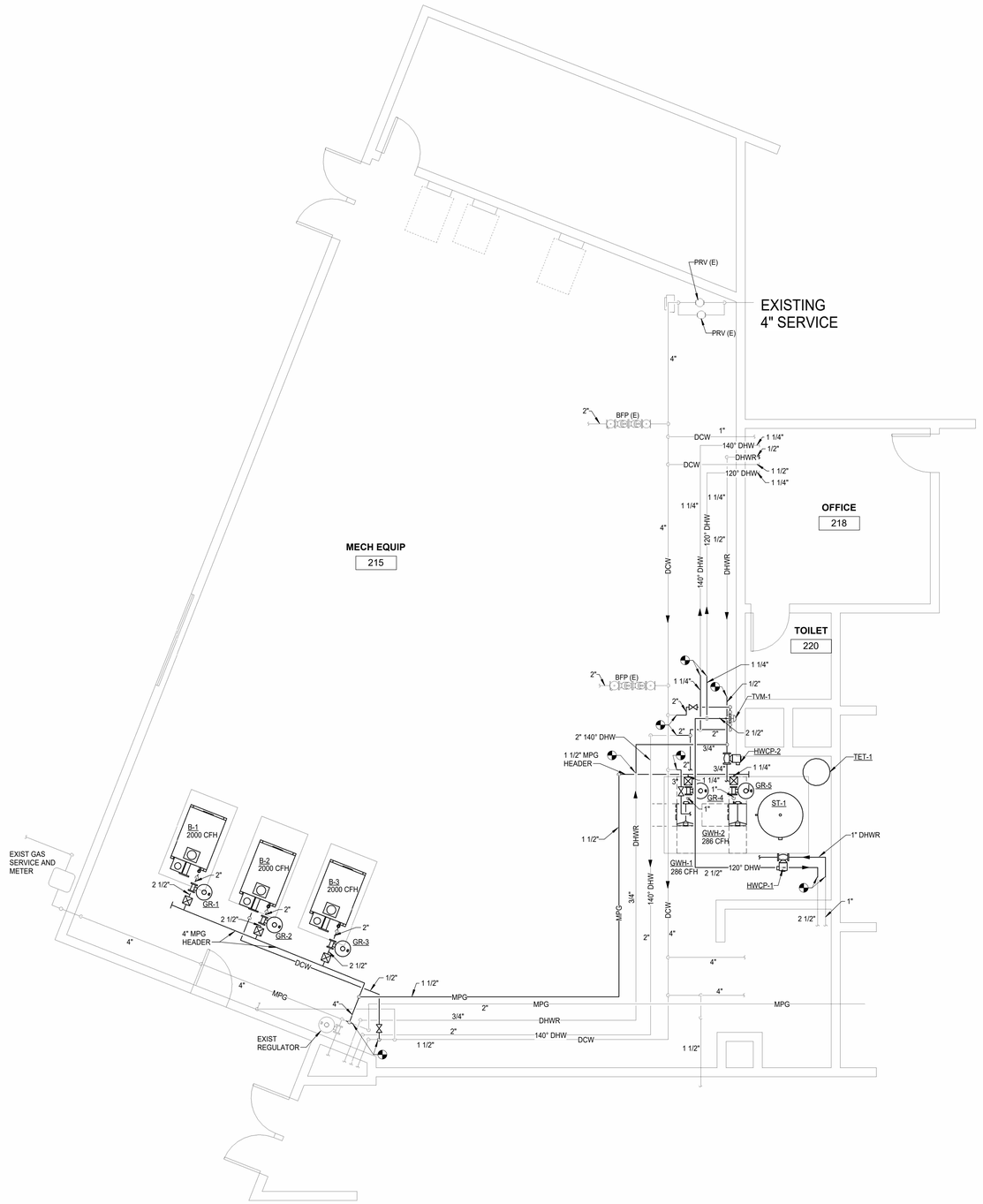
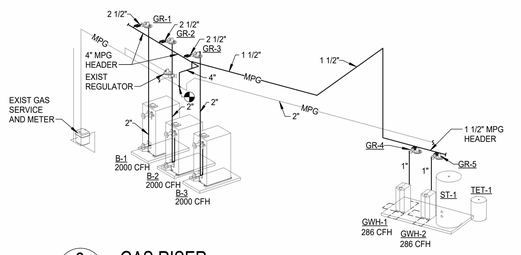


1 P201 FLOOR PLAN - DOMESTIC WATER AND GAS
SCALE: 1/4" = 1'-0"

GAS REGULATOR SCHEDULE					
MARK	EQUIPMENT	CONNECTED LOAD, CFH	INLET PRESSURE	OUTLET PRESSURE	SPECIFIC GRAVITY
GR-1	BOILER B-1	2000	1 PSI	14" W.C.	0.60
GR-2	BOILER B-2	2000	1 PSI	14" W.C.	0.60
GR-3	BOILER B-3	2000	1 PSI	14" W.C.	0.60
GR-4	GWH-1	286	1 PSI	11" W.C.	0.60
GR-5	GWH-2	286	1 PSI	11" W.C.	0.60

GAS SYSTEM SIZING CRITERIA:
MPG SIZING BASED ON 500' DEVELOPED LENGTH OF LONGEST RUN
ASPE DATA BOOK TABLE 7.5 FOR 1 PSI NATURAL GAS.
LPG SIZING BASED ON 30' DEVELOPED LENGTH OF LONGEST RUN
IFGC TABLE 402.4(2) FOR NATURAL GAS LESS THAN 2 PSI, 0.5" W.C. PRESSURE DROP



2 P201 GAS RISER

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PLUMBING FLOOR PLAN - DOMESTIC WATER AND GAS

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