Gary Housing Authority

CAROLYN B. MOSBY
AND
GLEN PARK
SENIOR BUILDINGS

SPECIFICATIONS
FOR
BOILER REPLACEMENT

ISSUED FOR BID

GARY PUBLIC HOUSING

ISSUED FOR BID

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SECTION 020810

ASBESTOS REMOVAL AND ENCAPSULATION

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Provide removal and disposal of all asbestos-containing piping insulation, and equipment as shown on the Drawings and as required in these specifications.

B. The Contractor shall submit bids with the assumption that the existing piping insulation, and equipment to be demolished for this project, contains asbestos unless specifically identified as non asbestos-containing within contract documents. All suspect asbestos-containinq insulation affected by the work of this project that has not previously been tested shall be tested by the Contractor to verify the presence of asbestos. This testing work is required. For all identified asbestos-containing materials, the Contractor shall retain a licensed asbestos abatement contractor to conduct the lawful removal and disposal of identified materials in accordance with applicable federal, state and local regulations and contract documents. The Contractor shall also retain an independent third-party consultant to provide air monitoring and project management during the abatement work. Test results shall also be submitted to GHA.

C. As verification of the Contractor's work, GHA may conduct monitoring operations simultaneous and/or subsequent to those described in this specification for the Contractor.

D. Furnish all materials, labor, services, tools, and equipment necessary for the removal, encapsulation, and legal disposal of asbestos-containing materials according to the latest EPA, NIOSH, OSHA, State, and City regulations, procedures, and certifications.

E. The Contractor must furnish all materials, labor, services, tools, and equipment necessary to perform asbestos abatement services, and the legal disposal of asbestos, asbestos containing materials, including, but not limited to, the following:

1. Personal air monitoring program.
2. Gross removal of asbestos containing material and legal disposal in accordance with regulations of Federal, State, and local authorities.
3. Glovebag removal of asbestos containing material and legal disposal in accordance with regulations of Federal, State, and local authorities.
4. Encapsulation of remaining asbestos-containing materials.
5. Various types of asbestos are anticipated which are to be abated, such as surfacing, thermal and miscellaneous materials. All work must be performed in accordance with the current OSHA, EPA, State of Indiana Department of Public Health (IDPH) and the City of Gary regulations, procedures, and certifications.

1.2 RELATED DOCUMENTS

A. Work under this specification Section is subject to the requirements of the Contract Documents. The most stringent requirements shall govern in regard to conflicts between drawings and this specification.

B. The Contractor shall hire a firm to do the abatement work and to supervise the abatement work, including evaluating test results. Test results shall also be submitted to GHA.

1.3 RELATED WORK

A. As specified in the following Divisions:

1. Division 23 – Mechanical.

1.4 REFERENCES

A. Compliance with all laws and regulations: The Contractor must be aware of and comply with all local, state, and federal laws and regulations concerning asbestos removal and disposal whether described herein or elsewhere throughout the duration of the Contract without additional cost to GHA. The work is subject to the following standards, regulations, and requirements:

1. Occupational Safety and Health Standards — 29 CFR 1910.001 and 29 CFR 1910.134.
2. USEPA Regulations for Asbestos — Federal Regulations 40 CFR 61 Subparts A and M and 40 CFR 763 Asbestos Containing Materials in Schools Final Rule and Notice.
3. U.S. Department of Health, Education and Welfare — NIOSH Specification (Criteria for a Recommended Standard — Occupation Exposure to Asbestos).
4. The Contractor must have a copy of the OSHA Regulations 29 CFR 1910.1001, 1926.1101 and USEPA 40 CFR Part 61, Subpart A and M, 40 CFR 763 at the job site at all times.

1.5 SUBMITTALS

A. It will be the sole responsibility of the Contractor to notify, secure, and pay for any and all EPA, and the City of Gary public health notifications and or permits. Copies of notification must be forwarded to GHA.

B. Each shop drawing and submittal shall be certified for this project and shall list the project name, site location, order number, equipment name with equipment number and specification Section number.

C. Submit documentation that arrangements for the transport and disposal of asbestos-containing or contaminated materials and supplies have been made. The name and location of the disposal site, a copy of handling procedures, and a list of protective equipment utilized for asbestos disposal at the landfill, prepared and signed by the landfill owner, shall be obtained and submitted to GHA.

D. The Contractor shall furnish to GHA proof that employees have been instructed on the dangers of exposure to asbestos, on proper use of respirators, and the latest OSHA regulations by acquiring signatures on statements to that effect.

E. The Contractor must supply copies of current abatement licenses and licenses for all workers to be designated for the project.

F. Notification to respective government agencies, where required of an asbestos removal project, shall be the Contractor's sole responsibility. Copies of notification shall be forwarded to GHA.

G. As stated in this specification Section, air sampling, monitoring, and analysis shall be performed by the Contractor and results shall be submitted to GHA for review. A minimum of five copies of all reports of testing shall be submitted to GHA.

H. Submit Abatement Plans designated by a licensed project designer for review. These plans must include: drawings of the decontamination facilities and their locations; work area isolation plan with layout of engineering controls (e.g. HEPA filters, etc.); and a listing of all tools, equipment, and supplies proposed for use in the abatement program. No abatement work will be performed without GHA's review of the Abatement Plans. A site specific asbestos work plan will be submitted.

I. A copy of the Employee Protection Program (including brand and model of respirators) developed for use on this project, must be submitted to GHA for review. No abatement work will be performed without GHA's review of the Employee Protection Program.

J. During abatement activities, the Contractor shall submit to GHA the following information:

1. Submit weekly, job progress reports detailing abatement activities, including a review of progress with respect to previously established schedules, problems and actions taken, injury reports, and equipment breakdowns.
2. Submit weekly, copies of all transport manifests, trip tickets, and disposal receipts for all asbestos waste materials removed from the work area during the abatement process.
3. Submit weekly, results of air sampling data collected during the course of the abatement for OSHA compliance air monitoring.
4. Submit weekly, copies of worksite entry log books with information on worker and visitor access.
5. Submit weekly, logs documenting filter changes on respirators, HEPA vacuums, negative pressure ventilation units, and other engineering controls.

1.6 QUALITY ASSURANCE

A. Contractor Qualifications: Work must be performed only by a qualified firm. The term qualified means experienced in performing the Work required by this Section. The qualified firm will be responsible for demonstrating to GHA satisfaction that he/she has sufficient experience in its role. The firm must submit evidence of such qualifications upon request by GHA.

B. Abatement work shall require the use of a licensed project designer. All abatement activities shall be performed by licensed asbestos workers.

C. Various types of asbestos are anticipated which are to be are to be abated such as surface, thermal, and miscellaneous materials. All work must be performed in accordance with the current OSHA, USEPA, State of Indiana Department of Public Health (IDPH) and the City of Gary regulations, procedures, and certifications.

1.7 DELIVERY, STORAGE AND HANDLING

A. Materials shall be delivered to the project in sealed containers (if applicable) bearing manufacturer's name and material identification. Materials shall be stored in strict accordance with the manufacturer's printed directions, copies of which shall be furnished to GHA.

B. Containers that have broken seals will not be accepted or are not to be used. Seals are not to be broken until inspected by GHA.

C. All unsatisfactory materials shall be removed from the premises, and all damaged materials shall be replaced with new materials at no cost to GHA.

1.8 WARRANTIES

A. For asbestos encapsulation, the Contractor shall repair or replace defective materials and workmanship during the Contract period and for one (1) year from the date of Substantial Completion of the project, at no additional cost to GHA. Any equipment, materials, and workmanship repaired or replaced shall have the warranty period extended for a period of one (1) additional year from the date of repairs and/or replacements.

B. The Contractor shall operate and maintain all Work including, but not limited to, mechanical, electrical, controls, temporary systems, etc., until such time that Substantial Completion is obtained. To achieve substantial completion, turn-over of as-built documents, operations and maintenance manuals, and operator training are required to be complete.

C. The warranty period for all systems and equipment shall commence at Substantial Completion of the project, and not the individual construction phases.

1.9 EXTRA MATERIALS AND SPARE PARTS

A. None used.

1.10 ENVIRONMENTAL REQUIREMENTS

A. None used.

1.11 SPECIAL REQUIREMENTS

A. Field Measurements: Before proceeding with fabrication of the Work, the Contractor shall verify all dimensions and take such measurements as are required for proper fabrication, installation and erection of the Work.

B. Coordination: Coordinate Work of this Specification Section with related 'Work specified in the other Divisions / Sections of the Contract Documents.

PART 2 - PRODUCTS

2.1 TOOLS AND EQUIPMENT FOR ASBESTOS ABATEMENT

A. Water sprayer will be an airless or other low pressure sprayer for amended water application.

B. Airless Sprayer: An airless or other low pressure sprayer, suitable for application of encapsulating material, will be used.

C. Vacuum Equipment: All vacuum equipment utilized in the work area will be high efficiency particulate aerosol (HEPA) equipment.

D. Scaffolding: Scaffolding, as required, to accomplish the specified work, will meet all applicable safety regulations.

E. Transportation Equipment: Transportation equipment, as required, will be suitable for loading, temporary storage, transit, and unloading of contaminated waste without exposure to persons of property.

F. Other Tools & Equipment: Provide tools for stripping, removal, encapsulation and disposal activities including but not limited to hand-held scrapers, wire scrapers, sponges, round edge shovels, brooms and carts.

PART 3 - EXECUTION

3.1 EXAMINATION OF SITE

A. The Contractor shall be held to have visited the site and be satisfied as to the existing conditions under which he/she will be obliged to operate in performing the work, or that will in any manner affect the work under this contract. No allowance will be made subsequently in this connection for any error or negligence of the Contractor.

B. Before starting asbestos removal work, Contractor shall carefully examine substrate surfaces to determine that they are free of conditions which might be detrimental to proper and timely completion of the work. Start of work shall indicate acceptance of the substrate.

3.2 SCHEDULE

A. No removal work or encapsulation work shall begin until a time schedule has been prepared and approved by GHA. Time schedule shall include phasing of work if necessary.

B. In general, work shall be scheduled to allow for operation of all equipment. Shutdown of equipment shall be as stated in the drawings and specifications. The affected areas shall be ready for occupancy, free from smell, debris, construction materials, and equipment.

C. When so approved by GHA, certain preparatory work, removal of plastic sheeting, and final cleanup may be done at any time.

3.3 WORK TAST REQUIREMENTS OF THE CONTRACTOR AT PROJECT WORK SITE

A. Prior to commencing the demolition and removal of the insulation material, the Contractor shall do the following:

1. Conduct an initial exposure assessment test plan or baseline report, which demonstrates that the Contractor's exposure to airborne asbestos fibers during removal in accordance with 29 CFR 1926.1101.
2. Have at least one worker, who is capable of identifying existing asbestos hazards at the work place, determining if NEA's exist, determining the level of personal protective equipment required, and has the authority to take prompt corrective measures to eliminate a hazardous exposure.

3.4 AMBIENT AIR MEASUREMENT SURVEY

A. Ambient air measurement survey shall be made prior to start of work by the Contractor and results shall be submitted to GHA.

3.5 PROTECTION FOR EMPLOYEES, INSPECTORS, OR OTHER PERSONNEL

A. Dress and equipment for asbestos removal shall be provided by the Contractor.

1. Contractor shall provide employees with NIOSH-approved respiratory protective equipment suitable for use in asbestos-containing atmospheres. Filters shall be changed as necessary.
2. Contractor shall establish a respiratory protection program which meets the requirements of the OSHA Respiratory Protection Standard.
3. Employees shall be trained in the proper use of respirators, including the limitations of this equipment. They shall have an opportunity to handle the respirator, have it fitted properly, test the face-to-face piece seal, wear it in normal air for a period of time, and finally have it fit test performed. Employees should also be able to inspect the respirator for worn or deteriorated parts.
4. Respirators shall be assigned to workers for their exclusive use.
5. Contractor shall provide regular cleaning and disinfecting of respirators, at least after each day's use.
6. Respirators shall be stored in a clean and sanitary location.

7. Contractor will provide disposable whole body clothing, including coveralls, head coverings, and gloves.

3.6 WORKER DECONTAMINATION FACILITY AND PRACTICES

A. The Contractor, if required, shall provide or construct an appropriate work decontamination facility at the site in compliance with State of Indiana.

B. The Contractor shall be solely responsible for maintenance of isolation / decontamination area and for disposal or protection of equipment used in the work, asbestos wastes including water, as well as for decontamination procedures for any occupants, workers, equipment, or related items. Maintenance of decontamination enclosure systems and workplace barriers shall be in compliance with State of Indiana - Asbestos Abatement Act and Rule requirements.

C. The cleanroom shall contain lockers for the storage of clean clothing.

D. Each day, prior to beginning work, all employees, without exception, shall remove street clothes and store them in the cleanroom, dress in clean disposable clothing, and don their respirators. Workers may then proceed to the work area.

E. Prior to leaving the work area at the end of the day, or for lunch, employees shall remove all disposable clothing and place it in a designated receptacle. The respirators should not be removed while in the work area.

F. While wearing the respirators, workers shall proceed to the shower and wet their entire bodies before removing the respirators. Upon removal, the filters will be discarded into a designated receptacle, and the employees will then finish their showers.

G. Workers shall not eat, drink, smoke, or chew tobacco or gum while in the work area.

H. No individual shall be permitted access to the work area that does not adhere strictly to the above work and hygiene practices.

I. Adequate toilet facilities should exist in the work area to avoid decontamination for this purpose. Where such facilities do not exist, the Contractor shall provide portable service.

3.7 PREPARATION-PROTECTION

A. Coordination: Contractor shall schedule work and operations so as to cause minimal disruption or interruption of on-going activities or building services.

B. Preparation of Work Area:

1. Shut down and isolate systems. Shutdown of these systems shall be performed by GHA operating personnel.
2. Preclean any movable objects within the work areas using HEPA (high efficiency particulate absolute) filtered vacuum equipment and/or wet cleaning methods, as appropriate, and remove such objects from work area to a temporary location in the building as directed by GHA.

3. Preclean fixed objects within the work areas using HEPA-filtered vacuum equipment and/or wet cleaning methods, as appropriate, and enclose with plastic (polyethylene 4 mil) sheeting and duct tape.
4. Clean work areas using HEPA-filtered vacuum or wet cleaning methods, as appropriate. Methods that raise dust, such as dry sweeping or vacuuming with equipment not equipped with HEPA filters, shall not be used.

C. Protection of Property:

1. Enclosing the Work Area: Contractor shall use all means necessary to prevent the spread of asbestos fibers or dust during the performance of this work to other parts of the building and to the outside. Contractor shall thoroughly seal all openings and fixtures including, but not limited to, HVAC ducts, skylights, doors, windows, or other openings that might reasonably permit the emission of visible particulate, with 6 mil polyethylene and duct tape. The enclosures shall remain in place until all asbestos-containing materials have been removed from the building and the work areas have been decontaminated. Mechanical systems within the work area shall be shut down for the duration of abatement activities.
2. Prior to beginning the removal work, all movable items in the work area must be cleaned, removed, and stored in a clean location.
3. Cover floor and wall surfaces with plastic sheeting sealed with tape. Use a minimum of two layers of 6 mil plastic on floor and walls. Cover floor first so that plastic extends at least 12 inches up on walls, then cover walls with plastic sheeting to the floor level, thus overlapping the floor material by a minimum of 12 inches. The plastic shall be sized to minimize seams. Seams shall be staggered and separated by a distance of at least 6 feet.
4. Remove and clean ceiling-mounted objects, such as light fixtures, electrical track, alarm systems, and other items not previously sealed off, that interfere with asbestos material removal. Use localized water spraying or HEPA-filtered vacuum equipment during fixture removal to reduce fiber dispersal..

D. Protection of Surfaces and Equipment:

1. Maintain all exits from the work areas or establish alternate exits.
2. Use all means necessary to protect existing equipment, ceilings, fixtures, appurtenances, and walls where the work occurs. In the event of damage, immediately make all repairs and replacements necessary.
3. All floors shall be protected from abrasion or damage by Contractor's operations, equipment, scaffolding, water damage, asbestos fallout, and any other potential damaging material, item, or operation. Contractor shall use plywood, polyethylene film, dropcloths, or other devices which are disposable.

E. Protection for Employees, Inspectors, or Other Personnel:

1. The work area shall be secured from GHA personnel and residents. Contractor shall post appropriate warning signs, barricades, and controls to prevent access by unauthorized persons. Area will be closed for Contractor's operations, and Contractor shall coordinate all security measures with GHA.
2. Contractor will provide disposable whole body clothing, including coveralls, head coverings and gloves. At any time during this Asbestos Abatement that air

monitoring results indicated that fiber counts are higher than the respiratory protection factor of the respiratory equipment being used by the Contractor, as listed in the OSHA Asbestos regulations for general industry 29 CFR 1910. 1001 or 29 CFR 1926.1101, the work will be stopped and the Contractor will be required to provide respirators with a higher protection factor. Respirators are to be provided for all Contractor personnel at the job site.

F. Negative Pressure System:

1. The Contractor shall use an HEPA air filtration system to maintain a negative air pressure in the work area and collect airborne fiber present during the time necessary to complete the removal work.
2. The negative pressure system shall operate continuously, 24 hours a day, from the start of the abatement work through the clearance air monitoring.
3. Negative air pressure equipment shall be in compliance with ANSI Z9.2 (1979) for local exhaust ventilation.
4. The Contractor shall obtain a license from the negative air pressure system manufacturer for its use if required by law.

3.8 SIGNS AND LABELS

A. Caution signs shall be posted at all entrances to the work areas. Signs shall comply with the requirement of the OSHA Asbestos Standard. Vertical format 20 inch by 14 inch signs shall display the following legend:

DANGER ASBESTOS
Causes Damage to Lungs
Authorized Personnel Only

B. Labels shall be affixed to all asbestos-containing waste. Labels shall comply with the requirements of the OSHA Asbestos Standard and shall be of a sufficient size and contrast to be readily visible and legible. The label shall state the following:

DANGER
Contains Asbestos Fibers
May Cause Cancer
Do Not Breathe Dust
Avoid Creating Dust

3.9 AIR MONITORING

A. Throughout the removal and cleaning operations, air sample monitoring shall be conducted by Contractor to ensure compliance with all codes, regulations, and ordinances.

B. A minimum of five copies of all reports of testing shall be submitted to GHA. Refer to the "Submittals" Section of this specification for more submittal requirements.

3.10 CLEANUP PROCEDURES

A. All visible accumulations of asbestos-containing material and asbestos-contaminated debris shall be removed and containerized utilizing rubber dust pans and rubber squeegees. Metal shovel shall not be used to pick up or move accumulated waste.

B. All surfaces in the work area shall be wet-cleaned using rags, mops, and sponges (first cleaning). To pick up excess water and gross wet debris, a wet-dry shop vacuum may be used. The vacuum will be contaminated and shall be decontaminated prior to removal from the work area.

C. The cleaned outer layer of plastic sheeting shall be removed from walls and floors. Windows, doors, HVAC system vents, and all other openings shall remain sealed. The negative pressure ventilation units shall remain in continuous operation. Decontamination enclosure systems shall remain in place and be utilized.

D. After the first cleaning, the Contractor shall wait at least 24 hours to allow fibers to settle. Then all objects and surfaces in the work area shall be HEPA-vacuumed and wet-cleaned (second cleaning). The remaining plastic on walls and floors only shall be removed. The windows, doors, HVAC system's vents, and all other openings shall remain sealed.

E. After the second cleaning, the Contractor shall wait 12 hours before wet-cleaning and/or HEPA-vacuuming all surfaces in the work area (third cleaning). The negative pressure ventilation units shall remain in continuous operation during the 48-hour settling period and the third cleaning process.

F. All containerized waste shall be removed from the work area and holding area.

G. All tools and equipment shall be removed from the work area and decontaminated in the equipment decontamination enclosure system.

H. The Contractor shall inspect the work area for visible residue by wiping surfaces with a dark cloth. If any accumulation of residue is observed, the residue will be assumed to be asbestos and the 12-hour settling period/cleaning cycle shall be repeated.

3.11 RESTORATION OF BUILDING AND SYSTEMS

A. Re-establishment of the work area shall only occur following the completion of the cleanup procedures and after clearance air monitoring has been performed and documented to the satisfaction of GHA.

1. The Contractor shall visually inspect the work area for any remaining visible residue. Evidence of contamination shall necessitate additional cleaning.
2. Additional air monitoring shall be performed in the event additional cleanup is necessary.
3. Following completion of clearance air monitoring of the work area, remaining polyethylene barriers and worker and equipment decontamination enclosure systems shall be removed and disposed of as asbestos-contaminated waste.
4. Mounted objects removed from former positions during area preparation activities shall be re-secured.

5. Objects that were removed to temporary locations may be relocated to original positions.

3.12 CLEARANCE AIR MONITORING AND ANALYSIS

A. Following the completion of cleanup operations, the Contractor shall notify GHA that work areas are ready for clearance air monitoring.

B. The Contractor shall arrange for an air sampling professional consultant, independent of the abatement firm, to sample the air in the work area and adjacent areas for airborne fiber concentrations. Results will be given to the Contractor within 24 hours of testing.

C. The HEPA-filtered negative air pressure equipment shall be in operation in the area during clearance air monitoring and until accepted by GHA.

D. The air sampling professional consultant shall perform an aggressive sampling technique.

E. The Contractor shall be released from the abatement project when every air sample value is 0.01 f/cc or below.

3.13 DISPOSAL OF ASBESTOS MATERIAL AND RELATED DEBRIS

A. All asbestos materials and miscellaneous debris in sealed drums shall be transported to the pre-designated site in accordance with the regulations of the EPA and state and local agencies.

1. All asbestos materials must be disposed of at an approved landfill which is operated in accordance with the provisions of the EPA's National Emissions Standard for Asbestos (40 CFR 61, Subpart M) and approved by GHA.
2. Workers unloading the sealed drums and machinery operations shall wear respirators when handling material at the disposal site.
3. If local authorities permit, drums may be reused by dumping the bags at the burial site. In the event the bag is broken or damaged, the entire drum must be buried.
4. The Contractor must dispose of all daily accumulated Asbestos Contaminated Materials (ACM) debris in an approved, lockable, fully contained/secured lined dumpster. Location/site of dumpster to be determined by GHA prior to beginning any ACM removal. Filled dumpsters to be removed from the location/site by an approved waste hauler and taken to a legally zoned, permitted and approved waste deposal site submitted on the Contractor's Affidavit.
5. If the Contractor elects, it may choose to remove the ACM from the work site on a daily basis by using an approved waste hauler who takes ACM to the approved waste disposal site. Choosing the daily removal of ACM will in no way affect the Contractor's bid.

3.14 FINAL CLEAN UP

A. On completion of the work and removal of all asbestos waste material and enclosures, and before acceptance by GHA, thoroughly clean the areas affected, including areas

outside the limits of the Contractor's work area where permission to work has been granted. Remove surplus construction material or debris resulting from the work and dispose of legally off the site.

END OF SECTION 020810

SECTION 230505

BASIC HVAC MATERIALS AND METHODS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes the following:

1. Piping materials and installation instructions common to most piping systems.
2. Concrete base construction requirements.
3. Dielectric fittings.
4. Mechanical sleeve seals.
5. Equipment nameplate data requirements.
6. Nonshrink grout for equipment installations.
7. Field-fabricated metal and wood equipment supports.
8. Installation requirements common to equipment specification sections.
9. Mechanical demolition.
10. Cutting and patching.
11. Touchup painting and finishing.
12. Bearings.
13. Drives.
14. Flashings.
15. Cleaning.

B. Pipe and pipe fitting materials are specified in Division 22.

1.2 DEFINITIONS

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

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

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

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

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

F. The following are industry abbreviations for rubber materials:

1. BS: Acrylonitrile-butadiene-styrene plastic.

2. CPVC: Chlorinated polyvinyl chloride plastic.
3. CR: Chlorosulfonated polyethylene synthetic rubber.
4. EPDM: Ethylene-propylene-diene terpolymer rubber.
5. NBR: Acrylonitrile-butadiene rubber.
6. PE: Polyethylene plastic.
7. PVC: Polyvinyl chloride plastic.

1.3 SUBMITTALS

A. Product Data: For dielectric fittings, flexible connectors, mechanical sleeve seals, access panels and identification materials and devices.

B. Coordination Drawings: For access panel and door locations.

C. Coordination Drawings: Detail major elements, components, and systems of mechanical equipment and materials in relationship with other systems, installations, and building components. Show space requirements for installation and access. Indicate if sequence and coordination of installations are important to efficient flow of the Work. Include the following:

1. Planned piping layout, including valve and specialty locations and valve-stem movement.
2. Planned duct systems layout, including elbow radii and duct accessories.
3. Clearances for installing and maintaining insulation.
4. Clearances for servicing and maintaining equipment, accessories, and specialties, including space for disassembly required for periodic maintenance.
5. Equipment and accessory service connections and support details.
6. Exterior wall and foundation penetrations.
7. Fire-rated wall and floor penetrations.
8. Sizes and location of required concrete pads and bases.
9. Scheduling, sequencing, movement, and positioning of large equipment into building during construction.
10. Floor plans, elevations, and details to indicate penetrations in floors, walls, and ceilings and their relationship to other penetrations and installations.
11. Reflected ceiling plans to coordinate and integrate installation of air outlets and inlets, light fixtures, communication system components, sprinklers, and other ceiling-mounted items.
12. Access panel locations in ceilings/walls/floors.

1.4 QUALITY ASSURANCE

A. Requirements of Regulatory Agencies:

1. American Society for Testing and Materials

a. ASTM A 53-98: Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless
b. ASTM B 32-96: Specification for Solder Metal
c. ASTM B 813-93: Specification for Liquid and Paste Fluxes for Soldering Applications of Copper and Copper Alloy Tube

d. ASTM B 828-98: Practice for Making Capillary Joints by Soldering of Copper and Copper Alloy Tube and Fittings
e. ASTM C 1107-97: Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink)
f. ASTM C 1173-97: Specification for Flexible Transition Couplings for Underground Piping Systems
g. ASTM D 1785-96b: Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120
h. ASTM D 2235-96a: Specification for Solvent Cement for Acrylonitrile-Butadiene-Styrene (ABS) Plastic Pipe and Fittings
i. ASTM D 2564-96a: Specification for Solvent Cements for Poly (Vinyl Chloride) (PVC) Plastic Piping Systems
j. ASTM D 2672-96a: Specification for Joints for IPS PVC Pipe Using Solvent Cement
k. ASTM D 2855-96: Practice for Making Solvent-Cemented Joints with Poly (Vinyl Chloride) (PVC) Pipe and Fittings
l. ASTM D 3139-98: Specification for Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals
m. ASTM F 402-93: Practice for Safe Handling of Solvent Cements, Primers, and Cleaners Used for Joining Thermostatic Pipe and Fittings
n. ASTM F 493-97: Specification for Solvent Cements for Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe and Fittings
o. ASTM F 656-96a: Specification for Primers for Use in Solvent Cement Joints of Poly (Vinyl Chloride) (PVC) Plastic Pipe and Fittings

2. American Water Works Association

a. AWWA C110-98: Ductile-Iron and Gray-Iron Fittings, 3 In. through 48 In. (76 mm through 1219 mm), for Water and Other Liquids
b. AWWA C219-97: Bolted, Sleeve-Type Couplings for Plain-End Pipe

3. American Welding Society

a. AWS A5.8-92: Specification for Filler Metals for Brazing and Braze Welding
b. AWS D1.1-98: Structural Welding Code--Steel
c. AWS D10.12-89: Recommended Practices and Procedures for Welding Low Carbon Steel Pipe
d. Brazing Handbook. 1991.

4. ASME International

a. ASME B1.20.1-83 (Reaffirmed 1992): Pipe Threads, General Purpose (Inch)
b. ASME B16.21-92: Nonmetallic Flat Gaskets for Pipe Flanges
c. ASME B18.2.1-96: Square and Hex Bolts and Screws--Inch Series
d. ASME B31 Series: Code for Pressure Piping
e. 1998 ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications"

5. Copper Development Association Inc.

    a. Copper Tube Handbook. 1995.

6. Manufacturers Standardization Society of the Valve and Fittings Industry, Inc.

    a. MSS SP-107-91: Transition Union Fittings for Joining Metal and Plastic Products

B. Steel Support Welding: Qualify processes and operators according to AWS D1.1, "Structural Welding Code--Steel."

C. Steel Pipe Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."

1. Comply with provisions in ASME B31 Series, "Code for Pressure Piping."
2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.

D. Equipment of higher electrical characteristics, physical dimensions, capacities, and ratings may be furnished provided such proposed equipment is approved in writing and connecting mechanical and electrical services, circuit breakers, conduit, motors, bases, and equipment spaces are increased. Additional costs shall be approved in advance by appropriate Contract Modification for these increases. If minimum energy ratings or efficiencies of equipment are specified, equipment must meet design and commissioning requirements.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe-end damage and prevent entrance of dirt, debris, and moisture.

B. Protect stored pipes and tubes from moisture and dirt. Elevate above grade. Do not exceed structural capacity of floor, if stored inside.

C. Protect flanges, fittings, and piping specialties from moisture and dirt.

1.6 SEQUENCING AND SCHEDULING

A. Coordinate phasing and sequencing of all work with the Owner and Building Engineer.

B. Coordinate mechanical equipment installation with other building components.

C. Coordinate installation of required supporting devices and sleeves in poured-in-place concrete and other structural components, as they are constructed.

D. Sequence, coordinate, and integrate installations of mechanical materials and equipment for efficient flow of the Work. Coordinate installation of large equipment requiring positioning before closing in building.

E. Coordinate connection of mechanical systems with exterior underground and overhead utilities and services. Comply with requirements of governing regulations, franchised service companies, and controlling agencies.

F. Coordinate requirements for access panels and doors if mechanical items requiring access are concealed behind finished surfaces. Access panels and doors are specified in Division 08 Section "Access Doors and Frames."

G. Coordinate installation of identifying devices after completing covering and painting, if devices are applied to surfaces. Install identifying devices before installing acoustical ceilings and similar concealment.

H. Coordinate connection of electrical services.

1.7 WARRANTY

A. Provide warranty on materials and labor for 18 months starting from date of delivery, or one year from date of substantial completion, whichever is longer.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

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

1. Dielectric Unions: No preference.
2. Dielectric Flanges: No preference.
3. Dielectric-Flange Insulating Kits: No preference.
4. Dielectric Couplings: No preference.
5. Dielectric Nipples: No preference.
6. Mechanical Sleeve Seals:

    a. Calpico, Inc.
    b. Metraflex Co.
    c. Thunderline/Link-Seal.

7. Metal, Flexible Connectors:

    a. Grinnell Corp.; Grinnell Supply Sales Co.
    b. Mercer Rubber Co.
    c. Metraflex Co.

8. Rubber, Flexible Connectors:

    a. General Rubber Corp.
    b. Metraflex Co.
    c. Red Valve Co., Inc.

2.2 PIPE, TUBE, AND FITTINGS

A. Refer to individual Division 22 piping Sections for pipe, tube, and fitting materials and joining methods.

B. Pipe Threads: ASME B1.20.1 for factory-threaded pipe and pipe fittings.

2.3 JOINING MATERIALS

A. Refer to individual Division 22 piping Sections for special joining materials not listed below.

B. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.

1. ASME B16.21, nonmetallic, flat, 1/8-inch maximum thickness unless thickness or specific material is indicated.

a. Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.
b. Narrow-Face Type: For raised-face, Class 250, cast-iron and steel flanges.

2. AWWA C110, rubber, flat face, 1/8 inch thick, unless otherwise indicated; and full-face or ring type, unless otherwise indicated.

C. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.

D. Plastic, Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer, unless otherwise indicated.

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

F. Brazing Filler Metals: AWS A5.8, BCuP Series, copper-phosphorus alloys for general-duty brazing, unless otherwise indicated; and AWS A5.8, BAg1, silver alloy for refrigerant piping, unless otherwise indicated.

G. Welding Filler Metals: Comply with AWS D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

2.4 DIELECTRIC FITTINGS

A. Description: Combination fitting of copper alloy and ferrous materials with threaded, solder-joint, plain, or weld-neck end connections that match piping system materials.

B. Insulating Material: Suitable for system fluid, pressure, and temperature.

C. Dielectric Unions: Factory-fabricated, union assembly, for 250-psig minimum working pressure at 180 deg F.

D. Dielectric Flanges: Factory-fabricated, companion-flange assembly, for 150- or 300-psig minimum working pressure as required to suit system pressures.

E. Dielectric-Flange Kits: Companion-flange assembly for field assembly. Include flanges, full-face- or ring-type neoprene or phenolic gasket, phenolic or polyethylene bolt sleeves, phenolic washers, and steel backing washers. Separate companion flanges and steel bolts and nuts shall have 150- or 300-psig minimum working pressure where required to suit system pressures.

F. Dielectric Couplings: Galvanized-steel coupling with inert and noncorrosive, thermoplastic lining; threaded ends; and 300-psig minimum working pressure at 225 deg F.

G. Dielectric Nipples: Electroplated steel nipple with inert and noncorrosive, thermoplastic lining; plain, threaded, or grooved ends; and 300-psig minimum working pressure at 225 deg F.

2.5 MECHANICAL SLEEVE SEALS

A. Description: Modular sealing element unit, designed for field assembly, to fill annular space between pipe and sleeve.

1. Sealing Elements: EPDM interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
2. Pressure Plates: Carbon steel. Include two for each sealing element.
3. Connecting Bolts and Nuts: Carbon steel with corrosion-resistant coating of length required to secure pressure plates to sealing elements. Include one for each sealing element.

2.6 FLEXIBLE CONNECTORS

A. General: Fabricated from materials suitable for system fluid and that will provide flexible pipe connections. Include 125-psig minimum working-pressure rating, unless higher working pressure is indicated, and ends according to the following:

1. 2-Inch NPS and Smaller: Threaded.
2. 2-1/2-Inch NPS and Larger: Flanged.
3. Option for 2-1/2-Inch NPS and Larger: Grooved for use with keyed couplings.

B. Bronze-Hose, Flexible Connectors: Corrugated, bronze, inner tubing covered with bronze wire braid. Include copper-tube ends or bronze flanged ends, braze welded to hose.

C. Stainless-Steel-Hose/Steel Pipe, Flexible Connectors: Corrugated, stainless-steel, inner tubing covered with stainless-steel wire braid. Include steel nipples or flanges, welded to hose. Do not use for potable water.

D. Stainless-Steel-Hose/Stainless-Steel Pipe, Flexible Connectors: Corrugated, stainless-steel, inner tubing covered with stainless-steel wire braid. Include stainless-steel nipples or flanges, welded to hose. Do not use for potable water.

E. Couplings may be used to provide allowance for controlled pipe movement, expansion, contraction, and or deflection to absorb movement for thermal changes, setting or seismic action and also vibration attenuation.

2.7 SLEEVES

A. Galvanized-Steel Sheet: 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint.

B. Steel Pipe: ASTM A 53, Type E, Grade B, Schedule 40, galvanized, plain ends.

C. Cast Iron: Cast or fabricated "wall pipe" equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.

D. Stack Sleeve Fittings: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring and bolts and nuts for membrane flashing.

1. Underdeck Clamp: Clamping ring with set screws.

2.8 GROUT

A. Description: ASTM C 1107, Grade B, nonshrink and nonmetallic, dry hydraulic-cement grout.

PART 3 - EXECUTION

3.1 MECHANICAL DEMOLITION

A. Remove and cap all inactive or abandoned piping in mechanical rooms.

B. Disconnect, demolish, and remove mechanical systems, equipment, and components indicated on the drawings to be removed.

1. Piping to Be Removed: Remove portion of piping indicated to be removed and cap or plug remaining piping with same or compatible piping material.

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

3.2 PIPING SYSTEMS - COMMON REQUIREMENTS

A. Install piping according to the following requirements and Sections specifying piping systems.

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

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

D. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

E. Install piping to permit valve servicing.

F. Install piping at indicated slopes.

G. Install piping free of sags and bends.

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

I. Install piping to allow application of insulation.

J. Select system components with pressure rating equal to or greater than system operating pressure.

3.3 PIPING JOINT CONSTRUCTION

A. Join pipe and fittings according to the following requirements and Division 22 Sections specifying piping systems.

B. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.

D. Soldered Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy complying with ASTM B 32.

E. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter, using copper-phosphorus brazing filler metal complying with AWS A5.8.

F. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:

1. Note internal length of threads in fittings or valve ends, and proximity of internal seat or wall, to determine how far pipe should be threaded into joint.
2. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
3. Align threads at point of assembly.
4. Tighten joint with wrench. Apply wrench to valve end into which pipe is being threaded.
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.

G. Welded Joints: Construct joints according to AWS D10.12, using qualified processes and welding operators according to Part 1 "Quality Assurance" Article.

H. Flanged Joints: Align flange surfaces parallel. Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Assemble joints by sequencing bolt tightening to make initial contact of flanges and gaskets as flat and parallel as possible. Use suitable lubricants on bolt threads. Tighten bolts gradually and uniformly using torque wrench.

3.4 PIPING CONNECTIONS

A. Make connections according to the following, unless otherwise indicated:

1. Install unions, in piping NPS 2 and smaller, adjacent to each valve and at final connection to each piece of equipment.
2. Install flanges, in piping NPS 2-1/2 and larger, adjacent to flanged valves and at final connection to each piece of equipment.
3. Wet Piping Systems: Install dielectric coupling and nipple fittings to connect piping materials of dissimilar metals

3.5 EQUIPMENT INSTALLATION - COMMON REQUIREMENTS

A. Install equipment to provide maximum possible headroom, if mounting heights are not indicated.

B. Install equipment according to approved submittal data. Portions of the Work are shown only in diagrammatic form. Refer conflicts to Architect.

C. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, unless otherwise indicated.

D. Install mechanical equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting, with minimum interference to other installations. Extend grease fittings to accessible locations.

E. Install equipment giving right of way to piping installed at required slope.

F. Install flexible connectors on equipment side of shutoff valves, horizontally and parallel to equipment shafts if possible.

3.6 GROUTING

A. Install nonmetallic, nonshrink, grout for mechanical equipment base bearing surfaces, pump and other equipment base plates, and anchors. Mix grout according to manufacturer's written instructions.

B. Clean surfaces that will come into contact with grout.

C. Provide forms as required for placement of grout.

D. Avoid air entrapment during placing of grout.

E. Place grout, completely filling equipment bases.

F. Place grout on concrete bases to provide smooth bearing surface for equipment.

G. Place grout around anchors.

H. Cure placed grout according to manufacturer's written instructions.

3.7 CLEANING

A. Coordinate general cleanup with the work as specified in Division 1.

3.8 ERECTION

A. Provide all necessary rigging, scaffolding, tools, tackle, labor and other like items necessary for the complete installation of the equipment.

B. Adapt his work to job conditions and install his work to clear beams, joists and light fixtures, adjusting risers, avoiding interferences with windows and openings, raising or lowering work to permit the passing of ductwork or the work of other trades, all as required or as job conditions dictate, without additional costs to the Owner.

C. Trade Contractor shall not rig, tie to, or rest weight upon any part of the building or make use of any stairway until specific permission is obtained.

1. Permission to rig to or make use of any part of the building premises shall not relieve the contractor of responsibility for any damage.

D. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor mechanical materials and equipment.

E. Field Welding: Comply with AWS D1.1, "Structural Welding Code--Steel."

END OF SECTION 230505

SECTION 230513

COMMON MOTOR REQUIREMENTS FOR HVAC EQUIPMENT

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. General construction and requirements.

B. Applications.

C. Single phase electric motors.

D. Three phase electric motors.

1.02 REFERENCE STANDARDS

A. ABMA STD 9 - Load Ratings and Fatigue Life for Ball Bearings; 2015.

B. IEEE 112 - IEEE Standard Test Procedure for Polyphase Induction Motors and Generators; 2004.

C. NEMA MG 1 - Motors and Generators; 2017.

D. NFPA 70 - National Electrical Code; 2017.

1.03 SUBMITTALS

A. See Specification 230505 1.3

B. Product Data: Provide wiring diagrams with electrical characteristics and connection requirements. Provide nameplate data and ratings; shipping, installed, and operating weights; enclosure type and mounting arrangements; size, type, and location of winding terminations; conduit entry and ground lug locations; and information on coatings or finishes.

C. Shop Drawings for Field-Installed Motors: Dimensioned plans, elevations, sections, and details, including required clearances and service space around equipment. Include the following:

1. Each installed unit's type and details.
2. Nameplate legends.
3. Diagrams of power, signal, and control wiring. Provide schematic wiring diagram for each type of motor and for each control scheme.

D. Coordination Drawings: Floor plans showing dimensioned layout, required working clearances, and required area above and around field-installed motors. Show motor layout, mechanical power transfer link, driven load, and relationship between electrical

components and adjacent structural and mechanical elements. Show support locations, type of support, and weight on each support. Indicate field measurements.

E. Test Reports: Indicate test results verifying nominal efficiency and power factor for three phase motors larger than 1/2 horsepower.

F. Manufacturer's Installation Instructions: Indicate setting, mechanical connections, lubrication, and wiring instructions.

G. Operation Data: Include instructions for safe operating procedures.

H. Maintenance Data: Include assembly drawings, bearing data including replacement sizes, and lubrication instructions.

1.04 QUALITY ASSURANCE

A. Conform to NFPA 70.

B. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc. as suitable for the purpose specified and indicated.

C. Product Options for Field-Installed Motors: Drawings indicate size, profiles, and dimensional requirements of motors and are based on the specific system indicated.

D. 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.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Protect motors stored on site from weather and moisture by maintaining factory covers and suitable weather-proof covering. For extended outdoor storage, remove motors from equipment and store separately.

1.06 COORDINATION

A. Coordinate features of motors, installed units, and accessory devices and features that comply with the following:

1. Compatible with the following:

    a. Magnetic controllers.
    b. Multispeed controllers.
    c. Reduced-voltage controllers.

2. Designed and labeled for use with variable frequency controllers, and suitable for use throughout speed range without overheating.
3. Matched to torque and horsepower requirements of the load.
4. Matched to ratings and characteristics of supply circuit and required control sequence.

B. Coordinate motor support with requirements for driven load; access for maintenance and motor replacement; installation of accessories, belts, belt guards; and adjustment of sliding rails for belt tensioning.

C. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.

1.07 WARRANTY

A. Written manufacturer's warranty covering parts and labor for a period of one year from substantial completion, or eighteen months from shipment, whichever is longer.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Baldor Electric Company/ABB Group

B. General Electric

C. Lincoln Motors

D. Marathon

E. Reliance

F. U.S. Motors

2.02 GENERAL CONSTRUCTION AND REQUIREMENTS

A. Electrical Service:

1. Motors 1/2 HP and Smaller: 115 volts, single phase, 60 Hz.
2. Motors Larger than 1/2 Horsepower: ___ volts, three phase, 60 Hz.

B. Construction:

1. Open drip-proof type except where specifically noted otherwise.
2. Design for continuous operation in 104 degrees F environment.
3. Design for temperature rise in accordance with NEMA MG 1 limits for insulation class, service factor, and motor enclosure type.

C. Visible Nameplate: Indicating motor horsepower, voltage, phase, cycles, RPM, full load amps, locked rotor amps, frame size, manufacturer's name and model number, service factor, power factor, efficiency.

D. Wiring Terminations:

1. Provide terminal lugs to match branch circuit conductor quantities, sizes, and materials indicated. Enclose terminal lugs in terminal box sized to NFPA 70, threaded for conduit.

2. For fractional horsepower motors where connection is made directly, provide threaded conduit connection in end frame.

2.03 APPLICATIONS

A. Motors located in exterior locations, wet air streams downstream of sprayed coil dehumidifiers, draw through cooling towers, air cooled condensers, humidifiers, direct drive axial fans, roll filters, explosion proof environments, and dust collection systems: Totally enclosed type.

B. Motors located outdoors and in draw through cooling towers: Totally enclosed weatherproof epoxy-sealed type.

2.04 SINGLE PHASE POWER - SPLIT PHASE MOTORS

A. Starting Torque: Less than 150 percent of full load torque.

B. Starting Current: Up to seven times full load current.

C. Breakdown Torque: Approximately 200 percent of full load torque.

D. Drip-proof Enclosure: Class A (50 degrees C temperature rise) insulation, NEMA Service Factor, prelubricated sleeve or ball bearings.

E. Enclosed Motors: Class A (50 degrees C temperature rise) insulation, 1.0 Service Factor, prelubricated ball bearings.

2.05 SINGLE PHASE POWER - PERMANENT-SPLIT CAPACITOR MOTORS

A. Starting Torque: Exceeding one fourth of full load torque.

B. Starting Current: Up to six times full load current.

C. Multiple Speed: Through tapped windings.

D. Open Drip-proof or Enclosed Air Over Enclosure: Class A (50 degrees C temperature rise) insulation, minimum 1.0 Service Factor, prelubricated sleeve or ball bearings, automatic reset overload protector.

2.06 SINGLE PHASE POWER - CAPACITOR START MOTORS

A. Starting Torque: Three times full load torque.

B. Starting Current: Less than five times full load current.

C. Pull-up Torque: Up to 350 percent of full load torque.

D. Breakdown Torque: Approximately 250 percent of full load torque.

E. Motors: Capacitor in series with starting winding; provide capacitor-start/capacitor-run motors with two capacitors in parallel with run capacitor remaining in circuit at operating speeds.

F. Drip-proof Enclosure: Class A (50 degrees C temperature rise) insulation, NEMA Service Factor, prelubricated sleeve bearings.

G. Enclosed Motors: Class A (50 degrees C temperature rise) insulation, 1.0 Service Factor, prelubricated ball bearings.

2.07 THREE PHASE POWER - SQUIRREL CAGE MOTORS

A. Starting Torque: Between 1 and 1-1/2 times full load torque.

B. Starting Current: Six times full load current.

C. Power Output, Locked Rotor Torque, Breakdown or Pull Out Torque: NEMA Design B characteristics.

D. Design, Construction, Testing, and Performance: Conform to NEMA MG 1 for Design B motors.

E. Insulation System: NEMA Class B or better.

F. All three phase motors shall be rated for VFD applications.

G. Testing Procedure: In accordance with IEEE 112. Load test motors to determine free from electrical or mechanical defects in compliance with performance data.

H. Motor Frames: NEMA Standard T-Frames of steel, aluminum, or cast iron with end brackets of cast iron or aluminum with steel inserts.

I. Bearings: Grease lubricated anti-friction ball bearings with housings equipped with plugged provision for relubrication, rated for minimum ABMA STD 9, L-10 life of 20,000 hours. Calculate bearing load with NEMA minimum V-belt pulley with belt center line at end of NEMA standard shaft extension. Stamp bearing sizes on nameplate.

J. Sound Power Levels: To NEMA MG 1.

K. Weatherproof Epoxy Sealed Motors: Epoxy seal windings using vacuum and pressure with rotor and starter surfaces protected with epoxy enamel; bearings double shielded with waterproof non-washing grease.

L. Nominal Efficiency: As indicated at full load and rated voltage when tested in accordance with IEEE 112.

M. Nominal Power Factor: As indicated at full load and rated voltage when tested in accordance with IEEE 112.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine areas to receive field-installed motors for compliance with requirements, installation tolerances, and other conditions affecting performance.

B. Examine roughing-in for conduit systems to verify actual locations of conduit connections before motor installation.

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

3.02 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install securely on firm foundation. Mount ball bearing motors with shaft in any position.

C. Check line voltage and phase and ensure agreement with nameplate.

3.03 FIELD QUALITY CONTROL FOR FIELD-INSTALLED MOTORS

A. Prepare for acceptance tests.

1. Align motors, bases, shafts, pulleys, and belts. Tension belts according to manufacturer's written instructions.
2. Verify bearing lubrication.
3. Run each motor with its controller. Demonstrate correct rotation, alignment, and speed at motor design load.
4. Test interlocks and control and safety features for proper operation.
5. Verify that current and voltage for each phase comply with nameplate rating and NEMA MG 1 tolerances.

B. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust field-assembled components and equipment installation, including connections, and to assist in field testing. Report results in writing.

C. Perform the following field tests and inspections and prepare test reports:

1. Perform electrical tests and visual and mechanical inspections including optional tests and inspections stated in NETA ATS on factory- and field-installed motors. Certify compliance with test parameters.
2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.

3.04 CLEANING

A. Comply with applicable requirements in Division 23 Section "HVAC Equipment Cleaning."

3.05 CONTRACTOR STARTUP AND REPORTING

A. Prepare for acceptance tests.

1. Align motors, bases, shafts, pulleys, and belts. Tension belts according to manufacturer's written instructions.
2. Verify bearing lubrication.

3. Run each motor with its controller. Demonstrate correct rotation, alignment, and speed at motor design load.
4. Test interlocks and control and safety features for proper operation.
5. Verify that current and voltage for each phase comply with nameplate rating and NEMA MG 1 tolerances.

B. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust field-assembled components and equipment installation, including connections, and to assist in field testing. Report results in writing.

C. Perform the following field tests and inspections and prepare test reports:

1. Perform electrical tests and visual and mechanical inspections including optional tests and inspections stated in NETA ATS on factory- and field-installed motors. Certify compliance with test parameters.
2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.

END OF SECTION 230513

SECTION 230516

EXPANSION FITTINGS AND LOOPS FOR HVAC PIPING

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Expansion joints - stainless steel bellows type.

B. Expansion loops - hard piped

C. Expansion loops - hose and braid

D. Alignment guides and anchors.

1.02 REFERENCE STANDARDS

A. ASME B31.9 - Building Services Piping; 2014.

B. ASME BPVC-IX - Boiler and Pressure Vessel Code, Section IX - Welding, Brazing, and Fusing Procedures; Welders; Brazers; and Welding, Brazing and Fusing Operators; 2017.

C. ASTM A183 - Standard Specification for Carbon Steel Track Bolts and Nuts; 2014.

D. ASTM A307 - Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60 000 PSI Tensile Strength; 2014 (Editorial 2017).

E. ASTM A36/A36M - Standard Specification for Carbon Structural Steel; 2014.

F. ASTM C1107/C1107M - Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink); 2014a.

G. ASTM C881/C881M - Standard Specification for Epoxy-Resin-Base Bonding Systems for Concrete; 2015.

H. ASTM F844 - Standard Specification for Washers, Steel, Plain (Flat), Unhardened for General Use; 2007a (Reapproved 2013).

I. AWS D1.1/D1.1M - Structural Welding Code - Steel; 2015, with Errata (2016).

1.03 SUBMITTALS

A. See Specification 230505 1.3

B. Product Data:

1. Flexible Pipe Connectors: Indicate maximum temperature and pressure rating, face-to-face length, live length, hose wall thickness, hose convolutions per foot

and per assembly, fundamental frequency of assembly, braid structure, and total number of wires in braid.

2. Expansion Joints: Indicate maximum temperature and pressure rating, and maximum expansion compensation.

C. Welding certificates

D. Product Certificates: For each type of pipe expansion joint, signed by product manufacturer.

E. Design Data: Indicate selection calculations.

F. Manufacturer's Instructions: Indicate manufacturer's installation instructions, special procedures, and external controls.

G. Maintenance Data: Include adjustment instructions.

H. Project Record Documents: Record installed locations of flexible pipe connectors, expansion joints, anchors, and guides.

1.04 QUALITY ASSURANCE

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

1. Steel Shapes and Plates: AWS D1.1/D1.1M

1.05 PERFORMANCE REQUIREMENTS

A. Compatibility: Products shall be suitable for piping system fluids, materials, working pressures, and temperatures.

B. Capability: Products shall absorb 200 percent of maximum axial movement between anchors.

PART 2 - PRODUCTS

2.01 EXPANSION JOINTS - STAINLESS STEEL BELLOWS TYPE

A. Manufacturers:

1. The Metraflex Company
2. Hyspan Precision Products, Inc.
3. Piping Technology & Products, Inc.
4. Senior Flexonics, Inc.

B. Pressure Rating: 150 psi and 400 degrees F.

C. Maximum Compression: 1-3/4 inches.

D. Maximum Extension: 1/4 inch.

E. Joint: Flanged.

F. Size: Use pipe sized units.

2.02 EXPANSION LOOPS - HARD PIPED

A. Joint: Welded.

B. Size: Use pipe sized units.

C. Dimensions: To be calculated by EOR based on pipe material, size, fluid temperature and available space.

2.03 ALIGNMENT GUIDES

A. Manufacturers

1. Metraflex
2. Hyspan Precision Products, Inc.
3. Piping Technology & Products, Inc.
4. Senior Flexonics, Inc.

B. Description: Steel, factory fabricated, with bolted two-section outer cylinder and base for alignment of piping and two-section guiding spider for bolting to pipe.

2.04 ANCHOR MATERIALS

A. Steel Shapes and Plates: ASTM A36/A36M.

B. Bolts and Nuts: ASME B18.10 or ASTM A183, steel, hex head.

C. Washers: ASTM F844, steel, plain, flat washers.

D. Mechanical Fasteners: Insert-wedge-type stud with expansion plug anchor for use in hardened portland cement concrete, and tension and shear capacities appropriate for application.

1. Stud: Threaded, zinc-coated carbon steel.
2. Expansion Plug: Zinc-coated steel.
3. Washer and Nut: Zinc-coated steel.

E. Chemical Fasteners: Insert-type-stud bonding system anchor for use with hardened portland cement concrete, and tension and shear capacities appropriate for application.

1. Bonding Material: ASTM C881/C881M, Type IV, Grade 3, 2-component epoxy resin suitable for surface temperature of hardened concrete where fastener is to be installed.
2. Stud: ASTM A307, zinc-coated carbon steel with continuous thread on stud, unless otherwise indicated.
3. Washer and Nut: Zinc-coated steel.

F. Concrete: Portland cement mix, 3000 psi minimum. Comply with requirements in Section 03 30 00 - Cast-in-Place Concrete for formwork, reinforcement, and concrete.

G. Grout: ASTM C1107/C1107M, factory-mixed and -packaged, dry, hydraulic-cement, nonshrink, nonmetallic grout; suitable for interior and exterior applications.

1. Properties: Nonstaining, noncorrosive, and nongaseous.
2. Design Mix: 5000-psi 28-day compressive strength.

2.05 EXPANSION LOOPS - HOSE AND BRAID

A. Manufacturers:

1. The Metraflex Company; Metraloop
2. Flex-Hose Co., Inc.
3. Flexicraft Industries

B. Provide flexible loops with two flexible sections of hose and braid, two 90 degree elbows, and 180 degree return with support bracket and air release or drain plug.

C. Provide flexible loops capable of movement in the x, y, and z planes. Flexible loops to impart no thrust loads to the building structure.

D. Flexible-Hose Expansion Joints for Copper Piping: Copper-alloy fittings with solder-joint end connections.

1. NPS 2 and Smaller: Bronze hoses and double-braid bronze sheaths with 700 psig at 70 deg F and 500 psig at 450 deg F ratings.
2. NPS 2-1/2 to NPS 4: Stainless-steel hoses and double-braid, stainless-steel sheaths with 420 psig at 70 deg F and 315 psig at 450 deg F ratings.

E. Flexible-Hose Expansion Joints for Steel Piping: Carbon-steel fittings with threaded end connections for NPS 2 and smaller and flanged end connections for NPS 2-1/2 and larger.

1. NPS 2 and Smaller: Stainless-steel hoses and double-braid, stainless-steel sheaths with 700 psig at 70 deg F and 515 psig at 600 deg F ratings.
2. NPS 2-1/2 to NPS 6: Stainless-steel hoses and double-braid, stainless-steel sheaths with 275 psig at 70 deg F and 200 psig at 600 deg F ratings.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install manufactured, nonmetallic expansion joints according to FSA's "Technical Handbook: Non-Metallic Expansion Joints and Flexible Pipe Connectors."

C. Install flexible pipe connectors on pipes connected to vibration isolated equipment. Provide line size flexible connectors.

D. Install flexible connectors at right angles to displacement. Install one end immediately adjacent to isolated equipment and anchor other end. Install in horizontal plane unless indicated otherwise.

E. Anchor pipe to building structure where indicated. Provide pipe guides so movement is directed along axis of pipe only. Erect piping such that strain and weight is not on cast connections or apparatus.

F. Provide support and equipment required to control expansion and contraction of piping. Provide loops, pipe offsets, and swing joints, or expansion joints where required.

G. Pipe Bend and Loop Installation

1. Attach pipe bends and loops to anchors.

    a. Steel Anchors: Attach by welding. Comply with ASME B31.9 and ASME BPVC-IX.
    b. Concrete Anchors: Attach by fasteners. Follow fastener manufacturer's written instructions.

H. Alignment-guide Installation

1. Install guides on piping adjoining pipe expansion fittings and loops.
2. Attach guides to pipe and secure to building structure.

I. Anchor Installation

1. Install anchors at locations to prevent stresses from exceeding those permitted by ASME B31.9 and to prevent transfer of loading and stresses to connected equipment.
2. Fabricate and install steel anchors by welding steel shapes, plates, and bars to piping and to structure. Comply with ASME B31.9 and AWS D1.1/D1.1M.
3. Construct concrete anchors of poured-in-place concrete of dimensions indicated and include embedded fasteners.
4. Install pipe anchors according to expansion-joint manufacturer's written instructions if expansion joints or compensators are indicated.
5. Use grout to form flat bearing surfaces for expansion fittings, guides, and anchors installed on or in concrete.

END OF SECTION 230516

SECTION 230519

METERS AND GAGES FOR HVAC PIPING

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Pressure gages and pressure gage taps.

B. Thermometers and thermometer wells.

1.02 REFERENCE STANDARDS

A. ASME B40.100 - Pressure Gauges and Gauge Attachments; 2013.

B. ASTM E1 - Standard Specification for ASTM Liquid-in-Glass Thermometers; 2014.

C. UL 393 - Indicating Pressure Gauges for Fire-Protection Service; Current Edition, Including All Revisions.

1.03 SUBMITTALS

A. See Specification 230505 1.3

B. Product Data: Provide list that indicates use, operating range, total range and location for manufactured components.

C. Project Record Documents: Record actual locations of components and instrumentation.

D. Product Certificates: For each type of thermometer and gage, signed by product manufacturer.

1.04 DELIVERY, STORAGE AND HANDLING

A. Follow manufacturer’s instructions for job site storage and protection of materials during construction.

PART 2 - PRODUCTS

2.01 PRESSURE GAGES

A. Manufacturers:

1. Ashcroft
2. Trerice
3. Weiss Instruments

B. Pressure Gages: ASME B40.100, UL 393 drawn steel case, glass window, phosphor bronze bourdon tube, rotary brass movement, brass socket, with front recalibration adjustment, black scale on white background.

1. Case: Steel with brass bourdon tube.
2. Size: 4-1/2 inch diameter.
3. Mid-Scale Accuracy: One percent.
4. Scale: Psi and KPa.
5. Range: 2 times operating pressure.

2.02 PRESSURE GAGE TAPPINGS

A. Needle Valve: Stainless Steel or 1/4 inch NPT for minimum 150 psi.

B. Pulsation Damper: ASME B40.5 Pressure snubber, brass with 1/4 inch connections.

C. Syphon: Brass, 1/4 inch angle or straight pattern, threaded ends.

2.03 DIAL THERMOMETERS

A. Manufacturers:

B. Thermometer: ASTM E1, stainless steel case, adjustable angle with front recalibration, bimetallic helix actuated with silicone fluid damping, white with black markings and black pointer hermetically sealed lens, stainless steel stem.

1. Size: 5 inch diameter dial.
2. Lens: Clear glass.
3. Accuracy: 1 percent.
4. Calibration: Degrees F.

C. Thermometers: Dial type vapor or liquid actuated; ASTM E1; stainless steel case, with brass or copper bulb, copper or bronze braided capillary, white with black markings and black pointer, glass lens.

1. Size: 4-1/2 inch diameter dial.
2. Lens: Clear glass.
3. Length of Capillary: Minimum 5 feet.
4. Accuracy: 1 percent.
5. Calibration: Degrees F.

2.04 THERMOWELLS

A. Socket: Pressure-tight, socket-type metal fitting made for insertion into piping and of type, diameter, and length required to hold thermometer.

1. Manufacturers:

a. Ashcroft
b. Trerice
c. Weiss Instruments

2. Stem length: Extend 2 inches into the fluid or into the center of the pipe. Extension for insulated pipe shall be 2 inches nominal, but not less than the thickness of the insulation.
3. Provide threaded cap nut with chain permanently fastened to well and cap.

2.05 TEST PLUGS

A. Manufacturers:

1. MG Piping Products
2. Trerice
3. Watts Industries

B. Description: Corrosion-resistant brass or stainless-steel body with core inserts and gasketed and threaded cap, with extended stem for units to be installed in insulated piping.

C. Test Plug: 1/4 inch or 1/2 inch brass fitting and cap for receiving 1/8 inch outside diameter pressure or temperature probe with neoprene core for temperatures up to 200 degrees F.

D. Test Plug: 1/4 inch or 1/2 inch brass fitting and cap for receiving 1/8 inch outside diameter pressure or temperature probe with Nordel core for temperatures up to 350 degrees F.

E. Test Plug: 1/4 inch or 1/2 inch brass fitting and cap for receiving 1/8 inch outside diameter pressure or temperature probe with Viton core for temperatures up to 400 degrees F.

F. Test Kit: Carrying case, internally padded and fitted containing one 2-1/2 inch diameter pressure gages (0-200 psi), one gage adapters with 1/8 inch probes, two 1 inch dial thermometers (one 25-125 deg. F and one 0-220 deg F).

PART 3 - EXECUTION

3.01 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install pressure gages with pulsation dampers. Provide gage cock to isolate each gauge. Provide siphon on gages in steam systems. Extend nipples and siphons to allow clearance from insulation.

C. Locate duct mounted thermometers minimum 10 feet downstream of mixing dampers, coils, or other devices causing air turbulence. Attach to duct with screws.

D. Coil and conceal excess capillary on remote element instruments.

E. Provide instruments with scale ranges selected according to service with largest appropriate scale.

F. Install gages and thermometers in locations where they are easily read from normal operating level. Install vertical to 45 degrees off vertical.

G. Adjust gages and thermometers to final angle, clean windows and lenses, and calibrate to manufacturers written instructions, after installation.

H. Locate test plugs adjacent thermometers and thermometer sockets.

I. Apply conductive paste to the thermometer or temperature sensor prior to installing it in the thermowell.

J. Install remote-mounting pressure gages on panel.

K. Install needle-valve and snubber fitting in piping for each pressure gage for fluids (except steam).

L. Install test plugs in tees in piping. Provide a test plug at every thermometer and pressure gage location, and where indicated on the Drawings.

3.02 SCHEDULE

A. THERMOMETER APPLICATIONS

1. Install liquid-in-glass thermometers in the following locations and elsewhere as noted:

    a. Inlet and outlet of each hydronic boiler.

2. Install dry-case-type, vapor-actuated dial thermometers at suction and discharge of each pump and as indicated on Drawings.
3. Provide the following temperature ranges for thermometers:

    a. Heating Hot Water (Non-condensing boiler applications): 30 to 300 deg F, with 2-degree scale divisions.

END OF SECTION 230519

SECTION 230523

GENERAL-DUTY VALVES FOR HVAC PIPING

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Applications.

B. General requirements.

C. Globe valves.

D. Ball valves.

E. Butterfly valves.

F. Check valves.

G. Plug valves.

H. Chainwheels.

1.02 ABBREVIATIONS AND ACRONYMS

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. PTFE: Polytetrafluoroethylene.

G. RS: Rising stem.

H. SWP: Steam working pressure.

I. TFE: Tetrafluoroethylene.

1.03 REFERENCE STANDARDS

A. See Specification 230505 1.3

B. ASME B1.20.1 - Pipe Threads, General Purpose (Inch); 2013.

C. ASME B16.1 - Gray Iron Pipe Flanges and Flanged Fittings: Classes 25, 125, and 250; 2015.

D. ASME B16.5 - Pipe Flanges and Flanged Fittings NPS 1/2 Through NPS 24 Metric/Inch Standard; 2017.

E. ASME B16.10 - Face-to-Face and End-to-End Dimensions of Valves; 2017.

F. ASME B16.18 - Cast Copper Alloy Solder Joint Pressure Fittings; 2012.

G. ASME B16.34 - Valves - Flanged, Threaded and Welding End; 2017.

H. ASME B31.9 - Building Services Piping; 2014.

I. ASME BPVC-IX - Boiler and Pressure Vessel Code, Section IX - Welding, Brazing, and Fusing Procedures; Welders; Brazers; and Welding, Brazing and Fusing Operators; 2017.

J. ASTM A48/A48M - Standard Specification for Gray Iron Castings; 2003 (Reapproved 2016).

K. ASTM A126 - Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings; 2004 (Reapproved 2014).

L. ASTM B62 - Standard Specification for Composition Bronze or Ounce Metal Castings; 2017.

M. MSS SP-67 - Butterfly Valves; 2017.

N. MSS SP-72 - Ball Valves with Flanged or Butt-Welding Ends for General Service; 2010a.

O. MSS SP-78 - Cast Iron Plug Valves, Flanged and Threaded Ends; 2011.

P. MSS SP-80 - Bronze Gate, Globe, Angle and Check Valves; 2013.

Q. MSS SP-85 - Cast Iron Globe & Angle Valves, Flanged and Threaded Ends; 2011.

R. MSS SP-110 - Ball Valves Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends; 2010.

S. MSS SP-125 - Gray Iron and Ductile Iron In-Line, Spring-Loaded, Center-Guided Check Valves; 2010.

T. NSF 61 - Drinking Water System Components - Health Effects; 2017.

1.04 SUBMITTALS

A. Product Data: Provide data on valves including manufacturers catalog information. Submit performance ratings, rough-in details, weights, support requirements, and piping connections.

B. Operation and Maintenance Data: Include manufacturer's descriptive literature, operating instructions, maintenance and repair data, and parts listings.

C. Maintenance Materials: Furnish Board with one wrench for every five plug valves, in each size of square plug valve head.

1. See Section 01 60 00 - Product Requirements, for additional provisions.

1.05 QUALITY ASSURANCE

A. Manufacturer:

1. Obtain valves for each valve type from single manufacturer.

B. Welding Materials and Procedures: Conform to ASME BPVC-IX.

C. ASME Compliance: ASME B31.9 for building services piping valves.

D. ASME Compliance for Ferrous Valves: ASME B16.10 and ASME B16.34 for dimension and design criteria.

E. NSF Compliance: NSF 61 for valve materials for potable-water service.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Prepare valves for shipping as follows:

1. Minimize exposure of operable surfaces by setting plug and ball valves to open position.
2. Protect valve parts exposed to piped medium against rust and corrosion.
3. Protect valve piping connections such as grooves, weld ends, threads, and flange faces.
4. Adjust globe and angle valves to the closed position to avoid clattering.
5. Secure check valves in either the closed position or open position.
6. Adjust butterfly valves to closed or partially closed position.

B. Use the following precautions during storage:

1. Maintain valve end protection and protect flanges and specialties from dirt.

a. Provide temporary inlet and outlet caps.
b. Maintain caps in place until installation.

2. Store valves in shipping containers and maintain in place until installation.

a. Store valves indoors in dry environment.
b. Store valves off the ground in watertight enclosures when indoor storage is not an option.

C. Exercise the following precautions for handling:

1. Handle large valves with sling, modified to avoid damage to exposed parts.

2. Avoid the use of operating handles or stems as rigging or lifting points.

PART 2 - PRODUCTS

2.01 APPLICATIONS

A. See drawings for specific valve locations.

B. Provide the following valves for the applications if not indicated on drawings:

1. Throttling (Hydronic): Butterfly, Ball, and Globe.
2. Isolation (Shutoff): Butterfly, Ball, and Plug.
3. Swing Check (Pump Outlet):

a. 2 NPS and Smaller: Bronze with bronze disc.
b. 2-1/2 NPS and Larger: Iron with lever and spring.

C. Substitutions of valves with higher CWP classes or SWP ratings for same valve types are permitted when specified CWP ratings or SWP classes are not available.

D. Heating Hot Water Valves:

1. 2 NPS and Smaller, Bronze Valves:

a. Threaded ends.
b. Ball: Full port, two piece, bronze trim.
c. Swing Check: Bronze disc, Class 125.
d. Globe: Bronze disc, Class 125.

2. 2-1/2 NPS and Larger, Iron Valves:

a. Ball: 2-1/2 NPS to 10 NPS, Class 150.
b. Single-Flange Butterfly: 2-1/2 NPS to 12 NPS, aluminum-bronze disc, EPDM seat, 200 CWP.
c. Single-Flange Butterfly: 14 NPS to 24 NPS, aluminum-bronze disc, EPDM seat, 150 CWP.
d. Swing Check: 2-1/2 NPS to 12 NPS, lever and spring closure control, Class 125.
e. Center-Guided Check: Compact-wafer, metal seat, Class 125.
f. Globe: 2-1/2 NPS to 12 NPS, Class 125.

2.02 GENERAL REQUIREMENTS

A. Valve Pressure and Temperature Ratings: No less than rating indicated; as required for system pressures and temperatures.

B. Valve Sizes: Match upstream piping unless otherwise indicated.

C. Valve Actuator Types:

1. Handwheel: Valves other than quarter-turn types.

2. Hand Lever: Quarter-turn valves 6 NPS and smaller.

D. Valves in Insulated Piping: Provide 2 NPS stem extensions and the following features:

1. Gate Valves: Rising stem.
2. Ball Valves: Extended operating handle of non-thermal-conductive material, and protective sleeve that allows operation of valve without breaking the vapor seal or disturbing insulation.
3. Butterfly Valves: Extended neck.
4. Memory Stops: Fully adjustable after insulation is installed.

E. Valve-End Connections:

1. Threaded End Valves: ASME B1.20.1.
2. Flanges on Iron Valves: ASME B16.1 for flanges on iron valves.
3. Pipe Flanges and Flanged Fittings 2 1/2 NPS through 24 NPS: ASME B16.5.
4. Solder Joint Connections: ASME B16.18.

F. General ASME Compliance:

1. Building Services Piping Valves: ASME B31.9.

G. Source Limitations: Obtain each valve type from a single manufacturer.

2.03 BRONZE GLOBE VALVES

A. Class 125: CWP Rating: 200 psig:, and Class 150: CWP Rating: 300 psig:.

1. Comply with MSS SP-80, Type 1.
2. Body: Bronze; ASTM B62, with integral seat and screw in bonnet.
3. Ends: Threaded or solder joint.
4. Stem: Silicon Bronze-alloy
5. Disc: Bronze or PTFE.
6. Packing: Asbestos free.

a. Handwheel: Malleable iron.
b. Manufacturers:

1) Crane Co.
2) Milwaukee Valve Company
3) NIBCO, Inc.
4) Apollo Valve

2.04 IRON GLOBE VALVES

A. Class 125: CWP Rating: 200 psig:.

1. Comply with MSS SP-85, Type I.
2. Body: Gray iron; ASTM A126, with bolted bonnet.
3. Ends: Flanged.
4. Trim: Bronze.

5. Packing and Gasket: Asbestos free, teflon-impregnated packing with bronze nut.
6. Operator: Aluminum or malleable-iron handwheel or chainwheel.
7. Manufacturers:

    a. Crane Co.
    b. Milwaukee Valve Company
    c. NIBCO, Inc.
    d. Apollo Valve

2.05 BRONZE BALL VALVES

A. Two Piece, Full Port with Bronze or Brass Trim:

1. Comply with MSS SP-110.
2. SWP Rating: 150 psig.
3. CWP Rating: 600 psig.
4. Body: Bronze.
5. Ends: Threaded or soldered.
6. Seats: PTFE .
7. Stem: Bronze or brass.
8. Ball: Chrome plated brass.
9. Manufacturers:

    a. Conbraco Industries
    b. Crane Co.
    c. NIBCO, Inc.
    d. Watts Industries
    e. Apollo Valve

2.06 IRON BALL VALVES

A. Split Body, Full Port:

1. Comply with MSS SP-72.
2. CWP Rating: 200 psig.
3. Body: ASTM A126, gray iron.
4. Ends: Flanged.
5. Seats: PTFE.
6. Stem: Stainless steel.
7. Ball: Stainless steel.

2.07 IRON, SINGLE FLANGE BUTTERFLY VALVES

A. Lug type: Bi-directional dead end service without downstream flange.

1. Comply with MSS SP-67, Type I.
2. CWP Rating: 200 psig.
3. Body Material: ASTM A126 cast iron.
4. Stem: One or two-piece stainless steel.
5. Seat: NBR.
6. Disc: Coated ductile iron.

7. Operator:

    a. Sizes 2 Inches to 6 Inches: Standard lever handle with memory stop.
    b. Sizes 8 Inches to 24 Inches: Gear operator with position indicator.
    c. Sizes 8 Inches and Larger, 96 Inches or Higher above Floor: Chain-wheel operator.

8. Manufacturers:

    a. Crane Co.
    b. Milwaukee Valve Company
    c. NIBCO, Inc.
    d. Watts Industries
    e. Apollo Valve

2.08 BRONZE SWING CHECK VALVES

A. Class 125: CWP Rating: 200 psig (1380 kPa) and Class 150: CWP Rating: 300 psig (2070 kPa).

1. Comply with MSS SP-80, Type 3.
2. Body Design: Horizontal flow.
3. Body Material: Bronze, ASTM B62.
4. Ends: Threaded.
5. Disc: Bronze.
6. Manufacturers:

    a. Crane Co.
    b. Milwaukee Valve Company
    c. NIBCO, Inc.
    d. Watts Industries
    e. Apollo Valve

2.09 IRON, CENTER-GUIDED CHECK VALVES

A. Class 125, Compact-Wafer:

1. Comply with MSS SP-125.
2. 2-1/2 NPS to 12 NPS, CWP Rating: 200 psig.
3. Body Material: ASTM A126, gray iron.
4. Metal Seat: Bronze.
5. Resilient Seat: Buna N.
6. Manufacturers:

    a. Crane Co.
    b. NIBCO, Inc.
    c. Watts Industries
    d. Apollo Valve

2.10 LUBRICATED PLUG VALVES

A. Regular Gland and Cylindrical with Threaded Ends:

1. Comply with MSS SP-78, Type II.
2. Class 125: 2-1/2 NPS to 12 NPS, CWP Rating: 200 psig.
3. Body Material: Cast iron with lubrication sealing system.
4. Pattern: Regular or short.
5. Plug: Cast iron or bronze with sealant groove.
6. Operator:

a. Lever for valves 5" and smaller
b. Worm and gear with handwheel for valves 6" and larger
c. Worm and gear with chain wheel, sizes 6 inches and larger, 96 inches or higher above floor.

7. Manufacturers:

a. General Signal; DeZurik Unit.
b. Grinnell Corporation.
c. Tyco International, Ltd.; Tyco Valves & Controls.

2.11 CHAINWHEELS

A. Description: Valve actuation assembly with sprocket rim, brackets, and chain.

1. Brackets: Type, number, size, and fasteners required to mount actuator on valve.
2. Attachment: For connection to ball, butterfly, and plug valve stems.
3. Sprocket Rim with Chain Guides: Ductile iron include zinc coating.
4. Chain: Hot-dip galvanized steel. Sized to fit sprocket rim.

B. Manufacturers:

1. Babbitt Steam Specialty Co.
2. Roto Hammer Industries, Inc.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Discard all packing materials and verify that valve interior, including threads and flanges are completely clean without signs of damage or degradation that could result in leakage.

B. Examine piping system for compliance with requirements for installation tolerances and other conditions affecting performance. Proceed with installation only after unsatisfactory conditions have been corrected.

C. 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.

D. Verify valve parts to be fully operational in all positions from closed to fully open.

E. Confirm gasket material to be suitable for the service, to be of correct size, and without defects that could compromise effectiveness.

F. Should valve is determined to be defective, replace with new valve.

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

H. 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.

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

3.02 INSTALLATION

A. Provide unions or flanges with valves to facilitate equipment removal and maintenance while maintaining system operation and full accessibility for servicing.

B. Provide separate valve support as required and locate valve with stem at or above center of piping, maintaining unimpeded stem movement.

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

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

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

F. Install chainwheel operators on valves NPS 4 and larger and more than 96 inches above floor. Extend chains to 60 inches above finished floor elevation.

G. Install check valves for proper direction of flow and as follows:
1. Swing Check Valves: In horizontal position with hinge pin level.

H. Provide chainwheels on operators for valves 4 NPS and larger where located 96 NPS or more above finished floor, terminating 60 NPS above finished floor.

END OF SECTION 230523

SECTION 230593

TESTING, ADJUSTING, AND BALANCING FOR HVAC

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Testing, adjustment, and balancing of air systems.

B. Testing, adjustment, and balancing of hydronic, steam, and refrigerating systems.

C. Measurement of final operating condition of HVAC systems.

1.02 DEFINITIONS

A. AABC: Associated Air Balance Council.

B. NEBB: National Environmental Balancing Bureau.

C. TAB: Testing, Adjusting, and Balancing.

D. TAB Firm: Entity responsible for performing and reporting TAB procedures.

E. TAB Specialist: Entity engaged by TAB Firm to perform TAB work.

1.03 REFERENCE STANDARDS

A. See Specification 230505 1.3

B. AABC (NSTSB) - AABC National Standards for Total System Balance, 7th Edition; 2016.

C. ASHRAE Std 111 - Measurement, Testing, Adjusting, and Balancing of Building HVAC Systems; 2008.

D. NEBB (TAB) - Procedural Standards for Testing Adjusting and Balancing of Environmental Systems; 2015, with Errata (2017).

E. SMACNA (TAB) - HVAC Systems Testing, Adjusting and Balancing; 2002.

1.04 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.

B. Installer Qualifications: Submit name of adjusting and balancing agency and TAB supervisor for approval within 30 days after award of Contract.

C. TAB Plan: Submit a written plan indicating the testing, adjusting, and balancing standard to be followed and the specific approach for each system and component.

1. Submit to Architect/Engineer of Record.
2. Submit six weeks prior to starting the testing, adjusting, and balancing work.
3. Include certification that the plan developer has reviewed the contract documents, the equipment and systems, and the control system with the Architect/Engineer of Record and other installers to sufficiently understand the design intent for each system.
4. Include at least the following in the plan:

    a. List of all water flow, measurements to be performed and a description of specific test procedures, parameters, formulas to be used.
    b. Copy of field checkout sheets and logs to be used, listing each piece of equipment to be tested, adjusted and balanced with the data cells to be gathered for each.
    c. Discussion of what notations and markings will be made on the duct and piping drawings during the process.
    d. Final test report forms to be used.
    e. Procedures for formal deficiency reports, including scope, frequency and distribution.

D. Final Report: Indicate deficiencies in systems that would prevent proper testing, adjusting, and balancing of systems and equipment to achieve specified performance.

1. Revise TAB plan to reflect actual procedures and submit as part of final report.
2. Submit draft copies of report for review prior to final acceptance of Project. Provide final copies for Architect/Engineer of Record and for inclusion in operating and maintenance manuals.
3. Include actual instrument list, with manufacturer name, serial number, and date of calibration.
4. Form of Test Reports: Where the TAB standard being followed recommends a report format use that; otherwise, follow ASHRAE Std 111.
5. Units of Measure: Report data in I-P (inch-pound) units only.

E. Sample report forms. Submit two copies of the sample TAB report forms

F. Instrument calibration reports, including the following:

1. Instrument type and make.
2. Serial number.
3. Application.
4. Dates of use.
5. Dates of calibration.

1.05 QUALITY ASSURANCE

A. TAB Contractor Qualifications: Engage a TAB entity certified by AABC or NEBB.

1. TAB Field Supervisor: Employee of the TAB contractor and certified by AABC or NEBB.
2. TAB Technician: Employee of the TAB contractor and who is certified by AABC or NEBB as a TAB technician.

B. TAB Conference: Prior to the start of the TAB work, and at Contractor's direction, coordinate a meeting at the Site to review the TAB strategies and procedures plan and to develop a mutual understanding of the details of the work involved. The meeting shall include the Architect/Engineer of Record, the Board Representative, the Commissioning Authority (CxA) (if applicable), the TAB field supervisor, and the TAB technicians. Provide at least seven days' advance notice of meeting date and time.

1. Agenda Items:

a. The Contract Documents examination report.
b. The TAB plan.
c. Coordination and cooperation of trades and subcontractors.
d. Coordination of documentation and communication flow.
e. Submittal distribution requirements.
f. Work Schedule and Project-Site requirements.

2. Record minutes and distribute copies within 5 days after meeting to participants as well as Architect/Engineer of Record, Board and those affected by decisions made.

C. Certification of TAB Reports: Certify TAB field data reports and perform the following:

1. Review field data reports to validate accuracy of data and to prepare certified TAB reports.
2. Certify that the TAB team complied with the approved TAB plan and the procedures specified and referenced in this Specification.

D. TAB Report Forms: Use standard TAB forms from NEBB or AABC as well as providing any additional information required by this specification.

E. Instrumentation Type, Quantity, Accuracy, and Calibration: As described in ASHRAE Std 111, Section 5, "Instrumentation."

1.06 COORDINATION

A. Coordinate the efforts of factory-authorized service representatives for systems and equipment, HVAC controls installers, and other mechanics to operate HVAC systems and equipment to support and assist TAB activities.

B. Notice: Provide seven days' advance notice for each test. Include scheduled test dates and times.

C. Perform TAB after leakage and pressure tests on water distribution systems have been satisfactorily completed.

1.07 WARRANTY

A. Provide warranty in accordance with AABC or NEBB standards:

1. National Project Performance Guarantee: Provide a guarantee on AABC's "National Standards for Testing and Balancing Heating, Ventilating, and Air

Conditioning Systems" forms stating that AABC will assist in completing requirements of the Contract Documents if TAB firm fails to comply with the Contract Documents.

2. Special Guarantee: Provide a guarantee on NEBB forms stating that NEBB will assist in completing requirements of the Contract Documents if TAB firm fails to comply with the Contract Documents.
3. Guarantee shall include the following provisions:

    a. The certified TAB firm has tested and balanced systems according to the Contract Documents.
    b. Systems are balanced to optimum performance capabilities within design and installation limits.

PART 2 - PRODUCTS - NOT USED

PART 3 - EXECUTION

3.01 GENERAL REQUIREMENTS

A. Perform total system balance in accordance with one of the following:

1. AABC (NSTSB), AABC National Standards for Total System Balance.
2. ASHRAE Std 111, Practices for Measurement, Testing, Adjusting and Balancing of Building Heating, Ventilation, Air-Conditioning, and Refrigeration Systems.
3. NEBB Procedural Standards for Testing Adjusting Balancing of Environmental Systems.
4. SMACNA (TAB).

B. Begin work after completion of systems to be tested, adjusted, or balanced and complete work prior to Substantial Completion of the project.

C. Where HVAC systems and/or components interface with life safety systems, including fire and smoke detection, alarm, and control, coordinate scheduling and testing and inspection procedures with the authorities having jurisdiction.

3.02 EXAMINATION

A. Examine the Contract Documents and field conditions to become familiar with Project requirements and to discover conditions that may preclude proper TAB of systems and equipment.

B. Examine the approved submittals for HVAC systems and equipment.

C. Verify that systems are complete and operable before commencing work. Ensure the following conditions:

1. Systems are started and operating in a safe and normal condition.
2. Temperature control systems are installed complete and operable.
3. Proper thermal overload protection is in place for electrical equipment.

4. Final filters are clean and in place. If required, install temporary media in addition to final filters.
5. Air coil fins are cleaned.
6. Hydronic systems are flushed, filled, and vented.
7. Pumps are rotating correctly.
8. Air has been eliminated from closed loop hydronic systems.
9. Proper strainer baskets are clean and in place.
10. Service and balance valves are open.
11. Installed balancing devices, such as test ports, gage cocks, thermometer wells, flow-control devices, balancing valves and fittings, and manual volume dampers-verify that locations of these balancing devices are accessible and all required devices have been installed for proper balancing of the systems.

D. Submit field reports. Report defects and deficiencies that will or could prevent proper system balance.

E. Beginning of work means acceptance of existing conditions.

3.03 PREPARATION

A. Hold a pre-balancing meeting at least one week prior to starting TAB work.

1. Require attendance by all installers whose work will be tested, adjusted, or balanced.

B. Provide a TAB Plan that includes strategies and step-by-step procedures.

C. Provide instruments required for testing, adjusting, and balancing operations. Make instruments available to Architect/Engineer of Record to facilitate spot checks during testing.

D. Provide additional balancing devices as required.

3.04 ADJUSTMENT TOLERANCES

A. Heating Water Systems: Adjust to within plus or minus 10 percent of design.

3.05 RECORDING AND ADJUSTING

A. Field Logs: Maintain written logs including:

1. Running log of events and issues.
2. Discrepancies, deficient or uncompleted work by others.
3. Contract interpretation requests.
4. Lists of completed tests.

B. Ensure recorded data represents actual measured or observed conditions.

C. Permanently mark settings of valves, dampers, and other adjustment devices allowing settings to be restored. Set and lock memory stops.

D. After adjustment, take measurements to verify balance has not been disrupted or that such disruption has been rectified.

E. Leave systems in proper working order, replacing belt guards, closing access doors, closing doors to electrical switch boxes, and restoring thermostats to specified settings.

3.06 WATER SYSTEM PROCEDURE

A. Adjust water systems to provide required or design quantities.

B. Use calibrated Venturi tubes, orifices, or other metered fittings and pressure gages to determine flow rates for system balance. Where flow metering devices are not installed, base flow balance on temperature difference across various heat transfer elements in the system.

C. Adjust systems to provide specified pressure drops and flows through heat transfer elements prior to thermal testing. Perform balancing by measurement of temperature differential in conjunction with air balancing.

D. Effect system balance with automatic control valves fully open to heat transfer elements.

E. Effect adjustment of water distribution systems by means of balancing cocks, valves, and fittings. Do not use service or shut-off valves for balancing unless indexed for balance point.

F. Where available pump capacity is less than total flow requirements or individual system parts, full flow in one part may be simulated by temporary restriction of flow to other parts.

G. Report flow rates that are not within plus/minus 10 percent of design flow.

3.07 BOILER PROCEDURE

A. Hydronic Boilers: Measure and record entering- and leaving-water temperatures and water flow.

3.08 HEAT TRANSFER COIL PROCEDURE

A. PROCEDURES FOR HEAT-TRANSFER COILS

1. Measure, adjust, and record the following data for each water coil:

a. Entering- and leaving-water temperature.
b. Water flow rate.
c. Water pressure drop.
d. Dry-bulb temperature of entering and leaving air.
e. Wet-bulb temperature of entering and leaving air for cooling coils.
f. Airflow.
g. Air pressure drop.

2. Measure, adjust, and record the following data for each electric heating coil:

    a. Nameplate data.
    b. Airflow.
    c. Entering- and leaving-air temperature at full load.
    d. Voltage and amperage input of each phase at full load and at each incremental stage.
    e. Calculated kilowatt at full load.
    f. Fuse or circuit-breaker rating for overload protection.

3. Measure, adjust, and record the following data for each steam coil:

    a. Dry-bulb temperature of entering and leaving air.
    b. Airflow.
    c. Air pressure drop.
    d. Inlet steam pressure.

4. Measure, adjust, and record the following data for each refrigerant coil:

    a. Dry-bulb temperature of entering and leaving air.
    b. Wet-bulb temperature of entering and leaving air.
    c. Airflow.
    d. Air pressure drop.
    e. Refrigerant suction pressure and temperature.

3.09 TOLERANCES

A. Set HVAC system air flow rates and water flow rates within the following tolerances:

1. Heating-Water Flow Rate: Plus or minus 10 percent.

3.10 REPORTING

A. Initial Construction-Phase Report: Based on examination of the Contract Documents as specified in "Examination" Article, prepare a report on the adequacy of design for systems' balancing devices. Recommend changes and additions to systems' balancing devices to facilitate proper performance measuring and balancing. Recommend changes and additions to HVAC systems and general construction to allow access for performance measuring and balancing devices.

3.11 FINAL REPORT

A. General: Prepare a certified written report; tabulate and divide the report into separate sections for tested systems and balanced systems.

1. Include a certification sheet at the front of the report's binder, signed and sealed by the certified testing and balancing engineer.
2. Include a list of instruments used for procedures, along with proof of calibration.

B. Final Report Contents: In addition to certified field-report data, include the following:

1. Pump curves.
2. Fan curves.
3. Manufacturers' test data.
4. Field test reports prepared by system and equipment installers.
5. Other information relative to equipment performance; do not include Shop Drawings and product data.

C. General Report Data: In addition to form titles and entries, include the following data:

1. Title page.
2. Name and address of the TAB contractor.
3. Project name.
4. Project location.
5. Architect's name and address.
6. Engineer's name and address.

D. Pump Test Reports: Calculate impeller size by plotting the shutoff head on pump curves and include the following:

1. Unit Data:

    a. Unit identification.
    b. Location.
    c. Service.
    d. Make and size.
    e. Model number and serial number.
    f. Fluid flow rate in gpm
    g. Fluid pressure differential in feet of head or psig
    h. Required net positive suction head in feet of head or psig
    i. Pump rpm.
    j. Impeller diameter in inches.
    k. Motor make and frame size.
    l. Motor horsepower and rpm.
    m. Voltage at each connection.
    n. Amperage for each phase.
    o. Full-load amperage and service factor.
    p. Seal type.

2. Test Data (Indicated and Actual Values): All values measured in a fluid other than water will include the measured value corrected to the equivalent in water.

    a. Static head in feet of head or psig,
    b. Pump shutoff pressure in feet of head or psig.
    c. Actual impeller size in inches.
    d. Full-open flow rate in gpm.
    e. Full-open pressure in feet of head or psig.
    f. Final discharge pressure in feet of head or psig.
    g. Final suction pressure in feet of head or psig.
    h. Final total pressure in feet of head or psig.

i. Final fluid flow rate in gpm.
j. Voltage, phase to phase.
k. Amperage for each phase.

E. Boiler Test Reports:

1. Unit Data:

a. Unit identification.
b. Location.
c. Service.
d. Make and type.
e. Model and serial numbers.
f. Fuel type and input in Btuh.
g. Number of passes.
h. Ignition type.
i. Burner-control types.
j. Voltage at each connection.
k. Amperage for each phase.

2. Test Data (Indicated and Actual Values):

a. Operating pressure in psig.
b. Operating temperature in deg F.
c. Entering-water temperature in deg F.
d. Leaving-water temperature in deg F.
e. Number of safety valves and sizes in NPS.
f. Safety valve settings in psig.
g. High-limit setting in psig.
h. Operating-control setting.
i. High-fire set point.
j. Low-fire set point.
k. Voltage at each connection.
l. Amperage for each phase.
m. Draft fan voltage at each connection.
n. Draft fan amperage for each phase.
o. Manifold pressure in psig.

END OF SECTION 230593

SECTION 230719

HVAC PIPING INSULATION

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Piping insulation.

B. Flexible removable and reusable blanket insulation.

C. Jackets and accessories.

1.02 REFERENCE STANDARDS

A. ASTM A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar; 2015.

B. ASTM B209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate; 2014.

C. ASTM B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate (Metric); 2014.

D. ASTM C165 - Standard Test Method for Measuring Compressive Properties of Thermal Insulations; 2007 (Reapproved 2012).

E. ASTM C177 - Standard Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded-Hot-Plate Apparatus; 2013.

F. ASTM C195 - Standard Specification for Mineral Fiber Thermal Insulating Cement; 2007 (Reapproved 2013).

G. ASTM C302 - Standard Test Method for Density and Dimensions of Preformed Pipe-Covering-Type Thermal Insulation; 2013.

H. ASTM C449 - Standard Specification for Mineral Fiber Hydraulic-Setting Thermal Insulating and Finishing Cement; 2007 (Reapproved 2013).

I. ASTM C450 - Standard Practice for Fabrication of Thermal Insulating Fitting Covers for NPS Piping, and Vessel Lagging; 2008 (Reapproved 2014).

J. ASTM C533 - Standard Specification for Calcium Silicate Block and Pipe Thermal Insulation; 2013.

K. ASTM C534/C534M - Standard Specification for Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form; 2016.

L. ASTM C547 - Standard Specification for Mineral Fiber Pipe Insulation; 2017.

M. ASTM C585 - Standard Practice for Inner and Outer Diameters of Thermal Insulation for Nominal Sizes of Pipe and Tubing; 2010 (Reapproved 2016).

N. ASTM C795 - Standard Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel; 2008 (Reapproved 2013).

O. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2017.

P. ASTM E96/E96M - Standard Test Methods for Water Vapor Transmission of Materials; 2016.

Q. UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials; Current Edition, Including All Revisions.

1.03 SUBMITTALS

A. See Specification 230505 1.3

B. Product Data: Provide product description, thermal characteristics, list of materials and thickness for each service, and locations.

C. 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, if any, 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 of field-applied jackets. Include outdoor piping insulation installation.
7. Detail application of identification
8. Detail application at linkages of control devices.
9. Detail field application for each equipment type.

D. Samples: For each type of insulation jacket, and identification indicated. Identify each Sample, describing product and intended use.

1. Sample Sizes:

a. Preformed Pipe Insulation Materials: 12 inches long by NPS 2.
b. Sheet Form Insulation Materials: 12 inches square.
c. Jacket Materials for Pipe: 12 inches long by NPS 2.
d. Sheet Jacket Materials: 12 inches square.
e. Manufacturer's Color Charts: For products where color is specified, show the full range of colors available for each type of finish material.

E. Manufacturer's Instructions: Indicate installation procedures that ensure acceptable workmanship and installation standards will be achieved.

1.04 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.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Accept materials on site, labeled with manufacturer's identification, product density, and thickness.

B. Protect insulation from weather and construction traffic, dirt, water, chemical, and mechanical damage, by storing in original wrapping.

1.06 COORDINATION

A. Coordinate size and location of supports, hangers, and insulation shields specified in other Division 23 Sections.

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

1.07 SCHEDULING

A. Schedule insulation application after pressure testing systems and after installation and testing of heat tracing, if required for the Project. 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 REGULATORY REQUIREMENTS

A. Surface Burning Characteristics: Flame spread index/Smoke developed index of 25/50, maximum, when tested in accordance with ASTM E84 or UL 723.

B. Regulatory Requirements: Insulation installations shall comply with the City of Chicago Building Code, Chapter 18-13, "Energy Conservation," and the Illinois Energy Conservation Code. Where conflicts exist between the codes identified above and this section, the more stringent requirement shall apply.

2.02 GLASS FIBER

A. Manufacturers:

1. Johns Manville Corporation; Micro-Lok
2. Knauf Insulation; Earthwool 1000 Degree Pipe Insulation
3. Owens Corning Corporation; Fiberglas Pipe Insulation ASJ

B. Insulation(Hot Pipes): ASTM C547 and ASTM C795; rigid molded, noncombustible.

1. 'K' Value: ASTM C177, 0.24 at 75 degrees F.
2. Maximum Service Temperature: 850 degrees F.
3. Maximum Moisture Absorption: 0.2 percent by volume.

C. Insulating Cement/Mastic: ASTM C195; hydraulic setting on mineral wool.

D. Insulating Cement: ASTM C449.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Verify that piping has been tested before applying insulation materials.

B. Verify that surfaces are clean and dry, with foreign material removed.

3.02 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Exposed Piping: Locate insulation and cover seams in least visible locations.

C. Coordinate insulation installation with the trade installing heat tracing, if any.

D. Insulated pipes conveying fluids below ambient temperature; insulate entire system including fittings, valves.

E. For hot piping conveying fluids over 140 degrees F, insulate flanges and unions at equipment.

F. Glass fiber insulated pipes conveying fluids above ambient temperature.

1. Provide standard jackets, with or without vapor barrier, factory-applied or field-applied. Secure with self-sealing longitudinal laps and butt strips with pressure sensitive adhesive. Secure with outward clinch expanding staples.
2. Insulate fittings, joints, strainers, and valves with insulation of like material and thickness as adjoining pipe. Finish with glass cloth and adhesive or PVC fitting covers.

G. Inserts and Shields:

1. Application: Piping 1-1/2 inches diameter or larger.
2. Shields: Galvanized steel between pipe hangers or pipe hanger rolls and inserts.
3. Insert location: Between support shield and piping and under the finish jacket.
4. Insert Configuration: Minimum 6 inches long, of same thickness and contour as adjoining insulation; may be factory fabricated.
5. Insert Material: Hydrous calcium silicate insulation or other heavy density insulating material suitable for the planned temperature range.

H. Continue insulation continuously through walls and partitions, sleeves, pipe hangers, and other pipe penetrations. Finish at supports, protrusions, and interruptions. At fire separations, refer to Section 07 84 00.

I. Install removable insulation covers at locations where access is required (e.g. - unions, flanges, strainers, and valves)

END OF SECTION 230719

SECTION 232113

HYDRONIC PIPING

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Hydronic system requirements.

B. Heating water piping, buried.

C. Heating water and dual temperature piping, above grade.

D. Chilled water piping, buried.

E. Chilled water and makeup water piping, above grade

F. Condenser water piping, buried.

G. Condenser water piping, above grade

H. Equipment drains and overflows

I. Pipe hangers and supports.

J. Unions, flanges, mechanical couplings, and dielectric connections.

1.02 REFERENCE STANDARDS

A. ASME BPVC-IX - Boiler and Pressure Vessel Code, Section IX - Welding, Brazing, and Fusing Procedures; Welders; Brazers; and Welding, Brazing and Fusing Operators; 2017.

B. ASME B16.3 - Malleable Iron Threaded Fittings: Classes 150 and 300; 2016.

C. ASME B16.18 - Cast Copper Alloy Solder Joint Pressure Fittings; 2012.

D. ASME B16.22 - Wrought Copper and Copper Alloy Solder-Joint Pressure Fittings; 2013.

E. ASME B31.9 - Building Services Piping; 2014.

F. ASME BPVC-VIII-1 - Boiler and Pressure Vessel Code, Section VIII, Division 1 - Rules for Construction of Pressure Vessels; 2017.

G. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless; 2012.

H. ASTM A106/A106M - Standard Specification for Seamless Carbon Steel Pipe for High-Temperature Service; 2015.

I. ASTM A234/A234M - Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service; 2017.

J. ASTM A536 - Standard Specification for Ductile Iron Castings; 1984 (Reapproved 2014).

K. ASTM B32 - Standard Specification for Solder Metal; 2008 (Reapproved 2014).

L. ASTM B88 - Standard Specification for Seamless Copper Water Tube; 2016.

M. ASTM B88M - Standard Specification for Seamless Copper Water Tube (Metric); 2016.

N. ASTM F708 - Standard Practice for Design and Installation of Rigid Pipe Hangers; 1992 (Reapproved 2014).

O. ASTM F1476 - Standard Specification for Performance of Gasketed Mechanical Couplings for Use in Piping Applications; 2007 (Reapproved 2013).

P. AWS A5.8M/A5.8 - Specification for Filler Metals for Brazing and Braze Welding; 2011 (Amended 2012).

Q. AWS D1.1/D1.1M - Structural Welding Code - Steel; 2015, with Errata (2016).

R. AWWA C105/A21.5 - Polyethylene Encasement for Ductile-Iron Pipe Systems; 2010.

S. AWWA C110/A21.10 - Ductile-Iron and Gray-Iron Fittings; 2012.

T. AWWA C111/A21.11 - Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings; 2017.

U. AWWA C151/A21.51 - Ductile-Iron Pipe, Centrifugally Cast; 2017.

V. AWWA C606 - Grooved and Shouldered Joints; 2015.

W. MSS SP-58 - Pipe Hangers and Supports - Materials, Design, Manufacture, Selection, Application, and Installation; 2009.

1.03 SUBMITTALS

A. See Specification 230505 1.3

B. Product Data:

1. Include data on pipe materials, pipe fittings, valves, and accessories.
2. Provide manufacturers catalogue information.
3. Indicate valve data and ratings.

C. Provide 1/4" scale layout/fabrication shop drawings for all piping systems.

D. Manufacturer's Installation Instructions: Indicate hanging and support methods, joining procedures.

E. Maintenance Data: Include record drawings, installation instructions, spare parts lists, exploded assembly views.

1.04 QUALITY ASSURANCE

A. Installer Qualifications:

1. Installers of Pressure-Sealed Joints: Installers shall be certified by the pressure-seal joint manufacturer as having been trained and qualified to join piping with pressure-seal pipe couplings and fittings.

B. Steel Support Welding: Qualify processes and operators according to AWS D1.1/D1.1M.

C. Welding: Qualify processes and operators according to ASME BPVC-IX.

1. Comply with provisions in ASME B31 Series, "Code for Pressure Piping."
2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.
3. All welders certificates shall be on file at project site
4. ASME Compliance: Comply with ASME B31.9 for materials, products, and installation. Safety valves and pressure vessels shall bear the appropriate ASME label. Fabricate and stamp air separators and expansion tanks to comply with ASME BPVC-VIII-1.

1.05 DELIVERY, STORAGE, AND HANDLING

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

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

C. Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.

D. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed system.

PART 2 - PRODUCTS

2.01 HYDRONIC SYSTEM REQUIREMENTS

A. Comply with ASME B31.9 and applicable federal, state, and local regulations.

B. Piping: Provide piping, fittings, hangers and supports as required, as indicated, and as follows:

1. Where more than one piping system material is specified, provide joining fittings that are compatible with piping materials and ensure that the integrity of the system is not jeopardized.
2. Use non-conducting dielectric connections whenever jointing dissimilar metals.

3. Provide pipe hangers and supports in accordance with ASME B31.9 or MSS SP-58 unless indicated otherwise.

C. Pipe-to-Valve and Pipe-to-Equipment Connections: Use flanges, unions, or grooved couplings to allow disconnection of components for servicing; do not use direct welded, soldered, or threaded connections.

1. Where grooved joints are used in piping, provide grooved valve/equipment connections if available; if not available, provide flanged ends and grooved flange adapters.

D. Valves: Provide valves where indicated:

1. On new piping, provide drain valves where indicated, and if not indicated provide at least at main shut-off, low points of piping, and at equipment. Use 3/4 inch ball valves with cap; pipe to nearest floor drain.
2. On discharge of condenser water pumps, use spring loaded check valves.
3. For throttling, bypass, or manual flow control services, use globe, ball, or butterfly valves.
4. For shut-off service, use ball valves.

2.02 EQUIPMENT DRAINS AND OVERFLOWS, AND MAKEUP WATER.

A. Steel Pipe: ASTM A53/A53M, Schedule 40 galvanized; using one of the following joint types:

1. Threaded Joints: Galvanized cast iron, or ASME B16.3 malleable iron fittings.
2. Grooved Joints: AWWA C606 grooved pipe, fittings of same material, and mechanical couplings.

B. Copper Tube: ASTM B88 (ASTM B88M), Type L (B), drawn; using one of the following joint types:

1. Solder Joints: ASME B16.18 cast brass/bronze or ASME B16.22 solder wrought copper fittings; ASTM B32 lead-free solder, HB alloy (95-5 tin-antimony) or tin and silver.
2. Mechanical Press Sealed Fittings: Double pressed type complying with ASME B16.22, utilizing EPDM, nontoxic synthetic rubber sealing elements.

2.03 PIPE HANGERS AND SUPPORTS

A. Provide hangers and supports that comply with MSS SP-58.

1. If type of hanger or support for a particular situation is not indicated, select appropriate type using MSS SP-58 recommendations.
2. Hangers for Pipe Sizes 1/2 to 1-1/2 Inch: Malleable iron, adjustable swivel, split ring.
3. Hangers for Cold Pipe Sizes 2 Inches and Greater: Carbon steel, adjustable, clevis.
4. Hangers for Hot Pipe Sizes 2 to 4 Inches: Carbon steel, adjustable, clevis.

5. Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods.
6. Multiple or Trapeze Hangers for Hot Pipe Sizes 6 Inches and Greater: Steel channels with welded spacers and hanger rods, cast iron roll.
7. Wall Support for Pipe Sizes to 3 Inches: Cast iron hook.
8. Wall Support for Pipe Sizes 4 Inches and Greater: Welded steel bracket and wrought steel clamp.
9. Wall Support for Hot Pipe Sizes 6 Inches and Greater: Welded steel bracket and wrought steel clamp with adjustable steel yoke and cast iron roll.
10. Vertical Support: Steel riser clamp.
11. Floor Support for Hot Pipe Sizes to 4 Inches: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.
12. Hanger Rods: Mild steel threaded both ends, threaded one end, or continuous threaded.
13. Inserts: Malleable iron case of galvanized steel shell and expander plug for threaded connection with lateral adjustment, top slot for reinforcing rods, lugs for attaching to forms; size inserts to suit threaded hanger rods.

2.04 UNIONS, FLANGES, MECHANICAL COUPLINGS, AND DIELECTRIC CONNECTIONS

A. Unions for Pipe 2 Inches and Less:

1. Ferrous Piping: 150 psig malleable iron, threaded.

B. Flanges for Pipe 2 Inches and Greater:

1. Ferrous Piping: 150 psig forged steel, slip-on.
2. Gaskets: 1/16 inch thick preformed neoprene.

C. Dielectric Connections:

1. Waterways:

a. Water impervious insulation barrier capable of limiting galvanic current to 1 percent of short circuit current in a corresponding bimetallic joint.
b. Dry insulation barrier able to withstand 600 volt breakdown test.
c. Construct of galvanized steel with threaded end connections to match connecting piping.
d. Suitable for the required operating pressures and temperatures.

2. Flanges:

a. Dielectric flanges with same pressure ratings as standard flanges.
b. Water impervious insulation barrier capable of limiting galvanic current to 1 percent of short circuit current in a corresponding bimetallic joint.
c. Dry insulation barrier able to withstand 600 volt breakdown test.
d. Construct of galvanized steel with threaded end connections to match connecting piping.
e. Suitable for the required operating pressures and temperatures.

PART 3 - EXECUTION

3.01 PREPARATION

A. Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.

B. Prepare pipe for grooved mechanical joints as required by coupling manufacturer.

C. Remove scale and dirt on inside and outside before assembly.

D. Prepare piping connections to equipment using jointing system specified.

E. Keep open ends of pipe free from scale and dirt. Protect open ends with temporary plugs or caps.

F. After completion, fill, clean, and treat systems. Refer to Section 23 25 00 - HVAC Water Treatment for additional requirements.

3.02 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install heating water piping to ASME B31.9 requirements.

C. Route piping in orderly manner, parallel to building structure, and maintain gradient.

D. Install piping to conserve building space and to avoid interfere with use of space.

E. Group piping whenever practical at common elevations.

F. Sleeve pipe passing through partitions, walls and floors.

G. Install firestopping to preserve fire resistance rating of partitions and other elements.

H. Slope piping and arrange to drain at low points.

I. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment. Refer to Section 23 05 16 - Expansion Fittings and Loops for HVAC Piping.

1. Flexible couplings may be used in header piping to accommodate thermal growth, thermal contraction in lieu of expansion loops.
2. Use flexible couplings in expansion loops.

J. Inserts:

1. Provide inserts for placement in concrete formwork.
2. Provide inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.
3. Provide hooked rod to concrete reinforcement section for inserts carrying pipe over 4 inches.
4. Where concrete slabs form finished ceiling, locate inserts flush with slab surface.

5. Where inserts are omitted, drill through concrete slab from below and provide through-bolt with recessed square steel plate and nut above slab.

K. Pipe Hangers and Supports:

1. Install in accordance with ASME B31.9, ASTM F708, or MSS SP-58.
2. Support horizontal piping as scheduled.
3. Install hangers to provide minimum 1/2 inch space between finished covering and adjacent work.
4. Place hangers within 12 inches of each horizontal elbow.
5. Use hangers with 1-1/2 inch minimum vertical adjustment. Design hangers for pipe movement without disengagement of supported pipe.
6. Support vertical piping at every other floor. Support riser piping independently of connected horizontal piping.
7. Where several pipes can be installed in parallel and at same elevation, provide multiple or trapeze hangers.
8. Provide copper plated hangers and supports for copper piping.
9. Prime coat exposed steel hangers and supports. Refer to Section 09 91 23. Hangers and supports located in crawl spaces, pipe shafts, and suspended ceiling spaces are not considered exposed.

L. Provide clearance in hangers and from structure and other equipment for installation of insulation and access to valves and fittings. Refer to Section 23 07 19 - HVAC Piping Insulation.

M. Where pipe support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc rich primer to welds.

N. No dual-temperature piping shall be installed below ground and within slabs.

3.03 FIELD QUALITY CONTROL

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

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

B. Perform the following tests on hydronic piping:

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

C. Perform the following before operating the system:

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

3.04 SCHEDULES

A. Hanger Spacing for Steel Piping.

1. 1/2 inch, 3/4 inch, and 1 inch: Maximum span, 7 feet; minimum rod size, 1/4 inch.
2. 1-1/4 inches: Maximum span, 8 feet; minimum rod size, 3/8 inch.
3. 1-1/2 inches: Maximum span, 9 feet; minimum rod size, 3/8 inch.
4. 2 inches: Maximum span, 10 feet; minimum rod size, 3/8 inch.
5. 2-1/2 inches: Maximum span, 11 feet; minimum rod size, 3/8 inch.
6. 3 inches: Maximum span, 12 feet; minimum rod size, 3/8 inch.
7. 4 inches: Maximum span, 14 feet; minimum rod size, 1/2 inch.
8. 6 inches: Maximum span, 17 feet; minimum rod size, 1/2 inch.
9. 8 inches: Maximum span, 19 feet; minimum rod size, 5/8 inch.
10. 10 inches: Maximum span, 20 feet; minimum rod size, 3/4 inch.
11. 12 inches: Maximum span, 23 feet; minimum rod size, 7/8 inch.
12. 14 inches: Maximum span, 25 feet; minimum rod size, 1 inch.
13. 16 inches: Maximum span, 27 feet; minimum rod size, 1 inch.
14. 18 inches: Maximum span, 28 feet; minimum rod size, 1-1/4 inch.

15. 20 inches: Maximum span, 30 feet; minimum rod size, 1-1/4 inch.

END OF SECTION 232113

SECTION 232114

HYDRONIC SPECIALTIES

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Expansion tanks.

B. Air vents.

C. Air separators.

D. Strainers.

E. Suction diffusers.

F. Pressure-temperature test plugs.

G. Balancing valves.

H. Relief valves.

I. Automatic fill valves.

J. Glycol or makeup water pressure fill system.

1.02 REFERENCE STANDARDS

A. ASME BPVC-VIII-1 - Boiler and Pressure Vessel Code, Section VIII, Division 1 - Rules for Construction of Pressure Vessels; 2017.

1.03 SUBMITTALS

A. See Specification 230505 1.3

B. Product Data: Provide product data for manufactured products and assemblies required for this project. Include component sizes, rough-in requirements, service sizes, and finishes. Include product description and model.

C. Certificates: Inspection certificates for pressure vessels from authority having jurisdiction.

D. Manufacturer's Installation Instructions: Indicate hanging and support methods, joining procedures.

E. Project Record Documents: Record actual locations of flow controls.

F. Maintenance Data: Include installation instructions, assembly views, lubrication instructions, and replacement parts list.

1.04 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this section, with minimum three years of documented experience.

1.05 DELIVERY, STORAGE, AND HANDLING

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

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

C. Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.

D. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed system.

PART 2 - PRODUCTS

2.01 EXPANSION TANKS

A. Manufacturers:

1. Amtrol Inc.
2. Armstrong International, Inc.
3. ITT Bell & Gossett
4. Taco, Inc.
5. Wessels

B. Construction: Welded steel, tested and stamped in accordance with ASME BPVC-VIII-1; supplied with National Board Form U-1, rated for working pressure of 125 psi, with flexible EPDM diaphragm or bladder sealed into tank, and steel support stand.

C. Accessories: Pressure gauge and air-charging fitting, tank drain; precharge to 12 psi.

2.02 AIR VENTS

A. Manufacturers:

1. Armstrong International, Inc.
2. ITT Bell & Gossett
3. Taco, Inc.

B. Manual Type: Short vertical sections of 2 inch diameter pipe to form air chamber, with 1/8 inch brass needle valve at top of chamber.

C. Float Type:

1. Brass or semi-steel body, copper, polypropylene, or solid non-metallic float, stainless steel valve and valve seat; suitable for system operating temperature and pressure; with isolating valve.
2. Cast iron body and cover, float, bronze pilot valve mechanism suitable for system operating temperature and pressure; with isolating valve.

2.03 AIR SEPARATORS

A. Centrifugal Air Separators/Strainers:

1. Manufacturers:

a. Armstrong International, Inc.
b. ITT Bell & Gossett
c. Taco, Inc.

2. Steel, tested and stamped in accordance with ASME BPVC-VIII-1; for 125 psi operating pressure, with integral bronze strainer, tangential inlet and outlet connections, and internal stainless steel air collector tube.
3. Size inlet and outlet to match system capacity.

2.04 STRAINERS

A. Manufacturers:

1. Armstrong International, Inc.
2. Flexicraft Industries
3. Grinnell Products, a Tyco Business
4. The Metraflex Company; LPD Y Strainer

B. Size 2 inch and Under:

1. Screwed brass or iron body for 175 psi working pressure, Y pattern with 1/32 inch stainless steel perforated screen. Include blow down valve with hose connection.

C. Size 2-1/2 inch to 4 inch:

1. Provide flanged iron body for 175 psi working pressure, Y pattern with 1/16 inch, or 3/64 inch stainless steel perforated screen. Include blow down valve with hose connection.

D. Size 5 inch and Larger:

1. Provide flanged iron body for 175 psi working pressure, Y pattern with 1/8 inch stainless steel perforated screen. Include blow down valve with hose connection.

2.05 SUCTION DIFFUSERS

A. Manufacturers:

1. ITT Bell & Gossett
2. Armstrong International, Inc.
3. Taco, Inc.
4. Victaulic Company of America

B. Fitting: Angle pattern, cast-iron body, threaded for 2 inch and smaller, flanged for 2-1/2 inch and larger, rated for 175 psi working pressure, with inlet vanes, cylinder strainer with 3/16 inch diameter openings, disposable 5/32 inch mesh strainer to fit over cylinder strainer, 20 mesh start up screen, and permanent magnet located in flow stream and removable for cleaning.

C. Accessories: Adjustable foot support, blowdown tapping in bottom, gauge tapping in side.

2.06 PRESSURE-TEMPERATURE TEST PLUGS

A. Manufacturers:

1. Ferguson Enterprises Inc.
2. Peterson Equipment Company Inc.
3. Sisco Manufacturing Company Inc.

B. Construction: Brass body designed to receive temperature or pressure probe with removable protective cap, and Neoprene rated for minimum 200 degrees F.

C. Application: Use extended length plugs to clear insulated piping.

2.07 BALANCING VALVES

A. Manufacturers:

1. Armstrong International, Inc.
2. ITT Bell & Gossett
3. Taco, Inc.
4. Griswold Controls
5. Nexus
6. Hays
7. Victaulic

B. Size 2 inch and Smaller:

1. Provide ball or globe style with flow balancing, flow measurement, and shut-off capabilities, memory stops, minimum of two metering ports and NPT threaded or soldered connections.
2. Metal construction materials consist of bronze or brass.
3. Non-metal construction materials consist of Teflon, EPDM, or engineered resin.

C. Size 2.5 inch and Larger:

1. Provide ball style with flow balancing, flow measurement, and shut-off capabilities, memory stops, minimum of two metering ports and flanged connections.
2. Valve body construction materials consist of cast iron or carbon steel.
3. Internal components construction materials consist of brass, bronze, Teflon, or EPDM.

2.08 COMBINATION FLOW CONTROLS

A. Manufacturers:

1. Flow Design Inc.
2. Griswold Controls
3. Nexus

B. Construction: Brass or bronze body with union on inlet and outlet, temperature and pressure test plug on inlet and outlet with blowdown/backflush drain.

C. Calibration: Control flow within 5 percent of selected rating, over operating pressure range of 10 times minimum pressure required for control, minimum pressure 3.5 psi.

D. Control Mechanism: Stainless steel or nickel plated brass piston or regulator cup, operating against stainless steel helical or wave formed spring.

2.09 RELIEF VALVES

A. Manufacturers:

1. Armstrong International, Inc.
2. ITT Bell & Gossett
3. Conbraco Industries

B. Bronze body, teflon seat, stainless steel stem and springs, automatic, direct pressure actuated, capacities ASME certified and labelled.

2.10 AUTOMATIC FILL VALVES

A. Manufacturers:

1. Amtrol Inc.
2. Armstrong International, Inc.
3. ITT Bell & Gossett
4. Taco, Inc.
5. Spence Engineering Company, Inc.
6. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

B. Operation: Automatically feeds make-up water to the hydronic system whenever pressure in the system drops below the pressure setting of the valve. Refer to Section 232113 - Hydronic Piping.

C. Materials of Construction:

1. Valve Body: Constructed of bronze or brass.
2. Internal Components: Construct of stainless steel or brass and engineered plastics or composition material.

D. Connections:

1. NPT threaded: 0.50 inch, or 0.75 inch.
2. Soldered: 0.50 inch.

E. Provide integral check valve and strainer.

F. Maximum Inlet Pressure: 100 psi.

G. Maximum Fluid Temperature: 180 degrees F.

H. Operating Pressure Range: Between 10 psi and 25 psi.

2.11 MAKEUP WATER PRESSURE FILL SYSTEM

A. Manufacturers:

1. Armstrong International, Inc.
2. ITT Bell & Gossett
3. Taco, Inc.

B. Provide a complete factory packaged automatic glycol / make-up water fill system unit per system. The unit shall consist of a base, 55 gallon tank (steel or polyethylene) with removable lid, fill vent opening, observable fluid level indicator scale (gallons), Y-strainers, isolation valves, triple combination shut off – Non slam check – calibrated balance valves, open drip proof motor, pump, expansion tank, motor contactor, pressure controls, interconnecting piping, low level safety shut down, remote alarm contacts, indicator light, fill valve (automatic for water systems, manual for glycol systems), discharge pressure gauge, discharge line pressure reducing valve, isolation valves, pressure gauge and single point power connection.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Install specialties in accordance with manufacturer's instructions and CPS standard mechanical details.

B. Provide manual air vents at system high points and as indicated.

C. For automatic air vents in ceiling spaces or other concealed locations, provide vent tubing to nearest drain.

D. Provide air separator on suction side of system circulation pump and connect to expansion tank in accordance with standard mechanical details.

E. Install piping from boiler air outlet or air separator to expansion tank with a 2 percent upward slope toward tank.

F. Provide valved drain and hose connection on strainer blow down connection.

G. Provide pump suction fitting on suction side of base mounted centrifugal pumps where indicated and in accordance with standard mechanical details. Remove temporary strainers after cleaning systems.

H. Support pump fittings with floor mounted pipe and flange supports.

I. Provide relief valves on expansion tanks.

J. Select system relief valve capacity so that it is greater than make-up pressure reducing valve capacity. Select equipment relief valve capacity to exceed rating of connected equipment.

K. Pipe relief valve outlet to nearest floor drain.

L. Where one line vents several relief valves, make cross sectional area equal to sum of individual vent areas.

M. Chemically clean and flush glycol system before adding glycol solution. Refer to Section 23 25 00 - HVAC Water Treatment.

N. Feed glycol solution to system through make-up line with pressure regulator, venting system high points.

END OF SECTION 232114

SECTION 232123

HYDRONIC PUMPS

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Close-coupled inline centrifugal pumps.

B. Split-coupled, base-mounted end suction pumps.

C. Automatic condensate pump units

1.02 REFERENCE STANDARDS

A. NFPA 70 - National Electrical Code; 2017.

B. UL 778 - Standard for Motor-Operated Water Pumps; Current Edition, Including All Revisions.

1.03 SUBMITTALS

A. See Specification 230505 1.3

B. Product Data: Provide certified pump curves showing performance characteristics with pump and system operating point plotted. Include NPSH curve when applicable. Include electrical characteristics and connection requirements.

C. Manufacturer's Installation Instructions: Indicate hanging and support requirements and recommendations.

D. Operation and Maintenance Data: Include installation instructions, assembly views, lubrication instructions, and replacement parts list.

E. Maintenance Materials: Furnish the following for Board's use in maintenance of project.
1. Extra Pump Seals: 1 for each type and size of pump.

1.04 QUALITY ASSURANCE

A. Source Limitations: Obtain hydronic pumps through one source from a single manufacturer.

B. 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.

C. UL Compliance: Comply with UL 778 for motor-operated water pumps.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Manufacturer's Preparation for Shipping: Clean flanges and exposed machined metal surfaces and treat with anticorrosion compound after assembly and testing. Protect flanges, pipe openings, and nozzles with wooden flange covers or with screwed-in plugs.

B. Store pumps in dry location.

C. Retain protective covers for flanges and protective coatings during storage.

D. Protect bearings and couplings against damage from sand, grit, and other foreign matter.

E. Comply with pump manufacturer's written rigging instructions.

1.06 COORDINATION

A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.

1.07 EXTRA MATERIALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
   1. Mechanical Seals: One mechanical seals for each pump.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Inline and Base Mounted Pumps

   1. Armstrong Fluid Technology, Inc.
   2. Bell & Gossett, a Xylem Inc. brand
   3. Taco

2.02 HVAC PUMPS - GENERAL

A. Provide pumps that operate at specified system fluid temperatures without vapor binding and cavitation, are non-overloading in parallel or individual operation, and operate within 25 percent of midpoint of published maximum efficiency curve.

B. Products Requiring Electrical Connection: Listed and classified by UL or testing agency acceptable to Authority Having Jurisdiction as suitable for the purpose specified and indicated.

2.03 CLOSE-COUPLED INLINE CENTRIFUGAL PUMPS

A. Type: Horizontal shaft, single stage, direct connected, with resiliently mounted motor for in-line mounting, oil lubricated, for 175 psi maximum working pressure.

B. Casing: Cast iron, with flanged pump connections.

C. Impeller: Cast Bronze or Stainless Steel keyed to shaft.

D. Bearings: Permanently-lubricated ball bearings.

E. Shaft: Alloy steel with copper sleeve, integral thrust collar.

F. Seal: Mechanical seal , 275 degrees F maximum continuous operating temperature.

PART 3 - EXECUTION

3.01 PREPARATION

A. Verify that electric power is available and of the correct characteristics.

3.02 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Provide access space around pumps for service. Provide no less than minimum space recommended by manufacturer.

C. Independently support pumps and piping so weight of piping is not supported by pumps and weight of pumps is not supported by piping.

D. Install continuous-thread hanger rods and spring hangers with vertical-limit stop of sufficient size to support pump weight. Vibration isolation devices are specified.

E. Set base-mounted pumps on concrete foundation. Disconnect coupling before setting. Do not reconnect couplings until alignment procedure is complete.

1. Support pump baseplate on rectangular metal blocks and shims, or on metal wedges with small taper, at points near foundation bolts to provide a gap of 3/4 to 1-1/2 inches between pump base and foundation for grouting.
2. Adjust metal supports or wedges until pump and driver shafts are level. Check coupling faces and suction and discharge flanges of pump to verify that they are level and plumb.

F. Decrease from line size with long radius reducing elbows or reducers. Support piping adjacent to pump such that no weight is carried on pump casings. For close-coupled or base-mounted pumps, provide supports under elbows on pump suction and discharge line sizes 4 inches and over and in accordance with CPS standard mechanical details.

G. Provide line sized shut-off valve and pump suction fitting on pump suction, and line sized soft seat check valve and balancing valve on pump discharge.

H. Provide drains for bases and seals, piped to and discharging into floor drains.

I. Check, align, and certify alignment of base-mounted pumps prior to start-up.

J. Lubricate pumps before start-up.

K. Align pump and motor shafts and piping connections after setting on foundation, grout has been set and foundation bolts have been tightened, and piping connections have been made.

L. Comply with pump and coupling manufacturers' written instructions.

M. Adjust pump and motor shafts for angular and offset alignment by methods specified in HI 1.1-1.5, "Centrifugal Pumps for Nomenclature, Definitions, Application and Operation."

N. After alignment is correct, tighten foundation bolts evenly but not too firmly. Completely fill baseplate with nonshrink, nonmetallic grout while metal blocks and shims or wedges are in place. After grout has cured, fully tighten foundation bolts.

3.03 CONTRACTOR STARTUP AND REPORTING

A. Engage a factory-authorized service representative to perform startup service. Startup service includes the testing, inspections and startup test reports.

1. Complete installation and startup checks according to manufacturer's written instructions.
2. Check piping connections for tightness.
3. Clean strainers on suction piping.
4. Perform the following startup checks for each pump before starting:

    a. Verify bearing lubrication.
    b. Verify that pump is free to rotate by hand and that pump for handling hot liquid is free to rotate with pump hot and cold. If pump is bound or drags, do not operate until cause of trouble is determined and corrected.
    c. Verify that pump is rotating in the correct direction.

5. Prime pump by opening suction valves and closing drains, and prepare pump for operation.
6. Start motor.
7. Open discharge valve slowly.

END OF SECTION 232123

SECTION 232513

WATER TREATMENT FOR CLOSED-LOOP HYDRONIC SYSTEM

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes the cleanout specifications for hot water systems:

1. Chemicals.

B. Related Requirements:

1. Section 232533 "HVAC Makeup-Water Filtration Equipment" for water treatment of water softeners, reverse osmosis equipment, and filtration equipment.

1.3 ACTION SUBMITTALS

A. Product Data: Include rated capacities, operating characteristics, and furnished specialties and accessories for the following products:

1. Bypass feeders.
2. pH controllers.
3. Injection pumps.
4. Chemical-treatment test equipment.
5. Chemical material safety data sheets.

B. Shop Drawings: Pretreatment, maintenance space required, and piping connections to hydronic systems.

1. Include plans, elevations, sections, and attachment details.
2. Include diagrams for power, signal, and control wiring.

1.4 INFORMATIONAL SUBMITTALS

A. Water-Analysis Provider Qualifications: Verification of experience and capability of HVAC water-treatment service provider.

B. Field quality-control reports.

C. Water Analysis: Illustrate water quality available at Project site.

D. Report outlining water chemistry analysis of hardness, pH, total dissolved solids, silica, and other characteristics pertinent to the water treatment system required.

E. Provide a letter from the HVAC Water Treatment Service Provider recommending specifically all chemicals (by product number) and at what concentrations they should be applied for fulfilling the requirements of this section of the specification. Methods of applying the chemical products should also be discussed where appropriate. The letter shall reference this project specifically, shall be dated and shall be signed by a person of responsibility employed by the water treatment company.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: Emergency, operation, and maintenance manuals.

1.6 QUALITY ASSURANCE

A. HVAC Water-Treatment Service Provider Qualifications: An experienced HVAC water-treatment service provider, capable of analyzing water qualities, installing water-treatment equipment, and applying water treatment as specified in this Section.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Provide all hardware, chemicals, and other material necessary to maintain HVAC water quality in all systems, as indicated in this Specification. Water quality for hydronic systems shall minimize corrosion, scale buildup, and biological growth for optimum efficiency of hydronic equipment without creating a hazard to operating personnel or the environment.

B. Base HVAC water treatment on quality of water available at Project site, hydronic system equipment material characteristics and functional performance characteristics, operating personnel capabilities, and requirements and guidelines of authorities having jurisdiction.

C. Closed hydronic systems, including hot-water heating, shall have the following water qualities:

1. pH: Maintain a value within 9.0-10.5.
2. Alkalinity: Maintain a value within 100 to 500 ppm as CaCO(3).
3. Steel Corrosion Inhibiters: Provide sufficient inhibitors to limit mild steel corrosion to 1.0 mils per year. Maintain soluble iron concentrations at or below 0.00025 mg/L.
4. Scale Control: Provide softened water for initial fill and makeup. Where softened water is not used, provide sufficient scale inhibitors to prevent formation of scale and maintain all scale-forming material in solution.
5. Dispersants: Provide sufficient dispersants to prevent sedimentation of fine particulate matter.

6. Microbiological Limits:

    a. Total Aerobic Plate Count: Maintain a maximum value of 1000 organisms/mL.
    b. Total Anaerobic Plate Count: Maintain a maximum value of 100 organisms/mL.
    c. Nitrate Reducers: Maintain a maximum value of 100 organisms/mL.
    d. Sulfate Reducers: Maintain a maximum value of 0 organisms/mL.
    e. Iron Bacteria: Maintain a maximum value of 0 organisms/mL.

2.2 CHEMICALS

A. Chemicals shall be as recommended by water treatment system manufacturer, compatible with piping system components and connected equipment, and able to attain water quality specified in "Performance Requirements" Article.

PART 3 - EXECUTION

3.1 WATER ANALYSIS

A. Perform an analysis of supply water to determine quality of water available at Project site.

3.2 INSTALLATION

A. Bypass Feeders: Install in closed hydronic systems, including hot-water heating, [glycol heating] and equip with the following:

    1. Install bypass feeder in a bypass circuit around circulating pumps unless indicated otherwise on Drawings.
    2. Install water meter in makeup-water supply.
    3. Install test-coupon assembly in bypass circuit around circulating pumps unless otherwise indicated on Drawings.
    4. Install a gate or full-port ball isolation valves on inlet, outlet, and drain below the feeder inlet.
    5. Install a swing check on the inlet after the isolation valve.

3.3 CLEANOUT SPECIFICATION HOT WATER SYSTEMS

A. Boiler Boil out
    1. Immediately after the hydrostatic testing has been completed, each boiler shall be drained, flushed with clean water, and refilled with clean water to which the appropriate alkaline cleaning boil out compound has been added to remove pipe dope, fabrication lubrications, oils, welding slag, existing scale, and other extraneous materials. Chemicals which are used shall be thoroughly dissolved prior to injection.

2. The boiler shall then be boiled out in accordance with the boiler manufacturer's instructions. The boiler shall then be cooled slowly and flushed with clean water.
3. Once the boiler is clean, it shall immediately be filled with clean water to which appropriate scale and corrosion inhibitors have been added.

B. Cleaning and Flushing
1. Be sure all screens/strainers are in place and chemical feed system is installed. Provide expansion control during cleaning and flushing operations. A safety relief valve shall be incorporated into the section or system piping to protect against over-pressurization during cleaning and flushing operations.
2. Fill system with water and simultaneously add manufacturer's non foaming chemical detergent to recommended dosage based on total system capacity through chemical feed system.
3. Fill, circulate and drain each closed piping system for four (4) six-hour cycles, minimum. Cycle time may be extended by the Contractor to ensure complete cleaning. In addition to specified drains provide a single main drain to allow full flow, size equal to largest system pipe or six (6) inches minimum, at the system low point.
4. Immediately after recirculation, so that removed and suspended foulants will not resettle, drain or purge system.
5. At the conclusion of each cycle, drain each system at maximum flow rates provided by the main drain to a location approved by the Owner’s representative.
6. Immediately after steps 4 and 5 above, so as to prevent corrosion from taking place on empty piping and equipment, fill the system adding 1/4 the theoretical dosage of the selected treatment, recirculate for a minimum of 4 hours, maximum of 24 hours. Then drain or purge system.

3.4 PIPING CONNECTIONS

A. Piping installation requirement are specified in other Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Where installing piping adjacent to equipment, allow space for service and maintenance.

C. Make piping connections between HVAC water-treatment equipment and dissimilar-metal piping with dielectric fittings. Dielectric fittings are specified in Section 232113 "Hydronic Piping."

D. Install shutoff valves on HVAC water-treatment equipment inlet and outlet. Metal general-duty valves are specified in Section 230523.11 "Globe Valves for HVAC Piping," Section 230523.12 "Ball Valves for HVAC Piping," Section 230523.13 "Butterfly Valves for HVAC Piping," and Section 230523.15 "Gate Valves for HVAC Piping."

E. Comply with requirements in Section 221119 "Domestic Water Piping Specialties" for backflow preventers required in makeup-water connections to potable-water systems.

3.5 ELECTRICAL CONNECTIONS

A. Confirm applicable electrical requirements in electrical Sections for connecting electrical equipment.

B. Ground equipment in accordance with Section 260526 "Grounding and Bonding for Electrical Systems."

C. Connect wiring in accordance with Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

3.6 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.

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

C. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

D. Perform tests and inspections with the assistance of a factory-authorized service representative.

E. Tests and Inspections:

1. Inspect field-assembled components and equipment installation, including piping and electrical connections.
2. Inspect piping and equipment to determine that systems and equipment have been cleaned, flushed, and filled with water, and are fully operational before introducing chemicals for water-treatment system.
3. Place HVAC water-treatment system into operation and calibrate controls during the preliminary phase of hydronic systems' startup procedures.
4. Do not enclose, cover, or put piping into operation until it is tested and satisfactory test results are achieved.
5. Leave uncovered and unconcealed new, altered, extended, and replaced water piping until it has been tested and approved. Expose work that has been covered or concealed before it has been tested and approved.

F. Equipment will be considered defective if it does not pass tests and inspections.

G. Prepare test and inspection reports.

H. Comply with ASTM D3370 and with the following standards:

1. Silica: ASTM D859.
2. Acidity and Alkalinity: ASTM D1067.
3. Iron: ASTM D1068.
4. Water Hardness: ASTM D1126.

END OF SECTION 232513

SECTION 235216

CONDENSING BOILERS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes packaged, factory-fabricated and assembled, gas-fired, condensing boilers, trim, and accessories for generating hot water.

1.2 SUBMITTALS

A. Product Data: Include performance data, operating characteristics, furnished specialties, and accessories.

B. Shop Drawings: For boilers, boiler trim, and accessories. Include plans, elevations, sections, details, and attachments to other work.

1. Wiring Diagrams: Power, signal, and control wiring. A laminated copy of the wiring diagram shall be affixed to the boiler near the electrical panel.

C. Source quality-control test reports.

D. Field quality-control test reports.

1. Startup Reports: Submit reports documenting the activities required to be performed in PART 3. These reports are to be submitted two weeks after the startup is completed.

E. Operation and Maintenance Data: Provide two operations and maintenance manuals, including boiler and burner drawings, schematics including fuel trains, general instructions for maintenance inspections, complete spare parts list and troubleshooting procedures.

F. Other Informational Submittals:

1. Provide efficiency curves, showing boiler thermal efficiency vs. return water temperature at 25%, 50%, 75% and 100% input.

G. Training Reports: Submit reports on training documenting dates and attendance.

1.3 QUALITY ASSURANCE

A. See Specification 230505 1.3

B. 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.

C. ASME Compliance: Fabricate and label boilers to comply with ASME Boiler and Pressure Vessel Code.

D. LEED/ASHRAE/IESNA 90.1-2004 Compliance: Provide certification that boilers shall have minimum efficiency according to Table 6.8.1F, "Gas and Oil Fired Boilers - Minimum Efficiency Requirements".

E. DOE Compliance: Minimum efficiency shall comply with 10 CFR 430, Subpart B, Appendix N, "Uniform Test Method for Measuring the Energy Consumption of Furnaces and Boilers."

F. DOE Compliance: Minimum efficiency shall comply with 10 CFR 431, "Energy Efficiency Program for Certain Commercial and Industrial Equipment: Test Procedures and Efficiency Standards for Commercial Packaged Boilers."

G. UL Compliance: Test boilers for compliance with UL 795, "Commercial-Industrial Gas Heating Equipment." Boilers shall be listed and labeled by Underwriters Laboratories

1.4 DELIVERY, STORAGE AND HANDLING

A. Follow manufacturer's instructions for unloading, rigging and storage of equipment.

B. Maintain manufacturer's recommended temperature and humidity limits during storage and installation. Protect equipment from dirt, dust and other jobsite contaminants and conditions detrimental to the equipment.

1.5 COORDINATION

A. Coordinate size and location of bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.

1.6 WARRANTY

A. Warranty Period for Fire-Tube Condensing Boilers:

1. Written manufacturer's warranty on materials and labor for 12 months starting from preliminary acceptance, or 18 months from startup, whichever is longer.
2. Leakage and Materials: 10 years from date of preliminary acceptance.
3. Heat Exchanger Damaged by Thermal Stress and Corrosion: Prorated for five years from date of preliminary acceptance.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. The specification has been written with the intent to include the following boiler models.

1. AERCO International (Model KC-1000)
2. Cleaver-Brooks (Model MCF)
3. Fulton (Model VTG)
4. Buderus (Model SB)

5. Bryan Triple Flex (Model TF)
6. Viessmann (Model Vertomat) – The boiler may only be used on systems operating at less then 30 psig or the elevation of the highest coil or pipe feed from unit is no more then 30 feet above the boiler whichever is more stringent.

2.2 PERFORMANCE REQUIREMENTS

A. General: Provide documentation showing that the boiler will meet or exceed the performance criteria as described in the following subparagraphs.

B. The boiler shall operate at a minimum 90% efficiency under the following conditions:

1. 25% to 50% firing rate with 122°F return water temperature.
2. 75% firing rate with 100°F return water temperature.
3. 100% firing rate with 93°F return water temperature.

C. Verification: Submit manufacturer's published efficiency curves for submitted boiler. Efficiency curves shall be generated using the test criteria established in GAMA/Hydronics Institute publication BTS-2000, "Method to Determine Efficiency of Commercial Space Heating Boilers."

2.3 MANUFACTURED UNITS

A. Description: Factory-fabricated, assembled, and tested, condensing boiler with heat exchanger sealed pressure-tight, built on a steel base; including insulated jacket; flue-gas vent; combustion-air intake connections; water supply, return, and condensate drain connections; and controls. Water heating service only. Manufacturer to specify sealed combustion air and exhaust ductwork to be provided and installed by contractor.

B. Heat Exchanger: The heat exchanger section will be either all stainless steel or carbon steel in the non-condensing section and stainless steel in the condensing section.

C. Pressure Vessel: The section of the boiler will be constructed of stainless steel or carbon steel with welded heads and tube connections.

D. Burner: Modulating natural gas, forced draft. Provide a minimum turndown ratio of 5 to 1, inlet burner silencer and tight shutoff inlet air louvers.

E. The burner air damper and fuel gas valve on each boiler-burner unit shall be operated by a motor or motors controlling both fuel and air supply. The fuel air drive shall be provided with a position indicating switch which shall be inter-locked with the flame safeguard system, to assure starting in the low fire position. Each burner shall have automatic modulation from a separate operating control. Provide in each boiler control panel a manual/automatic switch and potentiometer, for manual control of the firing rate from 20% to 100% of rated capacity over the full firing range.

F. Burner shall be equipped with a complete system of safety devices, including the electronic flame safeguard control with pre and post purge. Pre-purge shall be a full open purge of sufficient time to provide four air change ignition purges of the combustion chamber or a full 30 second duration pre-purge. All controls shall be approved by UL.

G. Provide one (1) self closing valve with a fusible switch at ceiling above the burners to shut off gas supply to burner upon sensing ambient temperature of 210 degrees.

H. Provide terminal strip for emergency fuel shut off switch. If switch is not provided by the Division 23 Section "Building Automation System (BAS)" it will be provided by this specification. Switch shall be complete with red and white cover plate clearly marked, “Emergency Shut Off Switch

I. Interlock control requirements

1. The boiler manufacturer will furnish all required control interlocks between the boiler-burner and related equipment as herein specified and as follows:

a. Contacts as required for all remote alarms.
b. Relays for remote boiler room combustion air dampers (if applicable).
c. Contacts for remote enable/disable of boiler-burner
d. Relays for remote gas booster enable/disable.

J. Blower: Fan to operate during each burner firing sequence and during prepurge and post purge the combustion chamber.

1. Motors: Comply with requirements specified in Division 23 Section "Common Motor Requirements for HVAC Equipment."

a. 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.

K. Gas Train: ASME CSD-1, IRI.

L. Ignition: Spark ignition with 100 percent main-valve shutoff with electronic flame supervision.

M. Casing:

1. Jacket: Sheet metal, with snap-in or interlocking closures.
2. Control Compartment Enclosures: NEMA 250, Type 1A.
3. Insulation: Minimum 2-inch thick, mineral-fiber insulation surrounding the heat exchanger.
4. Combustion-Air Connections: Inlet and vent duct collars.
5. Mounting base to secure boiler to concrete base.

2.4 TRIM

A. Aqua stat Controllers: Operating, firing rate, and high limit.

B. Safety Relief Valve: ASME rated.

C. Pressure and Temperature Gage: Minimum 3-1/2-inch diameter, combination water-pressure and -temperature gage. Gages shall have operating-pressure and -temperature ranges so normal operating range is about 50 percent of full range.

D. Boiler Air Vent: Automatic.

E. Drain Valve: Minimum NPS 3/4 hose-end gate valve.

F. Flue gas trap and Condensate neutralization basin.

2.5 CONTROLS

A. For each boiler, operating controls shall include the following devices and features:

1. Control transformer.
2. Set-Point Adjust: Set points shall be adjustable.
3. All wiring to be number coded at every termination. Numbering system to be professionally printed on heat-shrink tubing at the point of connection. Wiring diagrams shall clearly indicate wiring numbers and termination points. Provide separate contacts for a remote alarm.
4. Factory installed Hand-Off-Automatic switch for interface to BAS. When operating in the Hand position the burner modulation will be via internal boiler controls.
5. Power disconnect switch.
6. Provide combustion air damper relay when combustion damper is used in design
7. A ladder diagram of the boiler/burner controls laminated permanently on the inside panel door.
8. All terminals shall be uniquely identified with an alpha numeric sequence.
9. All wires shall be uniquely identified with an alpha numeric sequence.
10. A clear distinction shall be made of wiring to non-boiler vendor devices.

B. Burner Operating Controls: To maintain safe operating conditions, burner safety controls limit burner operation.

1. High Cutoff: Automatic reset stops burner if operating conditions rise above maximum boiler design temperature.
2. Low-Water Cutoff Switch: Electronic probe shall prevent burner operation on low water. Cutoff switch shall be manual -reset type (UL, CSD-1).
3. Blocked Inlet Safety Switch: Manual-reset pressure switch field mounted on boiler combustion-air inlet.
4. Audible Alarm: Factory mounted on control panel with silence switch; shall sound alarm for above conditions.
5. Provide auxiliary contacts for monitoring from building management system, if applicable.

C. Provide a boiler system control panel that will control the staging, lead boiler alternation and firing rate to maintain the common supply water temperature.

1. Include automatic, alternating-firing sequence for multiple boilers to ensure maximum system efficiency throughout the load range and to provide equal runtime for boilers.
2. The panel will use its own out side air temperature to reset boiler water temperature. The hot water common supply setpoint reset schedule will be adjustable at the boiler system control panel.

2.6 VENTING KITS

A. Kit: Complete system, ASTM A 959, Type 29-4C stainless steel or positive-pressure stainless steel 316L double-wall stack listed under UL certification number 1738, pipe, vent terminal, thimble, indoor plate, vent adapter, condensate trap and dilution tank, and sealant.

B. Combustion-Air Intake: Complete system, duct, vent terminal with screen, inlet air coupling, and sealant.

2.7 SOURCE QUALITY CONTROL

A. Burner and Hydrostatic Test: Factory adjust burner to eliminate excess oxygen, carbon dioxide, oxides of nitrogen emissions, and carbon monoxide in flue gas and to achieve combustion efficiency; perform hydrostatic test.

B. Test and inspect factory-assembled boilers, before shipping, according to ASME Boiler and Pressure Vessel Code.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Before boiler installation, examine roughing-in for concrete equipment bases, anchor-bolt sizes and locations, and piping and electrical connections to verify actual locations, sizes, and other conditions affecting boiler performance, maintenance, and operations.

1. Final boiler locations indicated on Drawings are approximate. Determine exact locations before roughing-in for piping and electrical connections.

B. Examine mechanical spaces for suitable conditions where boilers will be installed.

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

3.2 BOILER INSTALLATION

A. Install boilers level on 4-inch (Mosby) concrete base. Install boilers on vibration isolators (Glen Park).

B. Vibration Isolation: Elastomeric isolation pads with a minimum static deflection of 0.25 inch. Vibration isolation devices and installation requirements are specified in Division 23 Section "Vibration Controls for HVAC."

C. Install gas-fired boilers according to NFPA 54.

D. Assemble and install boiler trim.

E. Install electrical devices furnished with boiler but not specified to be factory mounted.

F. Install control wiring to field-mounted electrical devices.

3.3 CONNECTIONS

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

B. Install piping adjacent to boiler to allow service and maintenance.

C. Install piping from equipment drain connection to nearest floor drain. Piping shall be at least full size of connection. Provide an isolation valve if required.

D. Connect piping to boilers, except safety relief valve connections, with flexible connectors of materials suitable for service. Flexible connectors and their installation are specified in Division 23 Section "Basic HVAC Materials and Methods."

E. Connect gas piping with isolation valve and dirt leg to boiler gas-train inlet with union. Piping shall be at least full size of gas train connection. Provide a reducer if required. Route gas train vents line size to the outdoors. Maintain minimum 15’ from all building openings.

F. Hot water inlet & outlet connections: At a minimum connect inlet to the boiler with isolation valve, y-strainer w/ hose connection, P&T tap, manual air vent, controller-bulb well, thermometer, pressure gauge, drain connection valve and union or flange. At a minimum connect outlet to the boiler with isolation valve, control valve, calibrated balance valve, P&T tap, manual air vent, thermometer, controller-bulb well, pressure gauge, drain connection valve and union or flange. See drawings for additional requirements. Utilize a single pressure gauge with isolation valves across the boiler inlet and outlet in lieu of individual gauges to eliminate gauge error.

G. Install piping from safety relief valves to nearest floor drain.

H. Boiler Venting: Install flue venting kit and combustion-air intake.

I. Connect condensate drain lines from the boiler and flue to the neutralizing basin and flue gas trap and routed to the nearest floor drain.

J. The condensate drain lines from the boiler and flue to the neutralizing basin will be piped with polypropylene or schedule 80 PVC designed for acidic applications.

3.4 CONTRACTOR STARTUP AND REPORTING

A. Perform tests and inspections and prepare test reports.

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.

B. Tests and Inspections:

1. Perform installation and startup checks according to manufacturer's written instructions.
2. Leak Test: With system filled and operating at pressure and temperature, repair leaks and retest until no leaks exist.

3. Operational Test: Start units to confirm proper motor rotation and unit operation. Adjust air-fuel ratio and combustion.
4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

    a. Check and adjust initial operating set points and high- and low-limit safety set points of fuel supply, water level and water temperature.
    b. Set field-adjustable switches and circuit-breaker trip ranges as indicated.

C. Remove and replace malfunctioning units and retest as specified above.

D. Performance Tests:

1. Engage a factory-authorized service representative to inspect component assemblies and equipment installations, including connections, and to conduct performance testing.
2. Boilers shall comply with performance requirements indicated, as determined by field performance tests. Adjust, modify, or replace equipment to comply.
3. Perform field performance tests to determine capacity and efficiency of boilers.

    a. Test for full capacity.
    b. Test for boiler efficiency at low fire 20, 40, 60, 80, 100, 80, 60, 40, and 20 percent of full capacity. Determine efficiency at each test point.

4. Repeat tests until results comply with requirements indicated.
5. Provide analysis equipment required to determine performance.
6. Provide temporary equipment and system modifications necessary to dissipate the heat produced during tests if building systems are not adequate.
7. Notify Architect in advance of test dates.
8. Document test results in a report and submit to Architect. Submittal shall be within 4 weeks of each boilers startup.

3.5 DEMONSTRATION AND COMMISSIONING

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain boilers.

1. Train Owner's maintenance personnel on procedures and schedules for starting up and shutting down, troubleshooting, servicing, and maintaining the boilers. The training will occur after the startup report has been provided to the owner and the trainer will provide two (2) Installation and Operations manuals for the use of the owner’s personnel during training.
2. Review data in maintenance manuals. All required and recommended maintenance will be reviewed as well as operational trouble shooting.
3. Schedule training with Owner, through Architect, with at least seven days' advance notice.
4. Training will occur in two (2) separate two (2) hour sessions, neither on the same day nor on a day that the boilers are started up.

B. Demonstrate proper operation of equipment to designated owners personnel. The scope of the demonstration will include functional performance requirements under local control.

END OF SECTION 235216

SECTION 238236

FINNED-TUBE RADIATION HEATERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes hydronic finned-tube radiation heaters.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include rated capacities, operating characteristics, furnished specialties, and accessories.

B. Shop Drawings:

1. Include plans, elevations, sections, and details.
2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
3. Include details and dimensions of custom-fabricated enclosures.
4. Indicate location and size of each field connection.
5. Indicate location and arrangement of piping valves and specialties.
6. Indicate location and arrangement of integral controls.
7. Include enclosure joints, corner pieces, access doors, and other accessories.
8. Include diagrams for power, signal, and control wiring.

C. Samples: For each exposed product and for each color and texture specified.

D. Color Samples for Initial Selection: For finned-tube radiation heaters with factory-applied color finishes.

E. Color Samples for Verification: For each type of exposed finish.

1.4 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Floor plans and other details, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:

1. Structural members, including wall construction, to which finned-tube radiation heaters will be attached.
2. Method of attaching finned-tube radiation heaters to building structure.
3. Penetrations of fire-rated wall and floor assemblies.

B. Field quality-control reports.

PART 2 - PRODUCTS

2.1 HOT-WATER FINNED-TUBE RADIATION HEATERS

A. Performance Ratings: Rate finned-tube radiation heaters according to Hydronics Institute's "I=B=R Testing and Rating Standard for Finned-Tube (Commercial) Radiation."

B. Heating Elements: Copper tubing mechanically expanded into flanged collars of evenly spaced aluminum fins resting on element supports. One end of tube shall be belled.
1. Tube Diameter: NPS 1-1/4.
2. Fin Size: 4 by 4 inches.
3. Fin Spacing: 50 per foot.
4. Number of Tiers: 1 tier.
5. Heat Output: 1000 Btu/h per ft.
6. Entering-Air Temperature: 65 deg F.
7. Average Water Temperature: 180 deg F.
8. Minimum Water Velocity: 1/2 fps.

C. Element Supports: Ball-bearing cradle type to permit longitudinal movement on enclosure brackets.

D. Front Panel: Minimum 0.0428-inch.

E. Rust-Resistant Front Panel: Minimum 0.052-inch-thick, ASTM A653/A653M galvanized steel.

F. Wall-Mounted Back Panel: Minimum 0.0329-inch-thick steel, full height, with full-length channel support for front panel without exposed fasteners.

G. Floor-Mounted Pedestals: Conceal insulated piping at maximum 36-inch spacing. Pedestal-mounted back panel shall be solid panel matching front panel. Provide stainless-steel escutcheon for floor openings at pedestals.

H. Support Brackets: Locate at maximum 36-inch spacing to support front panel and element.

I. Finish: Baked-enamel finish in manufacturer's standard color as selected by Architect.

J. Damper: Knob-operated internal damper at enclosure outlet.

K. Access Doors: Factory made, permanently hinged with tamper-resistant fastener, minimum size 6 by 7 inches, integral with enclosure.

L. Enclosure Style: Sloped top.

1. Front Inlet Grille: Punched louver; painted to match enclosure.
2. Top Outlet Grille: Punched louver; painted to match enclosure.

M. Accessories: Filler sections, corners, relay sections, and splice plates all matching the enclosure and grille finishes.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas to receive finned-tube radiation heaters for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Examine roughing-in for hydronic-piping connections to verify actual locations before installation of finned-tube radiation heaters.

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

3.2 FINNED-TUBE RADIATION HEATER INSTALLATION

A. Remove additional 1 foot of piping from each side of the existing fin tubes and replace with new piping.

B. Install units level and plumb.

C. Install enclosure continuously around corners, using outside and inside corner fittings.

D. Join sections with splice plates and filler pieces to provide continuous enclosure.

E. Install access doors for access to valves.

F. Install enclosure continuously from wall to wall.

G. Terminate enclosures with manufacturer's end caps except where enclosures are indicated to extend to adjoining walls.

H. Install valves within reach of access door provided in enclosure.

I. Install air-seal gasket between wall and recessed flanges or front cover of fully recessed unit.

J. Install piping within pedestals for freestanding units.

3.3 CONNECTIONS

A. Piping installation requirements are specified in Section 232113 "Hydronic Piping" and Section 232116 "Hydronic Piping Specialties." Drawings indicate general arrangement of piping, fittings, and specialties.

B. Connect hot-water finned-tube radiation heaters and components to piping according to Section 232113 "Hydronic Piping" and Section 232116 "Hydronic Piping Specialties."

1. Install shutoff valves on inlet and outlet, and balancing valve on outlet.

C. Install control valves as required by Section 230923.11 "Control Valves."

D. Install piping adjacent to finned-tube radiation heaters to allow service and maintenance.

3.4 FIELD QUALITY CONTROL

A. Perform the following field tests and inspections:

1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
2. Operational Test: After electrical circuitry has been energized, start units to confirm proper operation.
3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

B. Units will be considered defective if they do not pass tests and inspections.

C. Prepare test and inspection reports.

END OF SECTION 238236