

# Exhibit B1 - HVAC Mechanical Specifications, pp. 1-55

## SECTION 22 00 00

### PLUMBING

#### PART 1 – GENERAL

##### 1.01 DESCRIPTION

- A. Work covered by this Section includes the furnishing and installation of all plumbing domestic hot and cold water piping.
- B. Related work specified elsewhere includes:
- |  |             |
|--|-------------|
| Site Work                              | Division 31 |
| Basic Mechanical Materials and Methods | 23 05 00    |
| Pipe and Pipe Fittings                 | 23 21 13    |
| Piping Specialties                     | 23 21 16    |
| Pipe Hangers and Supports              | 23 05 29    |
| Mechanical Insulation                  | 23 07 00    |
| Electrical                             | Division 26 |
- C. The plumbing work shown on the Drawings is schematic and the Specifications define the work in broad terms. As such, the Contract Documents shall not be construed as a complete description of all of the details of design and construction required. Provide all labor, materials, equipment, appliances, tools, hardware and accessories and perform all work necessary for the complete execution of the plumbing work as shown on the Drawings, required by the Specifications and work not specifically shown or specified, yet required to ensure proper and complete operation of all systems. The Work shall comply with all applicable codes, regulations, ordinances and Utility Companies' requirements.
- D. All plumbing fixtures and components that convey potable water shall comply with NSF/ANSI Standard 61, Annex G.
- E. This Contractor shall secure and pay for all required fees, permits, and inspections for the work included in this Section.

##### 1.02 QUALITY ASSURANCE

- A. Plumbing work shall be performed by a duly licensed plumber who is qualified to do such work and who is normally engaged in this type of work. He shall be familiar with the materials being installed, with all pertinent standards, codes, regulations and ordinances, the manufacturers' recommended installation procedures, the requirements of the Utility Companies, and the requirements of the Contract Documents.
- B. Plumbing materials, products, equipment, construction and installations shall comply with State and local plumbing codes, ANSI standards, and the requirements of the Utility Companies. Wherever a conflict may exist between these Contract Documents or any of the codes or Utilities' requirements, the more stringent shall govern.

##### 1.03 SUBMITTALS

- A. See Section 23 00 00.
- B. Submit one electronic copy of all submittal data and/or complete shop drawings as specified in each section for review.
- C. See Division 1, for Administrative Provisions.

- D. Mechanical/Plumbing contractor shall provide a list of Submittals for Engineers review prior to submitting on submittals.
- E. Submittals shall be complete by specification article. All items specified under the same article as the major item shall be included in the submittals. No partial or incomplete submittal will be accepted or reviewed. Submittals for equipment requiring electrical service shall include wiring diagrams.
- F. Provide copies of all required permits.
- G. Provide as-built plumbing drawings.
- H. Provide Operation and Maintenance Manuals for all equipment.
- I. Submittals and/or shop drawings are to be edited to show specific data for the mechanical equipment that the contractor intends to provide.
- J. Submittals and/or shop drawings are to be identified with numbers and letters identical to those listed on the drawings and/or specifications.

## **PART 2 – PRODUCTS**

### **2.01 ESCUTCHEONS**

- A. Provide chrome-plated, satin finish, cast brass escutcheons for exposed piping passing through or protruding from walls, ceilings, and floors.
- B. On bare pipes, affix escutcheons with set screw; on insulated pipes by spring tension, and on projections of fittings, provide special deep type escutcheons.

### **2.02 BACKFLOW PREVENTERS**

- A. Furnish and install where indicated on the Drawings or where required by Code, a reduced pressure backflow preventer. Manufacturer shall be Watts Model 007 or an approved equal.

### **2.03 VACUUM BREAKERS**

- A. All equipment having hose or tubing connections shall be provided with approved vacuum breakers.

### **2.04 OTHER MATERIALS**

- A. Refer to other applicable Sections.
- B. All other materials, not specifically shown or described, but required for a complete, proper and operational plumbing system, shall be as selected by Contractor and subject to the acceptance by Engineer.

## **PART 3 – EXECUTION**

### **3.01 INSPECTION AND PREPARATION**

- A. Prior to work of this Section, carefully inspect the work of other trades and verify that such work is complete to the point where this installation may properly commence.

- B. Verify that plumbing work may be installed in strict accordance with pertinent codes, regulations, ordinances, and Utility Companies' requirements.
- C. The scale of the Drawings precludes indicating all offsets, fittings, accessories and details which may be required. Carefully examine the Drawings and the work of other trades for conditions which may affect the installation of the plumbing. Re-arrange the plumbing work, as required, and provide all items required to meet such conditions to complete the systems.
- D. Lay out the plumbing systems and determine proper elevations for all components. Run pipelines in long straight lines and use the minimum number of bends possible. Do not run piping in areas exclusively containing telephone or electrical equipment. In other areas, do not run piping within 5' laterally of electrical equipment, such as motor control centers, switchgear, electrical motors, transformers, terminal strips and the like. Where this is not possible, provide drip pans. Do not penetrate structural members.
- E. Except where exposed pipe is specified, lay out plumbing so that piping is carried in partitions, chases or recesses where provided, floor openings, and above ceilings.
- F. Whenever possible, separate hot and cold water lines by at least 6" and never allow them to touch one another.

### **3.02 INSTALLATION**

- A. General - Install piping promptly, capping or plugging open ends and making pipe generally free from traps and in a manner to conserve space for other work. Run pipes straight and parallel or at right angles to walls with risers erected plumb and true.
- B. Horizontal Location - Install piping within walls where possible, otherwise, as close to walls, columns and the like as is possible, providing offsets, cleanouts, fittings, and other materials required.
- C. Fittings - Use reducing fittings for changes in pipe size.
- D. Drain Valves - Pitch piping to low points. Where low points or pockets occur because of changes in elevation required by structural or other interferences, provide a drain valve.
- E. Vacuum Breakers - Provide vacuum breakers on service sinks, hose bibs, and where otherwise indicated or required.
- F. Insulation - Provide pipe insulation on exposed and concealed hot and cold water lines in accordance with Section 230700.
- G. Expansion Loops - Provide expansion loops on hot water lines, as required. Connect fixture branches to risers in a manner to allow for expansion of riser without springing the branch piping.
- H. Cushions - Cushion traps and bearings to minimize transfer of sound, firmly anchor pipes in position, provide complete isolation of dissimilar metals, and provide air chambers at fixtures with each chamber at least 24" long and one size larger than the branch.

### **3.03 CLOSING IN WORK**

- A. Do not cover up or enclose work until it has been tested and inspected.

### **3.04 TESTING**

- A. Test all pipelines in accordance with the requirements of all local and state plumbing codes.
- B. Test underground piping prior to backfilling.

- C. Insure that the test pressure which might damage fixtures or equipment does not reach such units by valving them off or otherwise isolating them during the test.
- D. All hydrostatic tests shall be held for a minimum of eight hours without loss of pressure. All air tests shall be held for a minimum of one hour without loss of pressure.
- E. Test Procedure shall be as follows:
  - 1. Drainage systems (including sanitary sewers, storm sewers, and sanitary vents): All low points of such systems shall be plugged and filled with water to uppermost outlet. System shall stand full of water for 24 hours with no indication of leaks.
  - 2. Domestic hot and cold water: 150 psig hydrostatic test.
  - 3. Gas: 30 psig air test.
- F. Test piping prior to application of paint or insulation.
- G. Separately test portions of piping that will be concealed before completion.

### **3.05 DISINFECTION**

- A. Disinfect all pipes installed to carry potable water.
- B. Disinfect the systems, first being sure that trapped air is expelled, the system is full of water, and all loose material or debris has been washed out.
- C. Use a dosage which will produce not less than 50 ppm available chlorine throughout the entire system and not less than 10 ppm chlorine residual after a contact period of not less than 24 hours. Repeat disinfection if chlorine residual is less than 10 ppm after 24 hours contact period.
- D. During the disinfection period, exercise care to prevent harm to humans, animals, property or the environment, and to prevent contamination of water in the city water mains.
- E. After the disinfection period, flush the piping with clean potable water until the chlorine residual does not exceed 0.2 ppm.

### **3.06 ADJUST AND CLEAN**

- A. Make any adjustments which may be required to make systems perform as required. Set controls and prepare system for permanent operation.
- B. Thoroughly clean all work and remove labels, stamps, dirt, pipe jointing materials and the like to place the systems in a neat, clean and sanitary condition. Use only manufacturer recommended cleaning solutions on fixtures so as not to damage the finish.

### **3.07 REDUCED PRESSURE BACKFLOW PREVENTER INSTALLATION**

- A. Locate valve where it will be visible and accessible for maintenance and at such location that dripping or discharge of water from relief vent will not create a nuisance nor damage to finished surfaces.
- B. Install shut-off valve and strainer upstream of backflow preventer.

**END OF SECTION**

## SECTION 23 00 00

### BASIC MECHANICAL REQUIREMENTS

#### PART 1 – GENERAL

##### 1.01 DESCRIPTION

- A. Provide all labor, materials, equipment and transportation as required to completely install the HVAC and Plumbing Systems as shown on the Drawings and as specified in this Division.
- B. Drawings:
1. Contract drawings are, in part, diagrammatic and are intended to convey the scope of the work and indicate in general arrangement of the equipment and do not indicate every required offset, fitting, valve, etc. Follow these drawings in laying out the work. Consult all Drawings to become familiar with all conditions affecting the work and to verify spaces in which the work will be installed.
  2. Reasonable changes required by job conditions (including offsetting of piping and ductwork, etc.) shall be made at no additional cost to the owner.
- C. Definitions:
1. "Provide" shall have the same meaning as "furnish and install." All material so implied either on the drawings or in these specifications shall be furnished and installed unless specifically noted otherwise.
  2. Contractor Abbreviations:
    - a. MC Mechanical Contractor
    - b. EC Electrical Contractor
    - c. PC Plumbing Contractor
    - d. GC General Contractor
- D. Contractor shall be responsible to insure a complete system and compliance with all applicable codes. In the absence of a clarification by the Engineer, the contractor must install his work in accordance with the more stringent application. Contractor assumes full responsibility for any and all items furnished and installed without the written approval by the owner and/or Engineer. Under no circumstances will a change order be approved for work installed that was not approved by the owner and/or Engineer.
- E. Related work specified elsewhere includes:
1. Instructions to Bidders
  2. General Requirements Division 01
  3. Sitework Division 31
  4. Concrete Division 03
  5. Finishes Division 09
  6. Electrical Division 25
  7. Automatic control valves, separable wells for immersion elements, louvers and dampers furnished by others shall be installed by the Mechanical Contractor.

## **1.02 ELECTRICAL REQUIREMENTS FOR MECHANICAL EQUIPMENT**

- A. The HVAC work shall include the installation of all motors, temperature controls, limit switches, etc., as herein specified. All 240, 208, and 120 volt "power" wiring and connections, not specified in this Section, will be provided under Electrical Drawings.
- B. All wiring, motor starters and auxiliary devices required for the specified systems, equipment and operations indicated in this Section shall be provided under this Section, unless specifically indicated on the Drawings related to Electrical. This shall include, but is not necessarily limited to, all wiring for automatic temperature control and all wiring for automatic timing controls.
- C. The materials and methods for all electrical work provided under this Section shall comply with the requirements specified on electrical drawings. Coordinate equipment ratings, starter sizes, protective device sizes, wire and conduit sizes, holding coil voltages and control voltages with Electrical Drawings.
- D. All motors to be NEMA Premium Efficient.

## **1.03 SUBMITTAL DATA AND SHOP DRAWINGS**

- A. Submit one electronic copy of all submittal data and/or complete shop drawings as specified in each section for review.
- B. See Division 1, for Administrative Provisions.
- C. Mechanical/Plumbing contractor shall provide a list of Submittals for Engineers review prior to submitting on submittals.
- D. Submittals shall be complete by specification article. All items specified under the same article as the major item shall be included in the submittals. No partial or incomplete submittal will be accepted or reviewed. Submittals for equipment requiring electrical service shall include wiring diagrams.
- E. Provide copies of all required permits.
- F. Provide air and water balance reports.
- G. Provide as-built mechanical drawings.
- H. Provide Operation and Maintenance Manuals for all equipment.
- I. Submittals and/or shop drawings are to be edited to show specific data for the mechanical equipment that the contractor intends to provide.
- J. Submittals and/or shop drawings are to be identified with numbers and letters identical to those listed on the drawings and/or specifications.

## **1.04 RECORD DRAWINGS**

- A. During progress of the work, the contractor shall maintain an accurate record of all changes made in the mechanical system installation from the layout and materials shown. These shall be kept on a separate set of plans. At the completion of the project, transfer all information to the owner/engineer in electronic form.

## **1.05 OPERATIONS AND MAINTENANCE MANUAL**

- A. Upon completion of this portion of the work, and as a condition of its acceptance, deliver to the owner/Engineer three copies of a manual describing the system. Prepare manuals in durable plastic binders approximately 8½ by 11 inches in size with at least the following:

1. Identification on, or readable through, the front cover stating general nature of the manual.
2. Neatly typewritten index near the front of the manual, furnishing immediate information as to location in the manual of all data regarding the installation.
3. A copy of all reviewed submittals and shop drawings.
4. A simplified description of the operation of all systems including the function of each piece of equipment within each system. These descriptions shall be supported with a schematic flow diagram.
5. As-built controls, including wiring diagrams and sequences of operations, and post commissioning as-builts as required.
6. Valve tag charts, where applicable.
7. An explanation of the control sequence of each system along with the following instructions wherever applicable.
  - a. Emergency procedures for fire or failure of major equipment.
  - b. Normal starting, operation and shutdown.
  - c. Summer or winter shutdown.
8. An outline of a preventive maintenance program for each system which shall include a schedule of inspection and maintenance. It shall suggest the maintenance and inspection that should be done with outside service.
9. Complete name and address of nearest vendor of replaceable parts.
10. Copy of all guarantees and warranties issued.
11. Where contents of manual include manufacturer's catalog pages, clearly indicate the precise items included in this installation and delete, or otherwise clearly indicate, all manufacturer's data with which this installation is not concerned.
12. Letter of Guarantee from Contractor.

#### **1.06 DELIVERY, STORAGE, AND HANDLING**

- A. The Contractor shall be responsible for the care and protection of all materials and mechanical work until the project is accepted by the Owner.
- B. Immediately remove from the construction site all materials damaged and/or destroyed and replace with new materials to the complete satisfaction of the owner/Engineer without additional cost to the Owner.

#### **1.07 SUBSTITUTION FOR SPECIFIED MATERIALS:**

- A. Where a specific trade name, manufacturer and model number is mentioned, it is intended to establish the quality, style and type of equipment necessary to fulfill design criteria and shall not be construed as restricting or limiting competition among manufacturers.
- B. The specific name and model number scheduled on the drawings and/or the first name in the specification is the basis of the system design.
- C. Contractor may propose substitutes.

1. Any material or equipment other than that designated as system design shall be considered a substitute whether referenced as an equal or not.
  2. All submittals for substitution shall be in the form of a fully coordinated proposal covering all changes in the work associated with making the substitution.
  3. The change shall include the mechanical and all other disciplines associated with the change.
  4. Refer to Division 1, General Requirements for procedures to propose substitutes.
  5. Contractors shall be held responsible for all physical changes resulting from such substitutions of equipment and shall bear any and all increased costs to himself as well as to other trades in making said substitutions. Approval by the owner/Engineer of equipment other than the specified does not relieve the Contractor of this responsibility.
  6. In all instances, contractors shall assume full responsibility for proof of quality of the substitute to the equipment hereinafter specified. All data and information necessary for proof of equality, function and space requirements shall be prepared and accompany the submittal of the substitution to the owner/Engineer.
- D. In the event the substitute material or equipment does not perform, fit or meet quality standards, the Contractor shall provide the specified material or equipment and bear all costs to replace the substituted item with the specified.

#### **1.08 QUALITY ASSURANCE**

- A. All work specified in Division 15 shall be performed by approved workmen qualified by satisfactory experience in the particular work.
- B. Mechanical equipment, piping, etc... shall be designed to ANSI, ASME, NEMA, OSHA, IEEE, AGMA and other applicable standards.

#### **1.09 LAWS, PERMITS, INSPECTION, TAP FEES**

- A. Comply with all Federal, State, Municipal, OSHA, NFPA, AGA, NEC, and Utility Companies' laws, ordinances and regulations that apply to the work.
- B. Obtain all required permits and inspections. Pay all fees and costs.
- C. Before requesting final payment, submit certificates of approval (or final inspection) from the concerned above authorities.

#### **1.10 GUARANTEE**

- A. The Contractor will guarantee all materials, workmanship and the successful operation of all equipment and apparatus installed for a period of one year from the date of final acceptance.
- B. The Contractor will guarantee to repair or replace at his own expense any work or material installed or furnished under this contract which develops defects, except for normal wear, within one year from the date of final acceptance of the entire work.

## **PART 2 – PRODUCTS**



## **2.01 GENERAL**

- A. Provide and install only new materials and equipment of the latest design of the respective manufacturers.
- B. All materials and equipment of the same classification shall be the product of the same manufacturer unless otherwise specified.
- C. Furnish to the proper trades, all manufacturer's wiring diagrams for installation of mechanical equipment.
- D. Provide tee fittings, elbows, reducers, and other required components to install equipment and control devices furnished by other trades.

## **2.02 PAINTING**

- A. In general, all of the finish painting will be provided by the contractor, except as specified below:
  - 1. Pumps, motors, expansion tanks, and other factory manufactured parts shall be factory coated with a traditional shop coat of paint, except where there are special finishes required.
  - 2. Any item that is scratched or damaged shall be repainted to match original.
- B. Paint steel brackets, stands, hangers, etc... as mentioned in this section with a black rust inhibitive paint, compatible with other paints.
- C. Brackets, hangers, etc... that cannot be painted after installation shall be painted prior to installation.

## **2.03 ELECTRICAL EQUIPMENT**

- A. All electrical equipment shall conform to Electrical Specifications and shall be suitable for operation on the voltage and phase available at the building site. These characteristics shall be verified by the Contractor prior to ordering equipment.
- B. Provide motors as required for proper operation of all equipment furnished under this Division. The minimum motor horsepower ratings are specified or scheduled on the drawings. Minimum requirements for all motors are as follows:
  - 1. Dustproof/leakproof bearing rings
  - 2. Factory balanced
  - 3. TEFC Industrial duty
  - 4. Thermal overload protection
  - 5. Minimum efficiencies shall not be less than values in NEMA MGI 12.54
  - 6. Minimum efficiencies - 1-4HP, 78.5%;
  - 7. Furnish starters with thermal overload protection for all motors provided.
  - 8. All starters for three-phase motors shall be magnetic complete with the following accessories:
    - 9. Three-leg overload protection
    - 10. Control transformers with fused primary and secondary
    - 11. 120 volt holding coils
    - 12. Integral hand-off-auto switch
    - 13. Auxiliary contacts required for system operation plus one spare
    - 14. Conform to NEC and NEMA requirements.
- C. All starters for single-phase motors shall be horsepower rated thermal overload switches, unless magnetic starters are required for automatic control. If magnetic starters are necessary, provide as per above.

- D. Furnish all necessary control devices such as speed controls, transformers, and relays as required for proper operation of all equipment furnished under this Division.
- E. Furnish all remote switches and/or pushbutton stations required for manually operated equipment complete with pilot lights of an approved type lighted by current from load side of starter.
- F. Motors, starters, and other electrical control equipment installed in moist areas or areas of special conditions, shall be designed and approved for installation in such areas.
- G. Furnish identification as to purpose for each switch and/or pushbutton station furnished herein. Identification may be either engraved plastic sign or permanent mounting to wall below switch, or stamping on switch cover proper. All such identification signs and/or switch covers in finished areas shall match other hardware in the immediate area.

## **PART 3 – EXECUTION**

### **3.01 INSTALLATION**

- A. Install all work with a neat and orderly appearance, as specified and as shown on the Drawings.
- B. Make all installations structurally sound throughout.
- C. Coordinate mechanical work with all other trades.
- D. Locate all installations to avoid interference with equipment, storage areas, work of other trades, and traffic areas.
- E. Perform all work incidental to the installation of the apparatus and materials including, but not limited to, cutting, patching, trenching, excavating, backfilling, trench covering, plastering and the constructing of chases, slots, furring, foundations, piers and pads, when applicable. All work shall be performed in accordance with the applicable Divisions of this Specification by qualified workmen regularly employed in the applicable trades.
- F. The Contractor (CM) for the work of general construction will provide all boxed openings, chases, recesses, lintels and bucks required for the admission of the work. Furnish him with all necessary information in ample time.
- G. If openings, chases, recesses, lintels or bucks are omitted or not correctly located, bear the cost of subsequent patching as required.
- H. Do not cut walls or floors that are waterproofed or pierce any structural member without written permission from the owner.
- I. The Owner or Owner's Representative reserves the right to relocate terminal equipment (10) ten feet in any direction from locations indicated on plans, before roughing-in, with no change in contract price.
- J. All equipment shall be installed true, level and in the location shown on the drawings.
- K. Furnish and install all necessary guides, anchors, bolts and other accessories required with the installation of the equipment.
- L. All equipment shall be installed as to provide necessary access for maintenance and operation.

- M. Contractor is responsible for sizing, locating and design of all anchor pads, piers, thrust blocks, curb supports, structural steel supports and other structural support items as required.
- N. Provide all brackets and/or supports as required for mechanical installations in excess of building structure. Submit shop drawings of intended construction for review as required.

### **3.02 INSTRUCTIONS**

- A. On completion of the job, the Mechanical Contractor shall provide a competent technician to thoroughly instruct the Owner's representative in the care and operation of the mechanical and plumbing systems. The total period of instruction shall not exceed 24 hours by the MC. Time shall not be used all at one time. It shall be used in intervals as deemed necessary by the Owner's Representative. The time and number of personnel for instruction shall be arranged with the Owner's Representative. Refer to Mechanical Specification 230900-3.017 for the Required Controls System Training for the Owner.

### **3.03 CUTTING AND PATCHING**

- A. Perform cutting and patching in accordance with Division 1 Section "Cutting and Patching".
- B. Perform cutting and patching of mechanical equipment and materials required to:
  - 1. Uncover work to allow installation of late work.
  - 2. Remove and replace defective work.
  - 3. Remove and replace work not conforming to the construction documents.
  - 4. Install equipment and materials in existing structures.
- C. During cutting and patching, protect adjacent area structure, furnishings and finishes.
- D. Provide and maintain temporary partitions or barriers to prevent the spread of dust and dirt to the adjacent areas.

### **3.04 CODE CONFORMANCE**

- A. Install all systems of Division 23 sections in conformance with all applicable State of Vermont codes and Town of Randolph, VT codes in addition to the standards listed in the Division 15 specifications.
- B. Codes include but are not limited to the following:
  - 1. 2012 Vermont Fire & Building Safety Code
  - 2. 2012 The Uniform Fire Code, NFPA 1
  - 3. 2012 International Building Code
  - 4. 2006 International Mechanical Code
  - 5. 2012 International Plumbing Code
  - 6. 2015 CBES
  - 7. 2012 Standard for the Installation of Air Conditioning and Ventilation Systems, NFPA 90A

8. 2011 NFPA 96 Standard for Ventilation Control and Fire Protection of Commercial Cooking Appliances
9. 2011 NFPA 31 Standard for the Installation of Oil-Burning Equipment

### **3.05 INFORMATION FOR OTHER DIVISIONS**

- A. Provide all information concerning the equipment or work of Division 15 required by other Divisions in ample time to prevent delay in building progress.

### **3.06 EXCAVATING AND BACKFILLING**

- A. Provide all excavating and backfilling required in connection with the work under this Division.
- B. Include provisions for repairing of finished surfaces, all required shoring, bracing, pumping, and protection for safety of persons and property.
- C. Backfilling and compaction shall be in conformance with "Earthwork Division" of these specifications. Backfilling shall not be done until pipe lines are properly tested in the presence of the owner/Engineer or plumbing inspector.

### **3.07 FINAL ACCEPTANCE**

- A. When all work, testing, balancing, initial start-up and operation instructions have been completed, the Contractor shall notify owner and arrange for final acceptance.
- B. Contractor shall have all necessary test data complete in accordance with specifications and at hand during inspection.
- C. Items found not in accordance with Contract Documents or items functioning incorrectly will be itemized and submitted in writing to the Contractor for correction.

### **3.08 CLEANING**

- A. Do not allow refuse and surplus materials to accumulate and obstruct the construction site.
- B. Upon completion of the installation, remove refuse and surplus materials from the construction site and leave the building neat and clean.
- C. Repair any items that have been scratched or damaged during construction. Any item repaired or refinished shall be brought to the attention of the owner/Engineer.

### **3.09 GUARANTEE**

- A. Contractor by accepting the plans and specifications and signing the contract shall guarantee the following:
- B. All equipment, accessories and material furnished by him for a period of one year from final acceptance, against all defects in material and workmanship.
- C. If equipment fails, does not operate satisfactorily or shows undue wear, the Contractor will be notified and will be required to remedy the defect immediately at his own expense.
- D. That all equipment will produce the result specified or required.
- E. That all piping shall be drip-tight, properly installed and free of vibration, pounding or objectionable noise.

- F. Guarantee shall extend for one (1) year from date of acceptance by the Owner except where items of equipment, etc., are guaranteed by manufacturer for periods in excess of this time, manufacturer's guarantee shall take preference.

**END OF SECTION**

## SECTION 23 05 00

### BASIC MECHANICAL MATERIALS AND METHODS

#### PART 1 – GENERAL

##### 1.01 DESCRIPTION

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

##### 1.02 SUMMARY

- A. This Section specifies piping materials and installation methods common to more than one section of Division 23 and includes joining materials, piping specialties, and basic piping installation instructions.

##### 1.03 SUBMITTALS

- A. See Section 23 00 00.
- B. Product Data: Submit product data on the following items:
  - 1. Escutcheons
  - 2. Mechanical Sleeve Seals
  - 3. Mechanical equipment nameplate data
  - 4. Wall and floor sleeves
  - 5. Selective Demolition including: Nondestructive removal of materials and equipment for reuse or salvage as indicated, dismantling mechanical materials and equipment made obsolete by these installations.
  - 6. Miscellaneous metals for support of mechanical materials and equipment.
  - 7. Miscellaneous lumber for support and anchorage of mechanical materials and equipment.
  - 8. Firestopping caulk
  - 9. Elastomeric joint sealers for sealing around mechanical materials and equipment.
  - 10. Access Panels
- C. Quality Control Submittals (Welding)
  - 1. Contractor's procedure qualification record (form PQR) for brazing and welding.
  - 2. Contractor's format for welding procedure specification (form WPS) and brazing procedure specification (form BPS).
  - 3. Individual welder's qualification tests for each of the contractor's PQR's. Welder certification test must be administered within twelve months prior to the commencement of work.

##### 1.04 QUALITY ASSURANCE

- A. Use only thoroughly trained and experienced personnel who are completely familiar with the types of piping accessories required, the manufacturers' installation recommendations and the requirements of the Contract Documents.
- B. Welding procedure qualifications:
  - 1. Contractor shall submit for review the Contractor's standard procedures. Procedure shall be submitted on PQR form as described in the ASME Boiler and Pressure Vessel Code.

- C. Welder's Qualifications:
  - 1. All welders shall be certified to the WPS as listed on the Contractor's PQR. Certifications are to be performed by an independent testing laboratory within twelve months prior to the commencement of work.
  - 2. Each welder is to stamp the pipe adjacent to each weld performed by them. During the submittal process, the Contractor is required to provide a list of each welder's name and the mark used by each welder.
- D. Tack Welding: Tack welding may be performed by non-certified welders. All tack welds, whether performed by certified or non-certified welders, must be ground out and removed.
- E. No welding may take place until a satisfactory reviewed submittal is complete.

#### **1.05 DELIVERY, STORAGE, AND HANDLING**

- A. Provide factory applied plastic end caps on each length of pipe and tube, except for hub and spigot pipe. 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. Elevate above grade and enclose with durable, waterproof wrapping. When stored inside, do not exceed structural capacity of the floor.
- C. Protect flanges, fittings, and specialties from moisture and dirt by inside storage and enclosure, or by packaging with durable, waterproof wrapping.

#### **1.06 PROJECT CONDITIONS**

- A. Environmental Conditions: Apply joint sealers and firestopping under temperature and humidity conditions within the limits permitted by the manufacturer. Do not apply joint sealers and firestopping to wet substrates.

#### **1.07 SEQUENCE AND SCHEDULING**

- A. Coordinate the shut-off and disconnection of utility services with the Owner and the utility company.
- B. Notify the Architect at least 5 days prior to commencing demolition operations.

### **PART 2 – PRODUCTS**

#### **2.01 PIPE AND FITTINGS**

- A. Refer to the individual piping system specification sections in Division 15 for specifications on piping and fittings relative to that particular system.
- B. All pipe and fittings shall be fabricated in the USA or Canada.
- C. Elbows for all pipe sizes 2" diameter and over shall be long radius type (1.5R).
- D. Use reducers, increasers, or reducing tees for change of pipe size. Bushings are not allowed.
- E. Forged steel branch connectors, per the limits set forth in Part 3 of this section, may be used to create branch connections in steel piping systems. All branch connectors shall be 3,000# fittings.
  - 1. "Weld-O-Lets", "Thread-O-Lets", or "Sock-O-Lets"

2. "Trans-O-Con"

**2.02 JOINING MATERIALS**

- A. Welding Materials: Comply with Section II, Part C, ASME Boiler and Pressure Vessel Code for welding materials appropriate for the wall thickness and chemical analysis of the pipe being welded.
- B. Gaskets for Flanged Joints: Provide gasketed material for full faced cast iron flanges and raised face for steel flanges. Select materials to suit the service of the piping system in which installed and which conform to their respective ANSI Standard (A21.11, B16.20, or B16.21). Provide materials that will not be detrimentally affected by the chemical and thermal conditions of the fluid being carried. Gasket type shall be spiral wound 304 stainless steel/graphite type for raised faced joints; NBR gaskets shall be used for flat faced joints. Red rubber gaskets are not allowed.

**2.03 ESCUTCHEONS**

- A. Steel Escutcheons: Chrome plated, stamped steel, hinged, split ring escutcheon, with set screw. Inside diameter shall closely fit pipe outside diameter, or outside of pipe insulation where pipe is insulated. Outside diameter shall completely cover the opening in floors, walls, or ceilings. Where escutcheons are to be painted, furnish prime painted.
- B. Plastic style snap on type escutcheons: Provide chrome plated for exposed finish areas, plain finish for mechanical rooms and areas which will be painted.

**2.04 MECHANICAL SLEEVE SEALS**

- A. Modular mechanical type, consisting of interlocking synthetic rubber links shaped to continuously fill annular space between pipe and sleeve, connected with bolts and pressure plates which cause rubber sealing elements to expand when tightened, providing watertight seal and electrical insulation.

**2.05 MECHANICAL EQUIPMENT NAMEPLATE DATA**

- A. Nameplate: For each piece of power operated mechanical equipment provide a permanent operational data nameplate indicating manufacturer, product name, model number, serial number, capacity, operating and power characteristics, labels of tested compliances, and similar essential data. Locate nameplates in an accessible location.

**2.06 WALL AND FLOOR SLEEVES**

- A. Sheet Metal Sleeves (light): 20 gage galvanized sheet metal with Pittsburgh lock longitudinal joint.
- B. Sheet Metal Sleeves (heavy): 16 gage galvanized sheet metal with pipe or Pittsburgh lock longitudinal joint.
- C. Steel Sleeves: Schedule 10, steel pipe, ASTM A53, Grade A.

**2.07 MISCELLANEOUS METALS**

- A. Steel plates, shapes, bars, and grating: ASTM A 36.
- B. Cold-Formed Steel Tubing: ASTM A 500.
- C. Hot-Rolled Steel Tubing: ASTM A 501.
- D. Non-shrink, Non-metallic Grout: Pre-mixed, factory-packaged, non-staining, non-corrosive, nongaseous grout, recommended for interior and exterior applications.



- E. Fasteners: Zinc-coated, type, grade, and class as required.

## **2.08 MISCELLANEOUS LUMBER**

- A. Framing Materials: Standard Grade, light-framing-size lumber of any species. Number 2 Common boards complying with WCLIB or AWPB rules, or Number 2 boards complying with SPIB rules. Lumber shall be preservative treated in accordance with AWPB LP-2, and kiln dried to a moisture content of not more than 19 percent.
- B. Construction Panels: Plywood panels; APA C-D PLUGGED EXT, with exterior glue; thickness as indicated, or if not indicated, not less than 23/32 inches.

## **2.09 FIRESTOPPING**

- A. General: Firestopping caulk and other related materials compatible with each other and with joint substrates under conditions of service and application. All products shall be installed in the manner determined by the manufacturer as tested by an independent testing laboratory.
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. 3M Fire Protection Products
  - 2. Spec Seal (Specified Technologies Inc.)
  - 3. Rectorseal Corporation
  - 4. HILTI

## **2.10 ELASTOMERIC JOINT SEALERS**

- A. General: Joint sealers, joint fillers, and other related materials compatible with each other and with joint substrates under conditions of service and application.
- B. Colors: As selected by the Architect from manufacturer's standard colors.
- C. General Duty: One-part, neutral core silicone sealant of formulation indicated that is recommended for exposed applications on exterior and interior joints in vertical and horizontal surfaces of concrete, masonry, glass, aluminum, and steel.
- D. Wet Locations: Provide manufacturer's standard one part, mildew resistant, paintable silicone sealant that is recommended for exposed locations on interior ceramic tile, masonry, and metals in bathroom and shower room locations.
- E. Manufacturers:
  - 1. Dow Corning
  - 2. General Electric
  - 3. Pecora Corp.
  - 4. Tremco, Inc.

## **2.11 ACCESS PANELS**

- A. Provide access panels as shown on plans and where required for access to concealed valves, dampers, cleanouts, control devices, and equipment servicing.
- B. Panels located in public areas are to have keyed locks.
- C. Access panels are to have Underwriters' Laboratories B label fire rating where installation is required in fire rated walls or ceiling.
- D. All panels shall have hinging panels.

- E. Deliver all panels to general contractor for installation. Provide instructions for their location in sufficient time so that panels can be installed in the normal course of work.

## **PART 3 – EXECUTION**

### **3.01 GENERAL**

- A. Inspection: Examine areas and conditions under which pipe and piping accessories are to be installed. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to the Installer.
- B. Coordination: It is the responsibility of the contractor to coordinate the work of his trade with all other trades prior to the commencement of construction. Any conflicts must be brought to the attention of the Engineer. Any work requiring removal and re-installation due to the lack of coordination shall be the responsibility of the contractors with no additional cost to the owner.

### **3.02 PREPARATION**

- A. Ream ends of pipes and tubes, and remove burrs. Bevel plain ends of steel pipe.
- B. Remove scale, slag, dirt, and debris for both inside and outside of piping and fittings before assembly.

### **3.03 PIPING AND FITTING INSTALLATIONS**

- A. General Locations and Arrangements: Drawings indicate the general location and arrangement of the piping systems. Location and arrangement of piping layout take into consideration pipe sizing and friction loss, expansion, pump sizing, and other design considerations. So far as practical, install piping as indicated.
- B. Conceal all pipe installations in walls, pipe chases, utility spaces, above ceilings, below grade or floors, unless indicated otherwise
- C. Install piping free of sags or bends and with ample space between piping to permit proper insulation applications.
- D. Install exposed piping at right angles or parallel to building walls. Diagonal runs are not permitted, unless expressly indicated on the Drawings.
- E. Install piping tight to slabs, beams, joists, columns, walls and other permanent elements of the building. Provide space to permit insulation applications, with 1" clearance outside the insulation. Allow sufficient space above removable ceiling panels to allow for panel removal.
- F. Locate groups of pipes parallel to each other, spaced to permit applying full insulation and servicing of valves.
- G. Install drains at low points in mains, risers, and branch lines consisting of a tee fitting, ¾" ball valve with hose connection, cap and chain. Install vents at high points. Pitch water piping upward in direction of flow and arrange fittings to permit air to be vented to system high points or to expansion tank, and to permit complete drainage to low points. Use eccentric fittings where necessary.
- H. Temporarily cover the open ends of all pipes not actively being installed and at the end of each work day to prohibit the influx of foreign materials.

- I. Arrange piping to provide adequate provision for thermal expansion and contraction to prevent undue strains on piping or apparatus connected. Arrange branches to take up motion or strain.
- J. Use fittings for all changes in direction, at all branch connections, and for change in pipe size.
- K. Remake leaking joints using new materials.
- L. Reductions in pipe size made with eccentric reducers shall have the tops level for water piping and bottoms level for steam piping.
- M. Run all horizontal building drains at uniform pitch. Follow indicated lines generally, but make exact layout on the job to work actual fitting dimensions, align piping and avoid interferences. Unless otherwise specified or required by code, provide proper support to maintain uniform fall of 1/4" per foot for lines 3 inches and smaller and 1/8" per foot for lines larger than 3".

### 3.04 PIPING JOINT PREPARATION

#### A. Steel Pipe Joints:

- 1. Pipe 2-1/2" and Smaller: Thread pipe with tapered pipe threads in accordance with ANSI B2.1. Cut threads full and clean using sharp dies. Ream threaded ends to remove burrs and restore full inside diameter. Apply pipe joint sealant or Teflon tape suitable for the service for which the pipe is intended on the male threads at each joint and tighten joint to leave not more than three threads exposed.
- 2. Pipe Larger Than 2-1/2": Weld pipe joints in accordance with ASME Code for "Power Piping," B31.1 and per the contractor's tested Welding Procedure Specification (WPS).
  - a. Install weld neck flanges at all valves, appurtenances, and equipment with flange type connections. Weld pipe flanges to pipe ends in accordance with ASME B31.1 Code for "Power Piping." Clean flange faces and install gaskets. Align flange surfaces parallel. Use suitable lubricants, such as Never Seize, on bolt threads. Tighten bolts gradually and uniformly with a torque wrench. Do not mate flat face flanges with raised face flanges.
- 3. Flanged Joints: Align flange surfaces parallel. 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 with a torque wrench.

#### B. Non-ferrous Pipe Joints:

- 1. Brazed Joints: For copper tube and fitting joints, braze joints in accordance with the AWS "Soldering Manual", the contractor's tested Procedure Qualification Record, ANSI B31.1 - Standard Code for Pressure Piping, "Power Piping", ANSI B9.1 - Standard Safety Code for Mechanical Refrigeration and the following:
  - a. Fill and allow a trickle flow of an inert gas (ie., nitrogen) through the pipe and fittings during brazing to prevent formation of scale. Caution must be exercised not to allow the inert gas to deplete the oxygen, causing asphyxiation.
  - b. Heat joints using oxyacetylene torch. Heat to proper and uniform brazing temperature.

- c. After installation of piping, but prior to installation of outlet valves, blow lines clear with nitrogen.
2. Soldered Joints: For copper tube and fitting joints, solder joints in accordance with the AWS "Soldering Manual" and "The Copper Handbook". Thoroughly clean tube surface and inside surface of the cup of the fittings, using very fine emery cloth, prior to making soldered joints. Wipe tube and fittings clean and apply flux. Flux shall not be used as the sole means for cleaning tube and fitting surfaces.
  3. Copper and Brass Threaded Joint Pipe 2-1/2" and Smaller: Thread pipe with tapered pipe threads in accordance with ANSI B2.1. Cut threads full and clean using sharp dies. Ream threaded ends to remove burrs and restore full inside diameter. Apply pipe joint sealant or Teflon tape suitable for the service for which the pipe is intended on the male threads at each joint and tighten joint to leave not more than three threads exposed.
  4. Flanged Joints: Align flange surfaces parallel. 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 with a torque wrench.
- C. Joints for other piping materials are specified within the respective piping system sections.

### **3.05 INSTALLATION OF MECHANICAL SLEEVE SEALS**

- A. Mechanical Sleeve Seals: Install per manufacturer's recommended practices. The sleeve must be clean and dry prior to installation.

### **3.06 INSTALLATION OF SLEEVES**

- A. Provide sleeves and inserts for all duct and piping.
- B. Provide cutting and patching as required to install mechanical and duct piping.
- C. Make sleeves in floors and partitions of galvanized steel pipe.
- D. Make sleeves of extra heavy cast iron pipe or galvanized steel pipe in outside walls, foundations and footings.
- E. Sleeves for insulated pipe shall be of sufficient size to pass insulation and of sufficient diameter to permit free movement of pipe where expansion and contraction occur.
- F. Sleeves for bare pipe shall be two pipe sizes larger than the pipe passing through
- G. Terminate sleeves flush with walls, partitions and ceilings. Terminate sleeves 1/4" above finished floors, except in rooms having floor drains, where sleeves shall be extended 3/4" above floor.
- H. Fill space between sleeve and pipe in underground walls with oakum and caulk watertight on both sides of wall.
- I. Fill space between sleeves and pipe with fiberglass blanket insulation when sleeve does not occur in an underground wall.
- J. Sleeves through fire rated walls, shafts, floor and partitions shall be packed full length with UL listed fill to maintain the rating of the separation.

### **3.07 ERECTION OF METAL SUPPORTS AND ANCHORAGE**

- A. Cut, fit, and place miscellaneous metal fabrications accurately in location, alignment, and elevation to support and anchor mechanical materials and equipment.
- B. Field Welding: Comply with AWS "Structural Welding Code."

### **3.08 ERECTION OF WOOD SUPPORTS AND ANCHORAGE**

- A. Cut, fit, and place wood grounds, nailers, blocking, and anchorage accurately in location, alignment, and elevation to support and anchor mechanical materials and equipment.
- B. Select fastener sizes that will not penetrate members where opposite side will be exposed to view or will receive finish materials. Make tight connections between members. Install fasteners without splitting wood members.
- C. Attach to substrates as required to support applied loads.

### **3.09 APPLICATIONS OF FIRESTOPPING CAULK**

- A. Installation of Fire-Stopping Sealant: The Contractor must determine the penetration is of suitable size and is properly prepared for installation of the fire caulk. Install sealant, including forming, packing, and other accessory materials, to fill openings around mechanical services penetrating floors and walls, to provide fire-stops with fire-resistance ratings indicated for floor or wall assembly in which penetration occurs. Comply with installation requirements established by testing and inspecting agency.

### **3.10 APPLICATION OF ELASTOMERIC JOINT SEALER**

- A. General: Comply with joint sealer manufacturers' printed application instructions applicable to products and applications indicated, except where more stringent requirements apply. Comply with recommendations of ASTM C 1193 for use of elastomeric joint sealants.
- B. Surface Cleaning for Joint Sealers: Clean surfaces of joints immediately before applying joint sealers to comply with recommendations of joint sealer manufacturer.
- C. Tooling: Immediately after sealant application and prior to time skinning or curing begins, tool sealants to form smooth, uniform beads; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint. Remove excess sealants from surfaces adjacent to joint. Do not use tooling agents that discolor sealants or adjacent surfaces or are not approved by sealant manufacturer.

### **3.11 FIELD QUALITY CONTROL**

- A. Testing: Refer to individual piping system specification sections. Test all pipe prior to the installation of insulation.

**END OF SECTION**

## SECTION 23 05 16

### EXPANSION COMPENSATION DEVICES

#### PART 1 – GENERAL

##### 1.01 DESCRIPTION

- A. Work covered by this Section includes the furnishing and installation of a diaphragm-type expansion tanks, air separators and air eliminators for the hydronic heating systems shown on the drawings.
- B. Related work specified elsewhere includes:
- |  |          |
|--|----------|
| Basic Mechanical Requirements          | 23 00 00 |
| Basic Mechanical Materials and Methods | 23 05 00 |
| Pipe and Pipe Fittings                 | 23 21 13 |
| Pipe Hangers and Supports              | 23 05 29 |
| Centrifugal Pumps                      | 23 21 23 |

##### 1.02 QUALITY ASSURANCE

- A. Provide at least one person who shall be present during the execution of this portion of the Work, is familiar with the types of materials being installed and the methods for their installation, and who shall direct the work performed under this Section.

##### 1.03 SUBMITTALS

- A. See Section 23 00 00.
- B. Shop drawings, catalog cuts, and other technical data to fully define materials, equipment and performance capabilities.

##### 1.04 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, handle, and store in manufacturer's original, undamaged shipping containers, with tags and labels intact and legible.
- B. Store up off ground, under cover, protected from weather and construction activities.

#### PART 2 – PRODUCTS

##### 2.01 DIAPHRAGM TYPE EXPANSION TANK

- A. Expansion tank shall be suitable for working pressure of 100 psig. Sealed-in elastomer diaphragm shall be suitable for operating at 240°F.
- B. Tank to be pre-charged as required in the Mechanical Equipment Schedule.
- C. Acceptable Manufacturers:
1. Amtrol, Inc.
  2. Taco
  3. Bell and Gossett

##### 2.02 AIR SEPARATION DEVICES

- A. Constructed in accordance with applicable provisions of the ASME Code for Unfired Pressure Vessels; fabricated steel devices rated for 150 psi shall bear the ASME Stamp.

- B. Units should be selected at the point of peak efficiency per the manufacturer's recommendations. Standard unit selection is at a maximum of 4 feet/sec. High unit velocity selection is at a maximum of 10 feet/sec.
- C. Construction: Units shall include an internal bundle, filling the entire vessel to suppress turbulence and provide high efficiency. The bundle shall have a copper core tube with continuous wound copper affixed to the core. Each eliminator shall have a separate venting chamber to prevent system contaminants from affecting the float and venting valve. The top of the venting chamber shall have a full port brass venting mechanism. A valve shall be provided on the side of the air separator to flush out dirt, liquids and to bleed air off the system during system filling. There shall be a bottom connection provided on the unit.
- D. Permanent identification for inlet, outlet, and vent connections cast in the unit body.
- E. Acceptable Manufacturers:
  - 1. Spirotherm VSR

### **2.03 AIR ELIMINATION DEVICES**

- A. Automatic type, Amtrol Model 720 or 721, or approved equal, suitable for a working pressure of 100 psig and an operating temperature of 240°F.
- B. Manual type, Dole #14 key type with copper tubing drain.
- C. Acceptable Manufacturers:
  - 1. Amtrol, Inc.
  - 2. Taco
  - 3. Bell and Gossett

### **2.04 OTHER MATERIALS**

- A. Provide any materials not specifically shown or described, but required for a complete and proper installation. Materials shall be as selected by the Contractor subject to the approval of the Engineer.

## **PART 3 – EXECUTION**

### **3.01 INSPECTION**

- A. Before work is commenced, inspect the work of other trades and verify that the work is complete and correct, to the point where this installation may properly commence.

### **3.02 INSTALLATION**

- A. Provide expansion tanks in locations noted on the Drawings or as directed by the Engineer. Install so as not to block access to other equipment.
- B. Provide air elimination device where shown on Drawings and at the high point of each hot water heat riser, at high points in piping, and on all components in system where air could accumulate.
- C. Provide air separator where shown on Drawings.
- D. Provide manual air vent on all hot water radiation, hot water coils and at the top of the heating water riser loops.

**END OF SECTION**



## SECTION 23 05 29

### PIPE HANGERS AND SUPPORTS

#### PART 1 – GENERAL

##### 1.01 DESCRIPTION

- A. Work covered by this Section includes the furnishing and installation of pipe hangers and supports for interior and exposed piping.
- B. This section includes the following:
1. Horizontal piping hangers and supports.
  2. Vertical piping clamps.
  3. Hanger rod attachments.
  4. Building attachments.
  5. Saddles and shields.
  6. Stanchions and pipe rolls.
  7. Miscellaneous materials.
  8. Pipe alignment guides.
  9. Anchors.
  10. Equipment supports.
- C. Related work specified elsewhere includes:
- |                             |          |
|-----------------------------|----------|
| Basic Materials and Methods | 23 05 00 |
| Pipe and Pipe Fittings      | 23 21 13 |
| Plumbing                    | 22 00 00 |

##### 1.02 QUALITY ASSURANCE

- A. Use only thoroughly trained and experienced personnel who are completely familiar with the types of supports and hangers required, the manufacturers' recommendations and the requirements of the Contract Documents.
- B. Qualify welding processes and welding operators in accordance with AWS D1.1 "Structural Welding Code – Steel."
- C. Certify that each welder has satisfactorily passed AWS qualification tests for welding processes involved and, if pertinent, has undergone recertification.
- D. Acceptable Manufacturers - Grinnell, F & S Manufacturing, Crawford, or approved equal.
- E. Unless unavailable, all components of the pipe suspension systems shall be products prefabricated by an acceptable manufacturer whose primary work is the fabrication of such devices.

##### 1.03 SUBMITTALS

- A. See Section 23 00 00.
- B. Provide catalog cuts showing the types of hangers, supports and attachments proposed for use.

## **1.04 DELIVERY, STORAGE, AND HANDLING**

- A. Deliver, store and handle all components of the pipe suspension system to avoid rusting, twisting, the stripping of threads and from damage of any type.

## **PART 2 – PRODUCTS**

### **2.01 GENERAL**

- A. Provide a sufficient quantity of hangers and supports to maintain the pipelines, apparatus, and equipment in proper position and alignment under all operating conditions with due allowance for expansion and contraction. Provide hangers and supports of standard design where possible and that are best suited for the service required. Where required, provide hangers and supports that are screw adjustable after installation.
- B. Attach hangers and supports within buildings to walls, floors, ceilings, or beams, as appropriate.
- C. Minimize the injury hazard in all protruding supporting devices. Provide end caps on exposed ends of framing members.
- D. Include proper pipe protection saddles for pipes that are covered with insulation.
- E. Provide hot-dipped galvanized (ASTM B-6) when galvanizing is specified or required.
- F. Locate supports so that at least one support is provided per full pipe length.
- G. Pipe Supports Used with an EPDM membrane roof, in lieu of wood blocking.
  - 1. Carlisle's Pipe Support or equal.

### **2.02 PIPE SUPPORTING DEVICES**

- A. Saddles
  - 1. Use pipe saddles that are shaped to fit the pipe that they will support and that are capable of screw adjustment.
  - 2. Use floor stands or wall brackets to support saddles.
- B. Stanchions
  - 1. Provide pipe stanchion saddles with yokes and nuts; of similar construction to saddles.
  - 2. Use floor stands or wall brackets to support stanchions.
- C. Pipe Rolls
  - 1. Provide adjustable pipe rolls.
  - 2. Use floor stands, wall brackets, or ceiling or beam supports to support pipe rolls.
- D. Overhead Hangers - Support by threaded rods suspended from wall brackets or ceiling and beam supports.
- E. Saddles - Insulated pipe where specified to be continuous through hanger shall be protected at points of support with thermal hanger shields as manufactured by Pipe Shields, Inc. or equal of Insulshield or Uni-Grip. Thermal hanger shields shall consist of a 360 degree insert of high density, 100 psi, water-proofed calcium silicate, encased in a

360 degree sheet metal shield. Insert to be same thickness as adjoining pipe insulation. Shield length and minimum sheet metal gauges shown in chart below. If pipe hanger spacing exceeds 10 feet, utilize double layer shield on bearing surface.

<u>Pipe Size</u>	<u>Shield Length</u>	<u>Minimum Gauge</u>
1/2" – 1-1/2"	4"	26
2" – 6"	6"	20
8" – 10"	9"	16

F. Anchors

1. Provide cast-iron chair type anchors with steel straps, except where anchors form an integral part of pipe fittings or where an anchor of special design is required.
2. Fasten anchors rigidly to wall brackets or directly to the structure.

G. Non-adjustable Supports

1. Where adjustable supporting devices are not required, pipelines 3-inches in diameter or smaller may be supported using hooks, hook plates, rings, or ring plates made of cast-iron, malleable iron, polyvinyl chloride, or steel.
2. Mount as required or as directed by the Engineer.

**2.03 MOUNTING DEVICES**

A. Floor Stands

1. Brick and Concrete Piers - Shape the pier to conform accurately to the bottom one-third to one-half of the pipe.
2. Saddle Stands - Use a length of pipe fitted at the base with a standard threaded flange and at the top with an adjustable saddle, pipe roll, or stanchion. Bolt the base of the flange to the floor, foundation, or concrete base.

B. Wall Brackets

1. Provide welded steel support brackets.
2. Design wall brackets for three maximum loads classified as follows:

Light	750 pounds
Medium	1500 pounds
Heavy	3000 pounds
3. Furnish and install back plates of adequate size and thickness to distribute the load against the wall when bolting brackets to walls. When the use of back plates is not practicable, fasten the brackets to the wall in such a manner that the safe bearing strength of the wall will not be exceeded.

C. Ceiling and Beam Supports

1. Attach rods to the ceiling or beams using suitable adjustable concrete inserts, beam clamps, screws, bolts, or welding.
2. Concrete inserts - Provide galvanized inserts for concrete, recessed near the upper flange to receive reinforcing rods. Design inserts to permit the rods to be adjusted horizontally in one plane and to lock the rod nut or head automatically;

to carry safely the maximum load that can be imposed by the rod that they engage; and to be held in position during concrete pouring operations.

#### **2.04 TIE RODS AND CLAMPS**

- A. Furnish and install tie rods, clamps, couplings, and accessories to prevent the movement of branch valves, as indicated on the Drawings or as directed.

#### **2.05 OTHER MATERIALS**

- A. Provide any materials not specifically shown or described, but required for complete, adequate and proper pipe suspension systems. Select the materials and submit shop drawings to Engineer for acceptance.

### **PART 3 – EXECUTION**

#### **3.01 INSPECTION/COORDINATION/PREPARATION**

- A. Coordinate the work of the Section with the work of other trades and be sure that built-in items are properly and accurately installed. Also, coordinate with pipe installers to determine the final locations of piping and to ascertain the date by which components of the pipe suspension systems must be available so as not to delay the work of others.
- B. Carefully inspect the installed Work of other trades and verify that such Work is properly cured, braced and complete to the point where this work may properly commence.

#### **3.02 PERFORMANCE**

- A. Piping systems shall be provided with adequate anchorage, sway braces, guides, hangers and supports. Design the components to suit actual pipe installations under full operating conditions.
- B. Design all support equipment, except for springs, with a minimum factor of safety of 5, based upon the ultimate tensile strength of the material.
- C. Design hangers and supports, based upon the total weight of the pipe, fittings, valves, insulation, and appurtenances, and the weight of the liquid or gas to be transported or used in testing, whichever is greater. Hanger rods shall be subject to tensile loading only. Provide suitable linkage to permit swing when lateral or axial movement is anticipated.
- D. Anchors and guides shall be capable of withstanding all forces imposed upon them, including those from expansion and contraction.
- E. Design, fabricate and install supports so that they will not disengage as a result of movement in the supported pipe.
- F. Fit pipe hangers and supports with adequate adjusting nuts, of the locking type, threaded to a rod, which will allow adjustment after erection while still supporting the load.
- G. Carefully install the pipe suspension system so that pipes remain straight and at the required slopes and grades, free from sags, humps and unnecessary bends and twists. Follow the manufacturer's recommended installation instructions.
- H. All supporting devices shall be designed to minimize interference with access and movement.

### **3.03 SUPPORT SPACING AND HANGER ROD SIZES**

- A. No Hub Waste Pipe - Horizontally, at every joint; vertically, every 10'.
- B. Valves - At valves 3" and larger, install supports on each side of valve, spaced no further than 18" from valve except for plastic piping, then 9" from valve. Provide additional supports where required to prevent piping loads from placing damaging stresses on valves and equipment.
- C. Wall Penetrations - Provide pipe supports on each side of wall where pipe passes through a wall sleeve, spaced no further than 48" from the wall.
- D. Pipe Couplings - Provide additional supports on each side of pipe couplings, flexible connections, repair clamps and the like, spaced sufficiently close to prevent loads which may cause damage to or leakage from the device.
- E. Vertical Pipes - Use base fitting or hanger immediately adjacent to base and provide riser clamps as required, but not more than 15' on centers.
- F. Other Materials and Conditions - Where not included in the Specifications or shown on the Drawings, support piping materials in accordance with the manufacturers' design and installation instructions. Provide supports so as not to overstress the piping system, place stresses on equipment and machinery, cause leakage, or to adversely affect system performance.

### **3.04 ADJUST AND CLEAN**

- A. Adjust the pipe suspension systems as required.
- B. Thoroughly clean the piping support system and prepare exposed components for painting.

**END OF SECTION**

## SECTION 23 05 93

### TESTING, ADJUSTING, AND BALANCING

#### PART 1 – GENERAL

##### 1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 01 Specification sections, apply to work of this section.
- B. Related Sections:
  - 1. Other Division-23 Sections specify balancing devices and their installation, and materials and installations of mechanical systems.

##### 1.02 SUMMARY

- A. This Section specifies the requirements and procedures for total mechanical systems testing, adjusting, and balancing. Requirements include measurement and establishment of the hydronic and air quantities of the mechanical systems as required to meet design specifications, and recording and reporting the results.
- B. Test, adjust, and balance the following mechanical systems as shown on the plans:
  - 1. All hydronic systems.

##### 1.03 DEFINITIONS

- A. Systems testing, adjusting, and balancing is the process of checking and adjusting all the building environmental systems to produce the design objectives. It includes:
  - 1. The balance of water distribution.
  - 2. Adjustment of total system to provide design quantities.
  - 3. Electrical measurement.
  - 4. Verification of performance of all equipment and automatic controls.
- B. Approved Equal: Material, equipment, or method approved by the engineer for use in the work as being acceptable as an equivalent in essential attributes to the material, equipment, or method specified in the contract documents.

##### 1.04 QUALITY ASSURANCE

- A. Contractor Qualifications:
  - 1. Employ the services of an independent testing, adjusting, and balancing agency meeting the qualifications specified below, to be the single source of responsibility to test, adjust, and balance the building mechanical systems identified above, to produce the design objectives. Services shall include checking installations for conformity to design, measurement and establishment of the fluid quantities of the mechanical systems as required to meet design specifications, and recording and reporting the results.
  - 2. The independent testing, adjusting, and balancing agency certified by National Environmental Balancing Bureau (NEBB) or Associated Air Balance Council (AABC) in those testing and balancing disciplines required for this project.
  - 3. In lieu of satisfying the requirements of section 1.4.A.2, the contractor need not be certified, but rather, have a minimum of ten years experience with similar

projects. The contractor shall provide suitable evidence of past performance, including references, justifying the firm's capabilities. This does not relieve the contractor from the provisions stipulated in section 1.4.B

- B. Codes and Standards:
  - 1. NEBB: "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems".
  - 2. AABC: "National Standards For Total System Balance".
  - 3. ASHRAE: ASHRAE Handbook, 1985 HVAC Applications, Chapter 34, "Testing, Adjusting, and Balancing".

## **1.05 SUBMITTALS**

- A. Certified Reports: Submit testing, adjusting, and balancing reports bearing the signature of the test and balance lead technician. The reports shall be certified proof that the systems have been tested, adjusted, and balanced in accordance with the referenced standards; are an accurate representation of how the systems have been installed; are a true representation of how the systems are operating at the completion of the testing, adjusting, and balancing procedures; and are an accurate record of all final quantities measured to establish normal operating values of the systems. Final reports shall be type written, organized and formatted as specified below.
- B. Report Format: Report forms shall be those included in the first submittal for each respective item and system to be tested, adjusted, and balanced. Send report forms complete with schematic systems diagrams and other data in electronic .pdf format. Provide binding edge labels with the project identification and a title descriptive of the contents. Divide the contents of the binder into the below listed divisions, separated by divider tabs:
  - 1. General Information and Summary
  - 2. Hydronic Systems
  - 3. Special Systems
  - 4. Reports Contents: Provide the following minimum information, forms and data:
    - a. General Information and Summary: Inside cover sheet to identify testing, adjusting, and balancing agency, Contractor, Owner, Engineer, and Project; including addresses, contact names, and telephone numbers. Provide a listing of the instruments used for the procedures along with the proof of calibration.
    - b. The remainder of the report shall contain the appropriate forms containing as a minimum, the information indicated on the standard report forms prepared by the AABC or NEBB, for each respective item and system. Prepare a schematic diagram for each item of equipment and system to accompany each respective report form.

## **1.06 PROJECT CONDITIONS**

- A. Systems Operation: Systems shall be fully operational prior to beginning procedures.

## **PART 2 – PRODUCTS (Not Used)**

## **PART 3 – EXECUTION**

### **3.01 PRE-BALANCE PROCEDURES**

- A. General Procedures
  - 1. Obtain design drawings and specifications and become thoroughly acquainted with the design intent.
- B. Water System Procedures
  - 1. Verify all strainers have been cleaned. System shall be started up with construction strainers. Construction strainers shall be left at the equipment until completion of commissioning inspections as a means of verifying the construction strainers were used and then replaced prior to acceptance testing.
  - 2. Examine hydronic systems and determine if water has been treated and cleaned.
  - 3. Check pump rotation.
  - 4. Set automatic fill valves for required system pressure.
  - 5. Check expansion tanks to determine that they are not air bound.
  - 6. Check that the system is completely full of water.
  - 7. Check air vents at high points of systems and determine if all are installed and operating freely (automatic type) or to bleed air completely (manual type).
- C. Check lubrication of all motors and bearings.

### **3.02 MEASUREMENTS**

- A. Provide all required instrumentation to obtain proper measurements, calibrated to the tolerances specified in the referenced standards. Instruments shall be properly maintained and protected against damage.
- B. Provide instruments meeting the specifications of the referenced standards.
- C. Use only those instruments that have the maximum field measuring accuracy and are best suited to the function being measured.
- D. Apply instrument as recommended by the manufacturer.
- E. Use instruments with minimum scale and maximum subdivisions and with scale ranges proper for the value being measured.
- F. When averaging values, take a sufficient quantity of readings that will result in a repeatability error of less than 10%. When measuring a single point, repeat readings until 2 consecutive identical values are obtained.
- G. Take measurements in the system where best suited to the task.

### **3.03 GENERAL TESTING, ADJUSTING, AND BALANCING REQUIREMENTS**

- A. Cut insulation, ductwork, and piping for installation of test probes to the minimum extent necessary to allow adequate performance of procedures.
- B. Patch insulation, ductwork, and housings, using materials identical to those removed.
- C. Seal ducts and piping, and test for and repair leaks.
- D. Seal insulation to reestablish integrity of the vapor barrier.



- E. Mark equipment settings, including damper control positions, valve indicators, fan speed control levers, and similar controls and devices, to show final settings. Mark with paint or other suitable, permanent identification materials.
- F. As part of the scope of this specification section, the contractor shall make any changes in the pulleys, belts, or sheaves, as required, for correct balance at no additional cost to the owner.
- G. Retest, adjust, and balance systems subsequent to significant system modifications, and resubmit test results.
- H. Retest, adjust, and balance systems a second time if required for "comfort" balance.

#### **3.04 HYDRONIC SYSTEM BALANCING PROCEDURE**

- A. Initiate balancing with discharge balance valve full open to allow full flow to system.
- B. Through a global control system command or other means, force all terminal and coil control valves to full open position.
- C. Establish flow at all terminals and coils at design point. If system includes a diversity, proportionally balance all terminals and coils.
- D. Adjust discharge balance valve at pump as required to achieve design flows.

#### **3.05 RECORD AND REPORT DATA**

- A. Record all data obtained during testing, adjusting, and balancing in accordance with, and on the forms recommended by the referenced standards, and as approved on the sample report forms.
- B. The Balancing Contractor shall identify any problem areas, if they exist. The Mechanical Contractor shall work with the Balancing Contractor to correct the issues until the system is successfully balanced and operable.

**END OF SECTION**

## SECTION 23 07 00

### MECHANICAL INSULATION

#### PART 1 – GENERAL

##### 1.01 DESCRIPTION

- A. Work covered by this Section includes the furnishing and installation of insulation materials as follows:
1. Insulate all heating supply and return water piping.
  2. Insulate all new interior hot, cold and hot water recirculation potable water lines, whether exposed or not.
  3. Insulate all expansion tanks and buffer tanks.
  4. Insulate all boiler combustion air ductwork.
- B. Abbreviations
1. BTU – British Thermal Units
  2. SF – Square Feet
  3. Hr. – Hour
  4. °F – Degrees Fahrenheit

##### 1.02 QUALITY ASSURANCE

- A. Provide at least one person who shall be present at all times during execution of this portion of the Work and who shall be familiar with the type of materials being installed and the material manufacturers' recommended methods of installation and who shall direct all work performed under this Section.
- B. Appearance shall be of equal importance with its mechanical correctness and efficiency.

##### 1.03 SUBMITTALS

- A. See Section 23 00 00.
- B. Product Data: Submit manufacturer's technical product data and installation methods for each type of mechanical insulation specified in the schedule. Submit manufacturer's product number, k-value, thickness, and furnished accessories for each mechanical system requiring insulation.

##### 1.04 DELIVERY, STORAGE, AND HANDLING

- A. Comply with manufacturers' recommendations.
- B. Deliver, store and handle materials in a manner such that damage is avoided and the insulating properties are not decreased.

#### PART 2 – PRODUCTS

##### 2.01 MANUFACTURERS

- A. Manufacturer: Subject to compliance with requirements, provide products of one of the following:
  - 1. Johns Manville Products Corp.
  - 2. Owens-Corning Fiberglas Corp.
  - 3. Pittsburgh Corning Corp.
  - 4. Certainteed Corp.
  - 5. IMCOA

**2.02 INSULATING MATERIALS**

Insulating material and methods of installation shall conform to the following:

- A. Type A: One piece of half sectional fiberglass insulation jacketed with Owens-Corning Fiberglass, or equal, Fiberglass 25ASJ/SSL-II all service vapor barrier jacket.
  - 1. K: 0.24 BtuH in./°F sq. ft. at 75°F mean temperature.
  - 2. Operating temperatures: -60°F to 450°F.
  - 3. Jacket water vapor permeance: not more than 0.02 perm./inch.
  - 4. Jacket and butt strips: factory applied, self-sealing pressure sensitive adhesive or a conventional lap-seal adhesive.
  - 5. Surface burning characteristic ratings as tested by ASTM E-84, UL 723, or NFPA 255 not exceeding:
    - a. Flame Spread 25
    - b. Smoke Developed 50
  
- B. Type C: Flexible, elastomeric thermal insulation, Armstrong Armaflex II or equal.
  - 1. K: 0.27 BtuH in./°F sq. ft. at 75°F mean temperature.
  - 2. Operating temperatures: -20°F to 220°F.
  - 3. Water vapor permeance: not more than 0.20 perm./inch.
  - 4. Seal seams and butt joints with Armstrong 520.
  - 5. Fitting covers: fabricate and install in accordance with manufacturer's recommendations.
  - 6. Type C insulation shall not be used in air plenums or where prohibited by code.
  
- C. Type G: Foil-reinforced kraft faced vapor barrier jacketed, inorganic glass fiber blanket insulation, Owens-Corning Fiberglass T-100 FSK Faced Duct Work Insulation, Commercial Grade, or equal.
  - 1. K: 0.30 BtuH in./°F sq. ft. at 75°F mean temperature.
  - 2. Operating temperatures: 40°F to 250°F.
  - 3. Jacket water vapor permeance: not more than 0.02 perm./inch.
  - 4. Wrap insulation tightly on ductwork with all circumferential joints butted and longitudinal joints overlapped a minimum of 2"; ductwork over 24" wide use mechanical fasteners spaced not more than 18" on center.
  - 5. Adhere insulation to sheet metal with Foster 85-17 bonding adhesive.
  
- D. Type H: Bonded mat of glass fiber insulation coated with a black pigmented fire-resistant coating and EPA – Registered anti-microbial agent on the airstream side, Certain Teed Tough Guard or equal.
  - 1. K: 0.26 BtuH in./°F sq. ft. at 75°F mean temperature.
  - 2. Operating temperature: to 250°F.
  - 3. Airstream side coating shall prevent insulation erosion at velocities up to 6,000 fpm.
  - 4. Attach liner to duct with both mechanical fasteners and Foster 85-62 adhesive in conformance with SMACNA "Duct Liner Application Standard", latest edition.
  
- E. Type K: ADA compliant. Insulation with a white, fitted anti-microbial pipe cover. Cover shall be designed to allow access to the stop valves. Provide the following manufacturer:

1. Lav Guard; Truebro, Inc.
- F. Type L: Kitchen exhaust ductwork firewrap, Thermal Ceramics Firemaster® FastWrap XL or equal.
1. Meets ASTM E 2336
  2. Zero Clearance to combustibles at any location.
  3. 1-1/2" thick, 6 pcf density
  4. Operating temperatures: to 2000°F.
  5. Butt joints on inside layer.
  6. Fully foil encapsulated.
  7. To be applied in (2) 1-1/2" thick layers.

### **2.03 OTHER MATERIALS**

- A. All other materials, not specifically described within but required for complete, adequate and proper insulating systems, shall be as selected by Contractor and subject to the acceptance of Engineer.
- B. The thickness of all alternate insulating materials used shall be such as to provide the same minimum insulating efficiency as the specified as the specified materials at the thickness scheduled.
- C. Refer to Specification Section 3.03-D below for pipe fitting insulation requirements.

## **PART 3 – EXECUTION**

### **3.01 INSPECTION**

- A. Prior to work of this Section, carefully inspect the work of other trades and verify that such work is complete to the point where this work may properly commence.
- B. Verify that pipelines to be insulated have been tested and accepted.

### **3.02 PREPARATION**

- A. Remove all dirt, scale and rust from surfaces and thoroughly dry.
- B. Prepare surfaces as recommended by the manufacturer.

### **3.03 INSTALLATION**

- A. Install materials in accordance with the manufacturers' recommended installation instructions.
- B. Install insulation with longitudinal seams toward walls or ceilings and with joints butted firmly together to eliminate voids.
- C. Install pipe covering protectors, at each pipe hanger or support, simultaneously with the insulation. Also, provide pipe covering protectors at locations where insulation is subject to damage from traffic. Refer to Section 230529 for pipe saddle requirements.
- D. Install pre-fabricated, mitered insulation on fittings, valve bodies, flanges, and unions to the same thickness and with the same material as adjacent piping insulation. This insulation shall be installed to fit the fittings, valve bodies, flanges and unions. "Hand stuffing" of loose insulation at the fittings is not acceptable.
- E. Secure rigid insulation with stainless steel bands. Water and heating pipe insulation shall be zipped or joints sealed with an adhesive. Use of wire is not permitted.

- F. Secure aluminum jacketing with aluminum or stainless steel locking bands at each joint. Provide additional bands as required or use aluminum or stainless steel sheet metal screws. Rivets are not permitted.
- G. Pipe and duct insulation shall be continuous through walls and floor openings except where walls and floors are required to be fire stopped or required to have a fire resistance rating. Where this occurs, the open space remaining between the sleeve and pipe and/or duct shall be filled with fire stop insulation. Duct linings shall be interrupted at fire dampers and fire doors so as not to interfere with their operation.
- H. Insulation on all cold surfaces must be applied with a continuous, unbroken vapor seal. Supports, anchors, etc., that are secured directly to cold surfaces must be adequately insulated and vapor sealed to prevent condensation.
- I. All exposed raw edges shall be finished with finishing cement.
- J. Insulated cold pipes shall be insulated continuously through hangers. Rigid insulation inserts are to be provided at all pipe hangers and supports. Pipe insulation shall abut the rigid insulation insert. Apply a wet coat of vapor barrier lap cement on all butt joints and seal the joints with 3" wide vapor barrier tape or band.

#### **3.04 ADJUSTING AND CLEANING**

- A. Adjust the work as required to attain maximum insulating capabilities and to achieve a neat, clean appearance.
- B. Clean work to remove dirt, labels, and other materials.

### 3.05 INSULATION SCHEDULE

A. Contractor shall provide insulation as per the following Schedule:

Service	Location	Type	Size	Thickness
<b>PIPING</b>				
Heating Hot Water Piping	All	A	All	1½"
Domestic Cold Water Piping	All	A	All	½"
Domestic Hot Water Piping	All	A	All	½"
Domestic Hot Water Recirculation Piping as req'd.	All	A	All	½"
<b>DUCTWORK</b>				
Boiler Combustion Air	All	G	All	2"
Boiler Breeching	All	Per breeching mfg. specifications		
<b>EQUIPMENT</b>				
Expansion Tanks	All	C	All	2"
Magna3 Circulator Pumps	All	Insulation kit shall be provided by manufacturer		

Notes: The Type 'A' insulation noted for heating hot water piping, domestic hot water piping, and domestic cold water piping applies to copper piping. If the piping is to be pex, Type 'C' insulation shall be provided at the thickness noted above.

**END OF SECTION**

**SECTION 23 09 00**  
**AUTOMATIC CONTROLS**

**PART 1 – GENERAL**

**1.01 DESCRIPTION**

A. Work covered by this Section includes the furnishing and installation of all automatic controls, complete, as shown on the Drawings and specified herein.

B. Related work specified elsewhere includes:

Basic Mechanical Requirements	230000
Basic Mechanical Materials and Methods	230500
Electrical	Division 26

**1.02 QUALITY ASSURANCE**

A. Control devices shall be standard items commonly used in heating and cooling system control applications.

B. Acceptable manufacturers are Automated Logic, Invensys, Honeywell, Johnson, Taco iWorx or an approved equal.

**1.03 SUBMITTALS**

A. See Section 230000.

B. Provide shop drawings, catalog cuts, and technical data on materials and equipment.

C. Follow manufacturers recommended installation instructions.

D. Provide manufacturer's operation and maintenance manuals, troubleshooting guides, and list of recommended spare parts.

E. Provide Schematic Drawings for each building showing wiring and piping diagrams, components, and connections.

**1.04 GUARANTEE**

A. Control components shall be guaranteed by the manufacturer for proper operation and against defects in workmanship and materials for a period of one (1) year.

B. Guarantees shall commence on the date of final acceptance or when placed into use by the Owner, whichever comes first.

**PART 2 – PRODUCTS**

**2.01 CONTROL DEVICES**

A. Furnish thermostats, temperature controllers, and pressure controllers with field adjustable control unless otherwise indicated.

B. Except as noted below, mount all switches at 48" above finish floor to centerline and all controls, thermostats, etc. 48" above finish floor to centerline. Coordinate with adjacent electrical devices.

- C. Mount controls in mechanical rooms for convenience of operation in an accessible location.
- D. Install controls affected by vibration on a stable vibration free surface. Remote mount if necessary.

#### **2.01 THERMOSTATS – APARTMENTS – BASE BID**

- A. Controls fin-tube radiation.
- B. Heating only thermostat.
  - 1. 1 stage heating
  - 2. Digital, Non-Programmable
  - 3. 50°F to 90°F temperature range, 1°F +/-
  - 4. 24 VAC
  - 5. Non-battery
- C. Acceptable Manufacturers
  - 1. Chicago Thermostats Model HC7376, limits heat to 73°F
  - 2. Or an Approved Equal landlord thermostat for the elderly

#### **2.02 AUTOMATIC CONTROL VALVES**

- A. Valves: Shall be sized by the Controls Contractor and rated for the intended fluids, temperatures and pressures used.
  - 1. Coordinate with Mechanical Contractor to determine which control valves are factory furnished on the equipment and type and services for same.
  - 2. Furnish valve with replaceable disc and seat unless otherwise indicated.
- B. Automatic control valves and separable wells for immersion elements furnished by the control manufacturer shall be installed by the Mechanical Contractor under this contractor's supervision.
- C. Water pressure drop through the valves shall be 2.2 psig maximum.
- D. Zone valves shall be two-way, two-position valves.

#### **2.03 OPERATORS**

- A. Provide linkages with motors to control damper operation.
- B. All electric operators shall be U.L. listed and have a temperature range of -40°F to 125°F.
- C. Operators required to sequence with other operators shall be equipped with positive positioning devices.

#### **2.04 GUARANTEE**

- A. The overall automated and electronic temperature control system shall be guaranteed for a period of one year after acceptance by the Owner. During this period, all necessary service and replacement of defective material shall be made without cost to the Owner, willful damage, fire and negligence excepted.

#### **2.05 OTHER MATERIALS**



- A. Provide all other materials such as wire, transformers, relays, etc. that may be required for a complete control system as described herein and on the Drawings. Items shall be as selected by the Contractor subject to the acceptance of the Engineer.

## **PART 3 – EXECUTION**

### **3.01 INSTALLATION**

- A. Install products in accordance with manufacturer's instructions.

### **3.02 ADJUST AND CLEAN**

- A. After installation is complete, adjust and balance each system and zone so as to provide optimum system performance; see Section 230593 Testing, Adjusting and Balancing.
- B. Clean equipment of dirt and foreign matter.

### **3.03 PROTECTION**

- A. Protect systems and components from damage.

### **3.04 SEQUENCES OF OPERATION**

Note: All equipment shall be capable of being manually operated with 'Hand-Off-Auto' selector switch.

#### **A. Boilers, B-1, B-2**

1. A boiler controller shall control the operations for the boiler.
2. The boiler controller shall control boiler operation. Pumps shall be controlled by the boiler(s) controller. Pumps P-1 and P-2 shall inject heat into the loop to satisfy loop temperature based on outdoor air reset schedule.
3. The outdoor air sensor shall be located in the north side of the building in a location that is not susceptible to direct sun. Coordinate exact sensor location with the architect prior to installation.
4. The boiler shall follow an outdoor reset schedule as follows:
  - a. Outdoor air temperature  $\leq 0^{\circ}\text{F}$        $160^{\circ}\text{F}$  supply temperature (adjustable)
  - b. Outdoor air temperature  $\leq 60^{\circ}\text{F}$        $110^{\circ}\text{F}$  supply temperature (adjustable)
  - c. Proportional in between these two temperature ranges.

#### **B. Indirect Water Heater, IWH-1**

1. An immersion well aquastat shall be provided at the indirect water heater to sense tank water temperature. When the tank temperature drops below setpoint ( $135^{\circ}\text{F}$ ), a signal shall be sent to the boiler controller to activate pump P-4, and the boiler water supply temperature shall be reset to  $180^{\circ}\text{F}$ .

#### **C. Heat Pump Water Heater (HPWH-1)**

1. The water heater's onboard controller shall control operation. The tank temperature setpoint shall be  $140^{\circ}\text{F}$ .

#### **D. Main Heating Loop Pumps (P-3A and P-3B)**

1. Pumps shall be set up as lead/lag. Pump P-3A shall be the primary pump and P-3B shall be the secondary pump.
2. Controller shall alternate pumps based on run time to allow for equal run time.
3. Pumps P-3A and P-3B shall operate based on outdoor air temperature. At an outdoor air temperature  $\geq 70$  degF (adjustable) the pumps shall be off. MC/ATC contractor to verify this temperature setpoint with CM/Owner at Project Completion.
4. The pumps internal VFD will modulate the pump to maintain a proportional system pressure.

E. Fin Tube Heating and Panel Radiator

1. On a call for heating from the space thermostat, the zone valve will open.

F. Exhaust Fan, EF-1

1. This fan shall be controlled from a 120V thermostat. When the temperature is  $> 80$  degF (adjustable) the MD-1 shall be energized. When the end switch on MD-1 makes contact, EF-1 shall operate.

G. Domestic Hot Water Recirculation Pump, P-6

- a. Pump shall run on based on a call from a user-adjustable timeclock. Coordinate pump on/off times with owner.

### **3.05 ADJUST AND CLEAN**

- A. After installation is complete, adjust and balance each system and zone so as to provide optimum system performance.
- B. Clean equipment of dirt and foreign matter.

### **3.06 PROTECTION**

- A. Protect systems and components from damage.

### **3.07 MECHANICAL WIRING**

- A. Provide all temperature control wiring, all interlock wiring, and equipment control wiring for the equipment that is to be provided under this Division unless specifically shown on electrical drawings.
- B. Mechanical contractor shall be required to coordinate areas of responsibility for all HVAC equipment control wiring.
- C. All low voltage wiring shall be 18 gauge minimum. All wiring above 24 volts shall be not less than No. 14 insulated color coded wire in thinwall conduit. All wiring to be concealed in finished areas.
- D. Cable without conduit may be provided for control wiring (24 volt or less) where concealed and protected. Cable without conduit must be plenum rated and UL listed for its application. All other control wiring within the facility shall be installed in metallic conduit that is rated for the space, unless otherwise noted. Wiring must be shielded, when required, to prevent electrical or communication interference. The Control wiring contractor shall provide a separate pathway for all control wiring. The path shall consist of EMT conduit, J-hooks, and other means as described in the electrical specifications.

- E. The following schedule is intended to summarize the division of work and material responsibilities between the mechanical contractor and the electrical contractor.

230900 - CONTRACTOR SCHEDULE

Item	Furn. By	Set by	Power Wiring	Control Wiring
Equipment Motors	MC	MC	EC	MC
Motor starters, contactors, and overloads	MC	EC	EC	MC
Fused disconnect switches	EC	EC	EC	--
Manual operating switches, multispeed switches	MC	EC	EC	MC
Control relays	MC	MC	EC	MC
Control transformers	MC	EC	EC	MC
Thermostats - Low Voltage	MC	MC	--	MC
Thermostats - 120 VAC	MC	EC	EC	EC
Zone Valves	MC	MC	--	MC

**END OF SECTION**

## SECTION 23 21 13

### PIPE AND PIPE FITTINGS

#### PART 1 – GENERAL

##### 1.01 DESCRIPTION

A. This Section includes the material requirements for pipe and pipe fittings for piping provided under this Division unless otherwise indicated.

B. Related work specified elsewhere includes:

Basic Mechanical Methods	23 00 00
Basic Mechanical Materials and Methods	23 05 00
Piping Specialties	23 21 16
Pipe Hangers and Supports	23 05 29
Insulation	23 07 00
Plumbing	22 00 00

##### 1.02 QUALITY ASSURANCE

A. See Section 23 00 00.

##### 1.03 DELIVERY, STORAGE, AND HANDLING

A. Each length of pipe delivered to the site shall be clearly marked with the name of the manufacturer, class of pipe and pipe diameter. Store in accordance with manufacturer's approved instructions.

B. Carefully handle all pipes and fittings when loading and unloading.

C. Comply with all other recommendations of the manufacturers.

D. All pipe and pipe fittings shall meet ruling codes and regulations and shall be used and installed according to the ruling codes and regulations.

#### PART 2 – PRODUCTS

2.01 Pipe and pipe fittings for each service shall conform to the following schedule:

2.02 **QUALITY OF PIPING** (All standards shall be of the latest editions).

A. Copper tube, Type "L", hard temper: ANSI H23.1.

B. Copper tube, Type "K", soft temper: ANSI H23.1.

C. Cast iron soil pipe, service weight: C.I.S.P.I. HS-67.

D. Cast iron soil pipe, no hub: C.I.S.P.I., IAMPO.

E. Galvanized steel pipe, Schedule 40: ANSI B36.20.

F. Black steel pipe, Schedule 40: ANSI B36.20.

G. P.V.C. (Polyvinylchloride) - ASTM D3034.

H. Black steel pipe - Schedule 40: Coated and Wrapped.

- I. Black steel pipe, Schedule 80: ANSI B36.20.
- J. Brass pipe fittings.
- K. Ductile iron pipe - Class 50-56.
- L. FRP Pressure Carrier Pipe - chemically resistant resins reinforced with fiberglass filament. Rated 150 PSIG working pressure at 250 degrees F.
- M. Polypropylene: ASTM D635; rated SE-O in accord with UL94.
- N. Hard drawn copper refrigeration tubing. Cleaned and sealed.
- O. Polyethylene: ASTM D1248, ASTM D2737, AWWA CTS C901
- P. Pex tubing, high-density cross-linked polyethylene with oxygen barrier: ASTM F 876
- Q. Pex tubing, high-density cross-linked polyethylene with no barrier, suitable for domestic water usage, ASTM F 876

**2.03 QUALITY OF FITTINGS** (All standards shall be of the latest editions).

- A. Copper water tube solder joint fittings: Cast brass ANSI B16.18.
- B. Copper water tube flared joint fittings. Listed for underground service.
- C. Cast iron soil fittings, service weight: C.I.S.P.I., IAMPO.
- D. Cast iron, no hub fittings, C.I.S.P.I., IAMPO.
- E. Galvanized malleable iron fittings, 150 psig: ANSI B16.3.
- F. Black malleable iron fittings, 150 psig: ANSI B16.3.
- G. Steel butt welding fittings, A-106 seamless carbon steel, Schedule 40: ANSI B16.5; 150 psig welding neck forged steel flanges.
- H. P.V.C. (polyvinylchloride) - ASTM D3034.
- I. Cast Brass Compression: 85-5-5-5.
- J. Single rubber sealing type or mechanical joints AWWA specification C110.
- K. Bell X Bell - same material as that of the carrier pipe.
- L. Same material as pipe.
- M. Copper refrigeration tube solder joint fittings.
- N. Same material as pipe: ASTM F 1807

**2.04 JOINTS**

- A. Brazed Joints
  - Silver Brazing Alloy: "Stay-Silv "45" or approved equal.
  - Flux: Silver brazing flux as approved.
  - Remove excess flux.
  - Remake leaky joints with new pipe and fittings.

B. Threaded Joints

Ream and/or file before installation to remove all burrs.  
Remove all metal chips and filings.  
Pipe joint compound shall be suitable for service.

C. Gasketed Joints

Materials and methods shall be as recommended by the pipe and fittings Manufacturer and shall comply with C.I.S.P.I. HSN-68T.

D. No Hub Joints

Materials and methods shall be as recommended by the pipe and fittings manufacturer and shall comply with C.I.S.P.I. and IAMPO.

E. Welded Joints

F. Solvent Weld Joints

G. Soldered Joints

95-5 Tin-Antimony solder  
Flux: Paste form as approved  
Remove excess solder and flux

H. Mechanical Joints

I. Fuseal joints; As manufactured by R&G Sloane.

J. Compression; crimp or cinch

### **PART 3 – EXECUTION**

#### **3.01 INSTALLATION**

A. Interior and exposed piping installations are specified in other Division 15 Sections

#### **3.02 FIELD QUALITY CONTROL**

- A. Inspect pipe for compliance with the applicable specifications.
- B. All piping shall be installed with appropriate provisions for movement and expansion. Provide adequate expansion joints, guides, and anchors.
- C. All piping shall be installed according to ruling codes.
- D. All pipe and equipment openings shall be protected with temporary plugs or caps.
- E. Connections to equipment or control valves shall include unions whether shown on drawings or not.
- F. Chrome Plated Brass: Use white lead on threaded joints. Do not mar pipe. (Marred chrome pipe, valves, fittings, etc., shall be replaced.) Avoid use of toothed pipe wrench.
- G. Install piping approximately as indicated, straight, plumb and as direct as possible.
- H. Do not install within 6 inches of floors, or across doors or windows. Keep all piping concealed in finished rooms unless otherwise indicated. Install exposed risers as close

to wall as possible, without offsets unless otherwise noted. Center risers, pipe fine, etc., on adjacent construction.

- I. Keep all piping as high as possible. Locate groups of pipes parallel to each other and space to permit applying insulation and installation of valves.
- J. Bent nipples are not permitted; make offsets with fittings ream, file and remove all burrs and chips from pipe before installation.
- K. Use full length of pipe wherever possible.
- L. Provide drainage piping of sizes noted or directed for equipment requiring drains. Connect to drainage system or spill to floor drain. This shall include all relief valve discharges, control and equipment drains.
- M. Before starting installation of piping, survey the routes and check for interferences. Modify route as required with the permission of the Owner at no additional cost.

**3.03 ADAPTERS**

- A. Steel Pipe to Copper Tube: Provide dielectric union.

**3.04 SCHEDULE**

- A. Letters in the schedule refer to paragraphs of Articles 2.02, 2.03 and 2.04 of this Section. The reference in parenthesis is an option; select one. Use the following materials unless otherwise noted:

Service -	Size	Location	2.2 Pipe	2.3 Fittings	2.4 Joints
Domestic Water Piping	<3"	Above Slab	A	A	G
Domestic Water Piping	≤1"	All	A	A	G
Hot Water Heating	<3"	Indoor Exposed or Concealed	A	A	G
Fuel Oil Piping	<2-1/2"	Indoor	F	F	B
Refrigeration Piping	All	All	N	M	A

**END OF SECTION**

## SECTION 23 21 16

### PIPING SPECIALTIES

#### PART 1 – GENERAL

##### 1.01 DESCRIPTION

A. Work covered by this Section includes the furnishing and installation of piping specialties, including, but not limited to, unions, strainers, gauges, thermometers, manometers and other specialty items.

B. Related work specified in other Sections includes:

Basic Mechanical Requirements	23 00 00
Basic Mechanical Materials and Methods	23 05 00
Pipe and Pipe Fittings	23 21 13
Pipe Hangers and Supports	23 05 29
Plumbing	22 00 00

##### 1.02 QUALITY ASSURANCE

A. The items in this Section are specified in a general manner and for normal conditions. Where corrosive liquids or gases are involved, or where materials are encountered which require special construction, use materials adequate for the service intended.

##### 1.03 SUBMITTALS

A. See Section 23 00 00.

B. Product Data: Submit product data on the following items:

1. Unions
2. Dielectric Unions
3. Dielectric Waterway Fittings
4. Y-Type Strainers
5. Pressure Gauges
6. Thermometers
7. Temperature/Pressure Test Plug
8. Circuit Setters
9. Automatic Balancing Valves
10. Flexible Pipe Connections
11. Valves
12. Valve tags

C. Catalog cuts, technical data, and installation, operation and maintenance instructions for each item to be provided.

#### PART 2 – PRODUCTS

##### 2.01 UNIONS

A. Use Required - For pipes with threaded, soldered, solvent cemented, or welded joints, provide unions at piping connections to each piece of equipment, at intervals of not more than 50' in straight runs of pipe, at each valve or cock (except where valves and cocks have union ends), and elsewhere as required to adequately service the piping system and equipment.



- B. For Steel and Iron Pipe - Malleable-iron, Class 150, brass to brass or brass to iron seats, ground joint.
- C. For Copper Pipe - Cast bronze, 125 wsp, solder joint, copper to copper unions.

## **2.02 DIELECTRIC UNIONS AND FLANGES**

- A. Use required - Provide dielectric unions and flanges at the following locations:
  - 1. At the connection of dissimilar metal pipes.
  - 2. On steel pipe whenever it leaves the ground.
- B. Performance Requirements - Capable of separating metals in a manner which will prevent the passage of more than 1% of the galvanic current which would exist with metal to metal contact.
- C. Construction - Pressure and temperature rating shall be no lower than those of the piping system in which installed and shall be of the same material as the piping.
- D. Acceptable Manufacturers:
  - 1. Eclipse, Inc.
  - 2. Perfection Corp.
  - 3. Watts Regulator Co.

## **2.03 DIELECTRIC WATERWAY FITTINGS**

- A. Use required - Provide dielectric waterway fittings (wet service) at the following locations:
  - 1. At the connection of dissimilar metal pipes.
  - 2. On steel pipe whenever it leaves the ground.
- B. Performance Requirements - Capable of separating metals in a manner which will prevent the passage of more than 1% of the galvanic current which would exist with metal to metal contact.
- C. Construction - Pressure and temperature rating shall be no lower than those of the piping system in which installed and shall be of the same material as the piping.
- D. Acceptable Manufacturers:
  - 1. Epco Sales, Inc.
  - 2. Victaulic

## **2.04 STRAINERS, "Y" TYPE**

- A. Use Required - Where shown on the Drawings or specified.
- B. Construction - Provide strainers full line size of connecting piping, with ends matching piping system materials. Screens shall be Type 304 stainless steel, with 20 mesh perforations. Provide strainers with 125 psi working pressure rating except 250 psi pressure rating for systems 100 psig or greater.
- C. Threaded Ends, 2" and Smaller: Cast iron body for steel piping systems and cast bronze body for copper piping systems, screwed screen retainer with centered blowdown fitted valve and pipe plug.
- D. Flanged Ends, 2½" and Larger: Cast iron body, bolted screen retainer with off center blowdown fitted with valve and pipe plug.
- E. Acceptable Manufacturers:

1. Zurn Industries, Inc.
2. Keckley Company

## 2.05 PRESSURE GAUGES

- A. Use Required - Where shown on the Drawings or specified and on the suction and discharge of pumps. For circulator pumps, one pressure gauge is required with isolation valves to monitor both suction and discharge.
- B. Gauges - Dial type utilizing a phosphor bronze Bourdon bottom, complete with weatherproof black iron case, 4½" dial, ¼" NPT male threads, stainless steel rack and pinion movements with nylon faced segments, black pointers with micrometer zero adjustments and white plastic dials with black figures.
- C. Scales
  1. Pumps - In psig with range about two times the maximum operating pressure, but not less than 10% above the shut-off head, unless otherwise specified.
- D. Standard Gauge Accessories - Provide each gauge with pressure sensing tubing, main pipeline pressure tap, a shut-off cock, and an air bleed.
- E. Gauge Snubber - Provide a snubber with each gauge which may be subjected to rapid pressure changes so that pointers do not vibrate during operation.
- F. Acceptable Manufacturers:
  1. U.S. Gauge Company
  2. Ashcroft

## 2.06 THERMOMETERS

- A. Use Required - Where shown on the Drawings or specified and on the entering and leaving side of heat generating equipment.
- B. Thermometers shall Ashcroft Series EI Bimetal Thermometers or approved equal. Dial shall be 5" diameter. Model shall be EveryAngle to allow thermometer to be rotated 360° and angled 180°. Case and stem shall be made of stainless steel. Glass window shall be heavy duty.
- C. Provide appropriate temperature well for installation of thermometer.
- D. Install so that thermometer may be read from floor level.

## 2.07 TEMPERATURE/PRESSURE TEST PLUG

- A. Furnish and install as indicated on the Drawings, Pete's Plug.
- B. Temperature/pressure test plug to receive either a temperature or pressure probe 1/8" O.D. Solid brass fitting with valve core of Nordel color coded and marked cap with gasket rated at 1,000 psig.
- C. Provide test kit to the owner upon completion of testing consisting of the following:
  1. (2) pressure gauges 0 - 60 psi, 0.5% accuracy with adapters.
  2. (2) bimetal thermometers 0F to 220F, 0.5% accuracy.
  3. Compartmentalized protective carrying case.
- D. Acceptable Manufacturers:
  1. Petersen Products Company

## 2.08 CIRCUIT SETTERS

- A. Bronze calibrated balance valve with provisions for connecting a portable differential pressure meter. Meter connections to have built-in check valves. An integral pointer shall register degree of valve opening. Valve shall have internal seals. Constructed for 125 lb. wp at 250°F.
- B. All balancing cocks where shown on drawings are required to be of the flow measuring type. If non-flow measuring type are installed, contractor will be required to remove non-flow measuring balancing cocks and install flow measuring type prior to balancing.
- C. Acceptable Manufacturers:
  - 1. Tour and Anderson

## 2.09 AUTOMATIC BALANCING VALVES

- A. Bronze calibrated automatic balance valve with provisions for connecting a portable differential pressure meter. Meter connections to have built-in check valves. An integral pointer shall register degree of valve opening. Valve shall have internal seals. Constructed for 600 lb. wp at 225°F.
- B. FNPT and MNPT inlet/outlet connection options. Units are provided with changeable GPM flow cartridges, with +/- 10% accuracy.
- C. Differential Operating Pressure: 2-80 psid @ 0.5-5.0 gpm
- D. All balancing valves where shown on drawings are required to be of the automatic flow measuring type. If non-flow measuring type are installed, contractor will be required to remove non-flow measuring balancing valves and install flow measuring type prior to balancing.
- E. Acceptable Manufacturers:
  - 1. Hays Fluid Controls Model 2510 Mesurflo® Automatic Balancing Valve, ½" size for panel radiators, cabinet heater, and unit heaters.

## 2.10 VALVES – GENERAL TYPES

- A. Two-Piece, Full-Port, Brass Ball Valves with Stainless-Steel Trim:
  - 1. Manufacturers: Subject to compliance with requirements:
    - a. Crane Co.
    - b. Hammond Valves
    - c. Kitz Corporation
    - d. Milwaukee Valve Company
    - e. Nibco
  - 2. Description:
    - a. Sizes: up to 2"
    - b. Standard: MSS SP-110
    - c. SWP Rating: 150 PSIG
    - d. SWP Rating: 600 PSIG
    - e. Body Design: Two Piece
    - f. Body Material: Forged Brass
    - g. Ends: Threaded or socket
    - h. Seats: TFE
    - i. Stem: 316 Stainless Steel

- j. Ball: 316 Stainless Steel
- k. Port: Full

- B. 125 lb. WSP, Crane, as listed below, or Fairbanks, Lunkenheimer, Jenkins, Kennedy, Hammond, Nibco, Stockham or Walworth.
  - 1. Stopcocks: Brass square head screwed. (250)
  - 2. Petcocks: ¼" brass tee screwed. (700)
  - 3. Checks: ¼" - 1" bronze 90° swing disc screwed. (34)
  - 4. Checks: 1¼" - 70, 125 lb. WSP - Miller Fig. 162 or approved equal.
  - 5. Drain Valve – Bronze ball valve with dust cover and chain, Apollo 78-100 Series
- C. Any valves used for domestic cold water, domestic hot water or domestic hot water recirculation shall be "lead free" and contain no more than 0.25% weighted average lead content.

## **2.11 VALVE TAGS**

- A. The tag shall be made from a plastic laminate of heavy plastic with a brass eyelet in the corner. Typed information on the plate inside the laminate will show a valve number, the fluid in the pipe, and the direction of flow for the equipment involved. Seton SPT 3 or equal.

## **2.12 OTHER MATERIALS**

- A. Provide any materials not specifically shown or described, but required for a complete and proper installation. Select the materials and submit shop drawings to Engineer for acceptance.

## **PART 3 – EXECUTION**

### **3.01 GENERAL INSTALLATION**

- A. Carefully install work in accordance with the manufacturers' recommended installation instructions.

### **3.02 INSTALLATION OF DIELECTRIC UNIONS AND WATERWAY FITTINGS**

- A. Install dielectric unions and fittings to connect piping materials of dissimilar metals in wet piping systems.
- B. Bronze bodied valves and devices installed in steel piping systems do not require dielectric fittings when both connections are made with steel piping. Iron bodied valves and devices installed in copper systems require dielectric fittings.

### **3.03 INSTALLATION OF "Y" TYPE STRAINERS**

- A. . Install horizontal strainers for water systems with wye oriented vertically down.

### **3.04 VALVE TAGS**

- A. Fasten a tag to each valve with a brass chain.
- B. Provide a valve chart framed in glass or plastic laminate and hang in boiler room.

### **3.05 IDENTIFICATION**

- A. All piping shall be identified as to the service of the pipe and the normal direction of flow. The letters shall be at least 1" high and the flow arrows shall be at least 6" long.

- B. All equipment shall be identified by stenciling the title of the equipment in a position that is clearly visible.
- C. Piping shall be identified at all tees, at equipment locations and in each separate room.
- D. All color codes of piping shall comply with ANSI A 13.1.

**END OF SECTION**

## SECTION 23 25 00

### WATER TREATMENT

#### PART 1 – GENERAL

##### 1.01 DESCRIPTION

- A. Work under this section shall include furnishing and installing material and equipment related to water treatment for closed hydronic systems.
- B. Related work specified elsewhere includes:
  - Basic Mechanical Materials and Methods 23 00 00

##### 1.02 QUALITY ASSURANCE

- A. The chemical treatment program shall be under the supervision of a firm regularly engaged in the field of water treatment with a minimum of five years experience in the immediate area of the job site location.
- B. The Water Treatment Contractor shall have laboratory facilities, both central and field, to service the owners account.
- C. The Water Treatment Contractor shall provide a written engineering report on the water treatment for the first year. One copy to the Owner and one copy to the Engineer.

#### PART 2 – PRODUCTS

##### 2.01 CHEMICALS

- A. Closed Systems: Boiler heating loop.
- B. A corrosion and scale inhibitor shall be provided to treat the systems listed above and to maintain a pH of 8.5 to 9 and reserve alkalinity minimum of 15.0.
- C. Boiler Water Heating System
  - 1. A 35% industrial inhibited propylene glycol (phosphate based): Dowfrost HD, 65% distilled water solution shall be provided and shall meet the following requirements:
    - a. The fluid must be dyed (bright yellow) to facilitate leak detection.
    - b. The fluid must be easily analyzed for glycol concentration and inhibitor level.
    - c. The fluid must pass ASTM D1384 (less than 0.5 mils penetration per year for all system metals.)
    - d. The reserve alkalinity of the industrial inhibited propylene glycol fluid must be at least 15 ml to provide long-term resistance to acidic pH. The resulting pH of the fluid mix must exceed 8.5 pH. If pH of solution is less than 8.5 pH, inhibitors must be added until a pH of 8.5 is achieved.
- D. Hydronic System Feeders – *See Mechanical Equipment Schedule*
  - 1. Boiler Water Heating System: Axiom Industries Model MF200 or equal.

- a. Hydronic system feeder with 6-gallon tank for storage and mixing.
- b. Diaphragm pump, 120 VAC.
- c. Accumulator tank.
- d. Flow diverter valve for purging air and manual agitation of solution.
- e. Flexible connection hose with check valve.
- f. Fluid level switch to disable pump if storage tank level is too low.
- g. Auxiliary dry contact for remote low-pressure alarm.

### **PART 3 – EXECUTION**

#### **3.01 TECHNICAL INFORMATION AND SERVICE**

- A. Shop drawings shall be in accordance with Section 23 00 00.
- B. Technical literature shall be inserted into the O&M manual for each chemical and piece of equipment provided in accordance with Section 23 00 00.
- C. Provide four service calls to instruct contractors and owner's personnel in treatment and to provide testing and maintenance of the chemical treatment program from initial treatment until the end of the one-year guarantee.
- D. Written chemical test reports and recommendations shall be made at each visit with one copy to the Owner's designated representative and one copy to the Engineer.

#### **3.02 CLEANING OF PIPE LINES**

- A. Cleaning of Boiler Water Pipe Lines:
  1. After the system has been tested, the system shall be completely drained and flushed with fresh water. The system shall then be refilled with fresh water and a 1% to 2% solution of trisodium phosphate in water prior to the installation of the industrially inhibited propylene glycol fluid.
  2. The water shall be circulated for a period of at least 24 hours, be drained completely and then filled with fresh water. This procedure to be done a second time prior to final treatment.
  3. Immediately after the system is cleaned 35% solution of propylene glycol with corrosion inhibitor shall be added.

**END OF SECTION**