

SOUTHWEST ELEMENTARY UNDERGROUND PIPING

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SECTION 230500

COMMON WORK RESULTS FOR HVAC

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Work Included:
 - 1. Submittals
 - 2. Electrical Requirements
 - 3. Excavation & Backfilling
 - 4. Painting
 - 5. Cleaning
 - 6. Testing

1.3 SUBMITTALS

- A. The Contractor shall submit for review by the Architect data of materials and equipment to be incorporated in the work. Submittals shall be supported by descriptive material, catalogs, cuts, diagrams, performance curves, and charts published by the manufacturer to show conformance to specification and drawing requirements; model numbers alone will not be acceptable.
- B. Refer to the individual sections for identified equipment and materials for which submittals are required.
- C. Refer to the SHOP DRAWINGS, PRODUCT DATA AND SAMPLES Section for required procedures.
- D. Product Data Preparation: Product submittals shall be made by specification section. All items of a section, requiring submission, shall be submitted together at one time in a tabbed binder. If two or more sections require inter-coordination, (e.g. Air Handling Unit and Vibration Isolation or Air Handling Unit and Condensing Unit) they shall be submitted at the same time. Each individual submittal item within a binder shall be marked to show paragraph number which pertains to the item. Binders for mechanical submittals shall be color coded - Black for HVAC. Binders shall be labeled on outside with project name, contractors name, date of submission, and specification section and number. Binders shall also have a tab indicating submittal number and specification section number. If product submittals for section exceed the capacity of one binder, two or more binders shall be used. In addition to above, a notation cover shall indicate the number of binders for the section and the number of that binder (i.e., 2 of 3). Section binders shall be report cover type with solid cover and 3 metal fasteners or 3-ring type. Report cover binders shall be Duo-Tang Series L2-53558 or approved equal. Electronic submittals shall also be acceptable.
- E. Mechanical Equipment Electrical Data
 - 1. Prior to submitting data for equipment requiring electrical service, the Contractor shall verify that electrical characteristics of equipment submittals comply with electrical service provided for the specified items of equipment.
 - 2. Upon receipt by the Contractor of reviewed submittals for equipment provided under this Division, the Contractor shall coordinate the electrical service requirements, i.e., motor horsepower and full load amps, electrical service characteristics (voltage and phase), and number of services for each item of equipment requiring electrical connections with the electrical drawings and specifications. The Contractor shall furnish to the Architect a complete typewritten list of electrical requirements for each item of equipment to be installed.

- F. Items on or projecting through the ceiling shall be coordinated with other items.
- G. Relocated equipment or existing systems
 1. The Contractor and Owner's representative shall inspect all relocated equipment for operation and condition. The results of the inspection shall be typewritten and signed by the Contractor and Owner's representative. Any conditions not noted on this list shall be repaired by the Contractor at no additional cost to the Owner.
 2. The Contractor and Owner's representative shall inspect and test all existing water systems to be extended or altered. The results of this inspection and test shall be typewritten and signed by the Contractor and Owner's representative. Any condition not noted on this report shall be repaired by the Contractor at no additional cost to the Owner.
 3. The list and report shall be submitted to the Architect for the record.

1.4 QUALITY ASSURANCE

- A. The mechanical equipment and installation shall conform to the following codes:
 1. The International Building Code 2012 Edition with Georgia Amendments.
 2. The International Mechanical Code 2012 Edition with Georgia Amendments.
 3. The International Energy Conservation Code, 2009 Edition with Georgia Amendments.
 4. National Electrical Code, 2014 Edition with Georgia Amendments.
- B. The mechanical equipment and installation shall conform to the following standards:
 1. Associated Air Balance Council (AABC):
 - a. National Standard for Total System Balance.
 2. National Fire Protection Association (NFPA):
 - a. Standard 70, National Electric Code.
 - b. Standard 90A, Installation of Air Conditioning and Ventilating Systems.
 - c. Standard 101, Code for Safety to Life from Fire in Buildings and Structures.
- C. Publication Dates: Where the date of issue of a Reference Standard is not specified, comply with the Standard is effective as of Date of Contract Document.
- D. Permits
 1. Obtain all permits and inspections for the installation of this work and pay all charges incident thereto. Deliver to the Owner all certificates of said inspection issued by authorities having jurisdiction.
- E. Workmanship and Materials
 1. The workmanship and materials covered by these specifications shall conform to all ordinances and regulations of the city, county and/or other authorities having jurisdiction.

1.5 OPERATION AND MAINTENANCE INSTRUCTIONS

- A. Refer to Division 1 for Detail Requirements.
- B. Printed Material: Provide required printed material for binding in operation and maintenance manuals.
 1. Refer to the individual sections for identified equipment for which material is to be provided.
 2. The Operations and Maintenance Manual shall include a section for certifications and project warranty data. Refer to individual sections for certifications. Warranties for equipment shall be included in the equipment section of the Operation and Maintenance Manual.
- C. The Manuals shall be a 3 ring binder with tabs for each item listed in specifications. The manuals shall be submitted to the Architect for approval 30 days prior to instruction of Owner personnel. The manual shall include the following items:
 1. Parts list
 2. Lubrication requirements
 3. Preventative maintenance requirements

4. Name, address, and telephone numbers for supplier of equipment.

D. Instructions of Owner personnel:

1. Before final inspection, at a time designated by the Architect, provide a competent representative to instruct Owner's designated personnel in operation, adjustment, and maintenance of products, equipment, and systems under this division of the specifications. For equipment requiring seasonal operation, perform instructions for other seasons within six months unless requested otherwise.
2. Use operation and maintenance manuals as basis of instruction. Review contents of manual with personnel in detail to explain all aspects of operation and maintenance.
3. Prepare and insert additional data in Operation and Maintenance Manual when need for such data becomes apparent during instruction.

1.6 SPARE PARTS

- A. The Contractor shall prepare a typed written list of spare parts or equipment to be turned over to the Owner. The list shall indicate the equipment the parts are for, model numbers and quantity of parts. Refer to individual sections for the spare parts or equipment required by these specifications.

1.7 RECORD DOCUMENTS

- A. Refer to Division 1 for record documents and related submittals.

1.8 CONTRACT DRAWINGS

- A. Drawings are diagrammatic and indicate general arrangement of systems and work. Provide offsets, transitions, and fittings to coordinate the work of each trade with that of other trades, including HVAC, plumbing, fire protection, electrical, structural, and architectural.
- B. Follow drawings in laying out work and check drawings of other disciplines relating to work to verify space conditions. Do not scale drawings.
- C. Equipment layout is based on one manufacturer's product. Where equipment selected by the Contractor for use on the job differs from layout, the Contractor shall be responsible for coordinating space requirements and connection arrangements.

1.9 GUARANTY

- A. The components of the mechanical systems furnished under this division of the Specifications shall be guaranteed for a period of one year from the date of acceptance thereof, either for beneficial use or final acceptance, whichever is earlier, against defective materials, design, and workmanship. Upon receipt of notice from the Architect of failure of any part of the equipment during the guaranty period, the affected part or parts shall be replaced promptly which includes removing the defective part or parts, replacing and installing the new part or parts, at the expense of the Contractor. In addition to the one year guaranty required, each air conditioning compressor shall have an additional four year guaranty on the compressor which shall include parts only.

PART 2 - PRODUCTS

2.1 ELECTRICAL WORK

- A. All electrical equipment furnished under this Division of these Specifications shall comply with the electrical system characteristics indicated on the mechanical drawings.
- B. Motors shall be as specified in the MOTORS Section.

- C. Motor control components furnished as an integral part of the mechanical equipment shall conform to requirements of Division 26 - Electrical.
- D. For all motors furnished under this Division of these Specifications for which motor controls are not specified to be integral with the equipment, the controls shall be provided under Division 26 - Electrical.
- E. Power wiring (i.e., feeders to motors, water heaters, and electric heaters and tapes including final connection to equipment) shall be provided under Division 26 - Electrical.
- F. Control wiring (i.e. 120 volt and below) including 120 volt control power to motor operated dampers valves, and variable volume boxes shall be provided under this division.

PART 3 - EXECUTION

3.1 PAINTING

- A. Factory painted equipment that has been scratched or marred shall be repainted to match original color.
- B. Steel equipment hangers, threaded rods, bolts, nuts, and supports and uninsulated black steel pipe exposed to sight inside the building which are not provided with a factory applied prime coat shall be cleaned of rust, grease and scale. After cleaning hangers, supports and pipe, a field-applied prime coat shall be provided. In addition, such items in finished spaces shall also be provided with two coats of finish paint in a color to match adjacent surfaces or as noted on the architectural drawings.
- C. Steel equipment hangers and supports, uninsulated black steel pipe, and black steel pipe supports exposed to sight outside the building which are not provided with factory prime coat shall be cleaned of rust, grease and scale. After cleaning hangers, supports and pipe, a field-applied prime coat and two coats of bituminous aluminum paint shall be provided. Insulated pipes outside the building shall be cleaned of rust, grease and scale, and shall be provided with a field-applied prime coat before installing insulation.

3.2 CLEANING AND ADJUSTING

- A. All equipment, pipe, valves, and fittings shall be cleaned of grease, oil, paint spots, metal cuttings, sludge, and construction debris.
- B. Ducts, plenums and casings shall be cleaned of all debris and blown free of all particles of rubbish and dust before installing outlet faces.
- C. Bearings shall be lubricated as recommended by the equipment manufacturer.
- D. Temporary filters shall be provided for fans that are used during construction. Where supply, exhaust, or return fans (whether alone or part of mechanical equipment), are used, all return/exhaust inlets shall be covered with roll filter media. Media shall be taped in place to face of air inlet device or opening. At the time of starting the balancing of the air distribution system, new filters shall be installed.

3.3 EXCAVATION, TRENCHING AND BACKFILLING

- A. General: The Contractor shall perform all excavation to install piping herein specified. During excavation, material for backfilling shall be piled back from the banks of the trench to avoid over-loading and to prevent slides and cave-ins. All excavated materials not to be used for back filling shall be removed and disposed of by the Contractor. Grading shall be done to prevent surface water from flowing into trenches and excavations, and any water accumulating therein shall be removed by pumping. All excavation shall be made by open cut. No tunneling shall be done. Trenches shall not be cut below a plane extending at a 45 degree angle down and away from any footing.

- B. Trench Excavation. The bottom of the trenches shall be graded to provide uniform bearing and support for each section of the pipe on undisturbed soil at every point along its entire length, except for the portions of the pipe sections excavated for sealing of pipe joints. Depressions for joints shall be dug after the trench bottom has been graded. Over depths shall be backfilled with loose, granular, moist earth, tamped. Remove unstable soil that is not capable of supporting the pipe and replace with specified material for a minimum depth of 12" below invert of pipe.
- C. Backfilling. The trenches shall not be backfilled until all specified pressure tests are performed. The trenches shall be backfilled with the excavated materials approved for backfilling consisting of earth, loam, sandy clay, sand and gravel or soft shale, free from large clods of earth and stones, deposited in 6" layers and rammed until the pipe has a cover of not less than the adjacent existing ground, but not greater than 2" above existing ground. The backfilling shall be carried on simultaneously on both sides of the trench so that injurious side pressures do not occur. All trenches under pavements and all trenches within the building walls and to 5 ft. outside the building walls shall be compacted. For all trenches, the compaction of the filled trench shall be at least equal to that of the surrounding undisturbed material, except that trenches occurring in areas to be filled shall be backfilled in 6" maximum layers and each layer compacted to 95% maximum density. Settling the backfill with water will not be permitted. Reopen any trenches not meeting compaction requirements; or where settlement occurs, refill, compact, and restore the surface to the grade and compaction specified above, mounded over and smoothed off.

3.4 TESTING PIPE AND DUCT SYSTEMS

- A. General: Concealed piping and duct work and insulated piping and ductwork shall be tested in place before concealing or covering. Piping and ductwork located underground shall be tested before backfilling. Equipment, materials, and instruments for testing shall be furnished by the Contractor without additional cost to the Owner. System components not rated for the respective test pressure shall be isolated from the system during the test.
- B. Observation: The contractor shall notify the owner's representative 7 days prior to a scheduled test. The owner's representative, at his option, has the right to witness the test.
- C. Heating & Air Conditioning Piping System
 1. All chilled water piping shall be tested hydrostatically and proved tight at a pressure of not less than 100 psi (690 kPa) for a period of not less than 2 hours.
 2. No loss in pressure will be permitted. Leaks detected shall be repaired by tightening, rewelding joints, or replacing pipe and fittings. Caulking of joints will not be permitted.

END OF SECTION

SECTION 230519

METERS AND GAGES FOR HVAC PIPING

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Work Included
 - 1. Piping specialties for HVAC systems.

1.3 SUBMITTALS

- A. General: All submittals shall conform to the requirements of Division 1 - GENERAL REQUIREMENTS and Section 230500 COMMON WORK RESULTS FOR HVAC.
- B. Product Data: Data shall be submitted on the following items:
 - 1. Dielectric Adapters
 - 2. Thermometers and Test Wells
 - 3. Pressure Gauges and Gauge Cocks
 - 4. Temperature/Pressure Test Fittings

1.4 QUALITY ASSURANCE

- A. Standards
 - 1. American Society of Mechanical Engineers (ASME):
 - a. Boiler and Pressure Vessel Code, Section VIII - Rules for Construction of Pressure Vessels.
 - 2. American Society for Testing and Materials (ASTM):
 - a. Standard A53, Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
 - b. Standard A74, Cast Iron Soil Pipe and Fittings.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Piping specialties received and stored on the job site shall be stored in dry storage spaces, (e.g. building, a storage trailer, or shed). Under no condition shall the units be stored in such a way that metal components are in direct contact with the ground.

PART 2 - PRODUCTS

2.1 DIELECTRIC ADAPTERS

- A. Dielectric adapters shall be the union type for pipes 2" (50mm) in size and smaller and flanged type for pipes 2-1/2" (12mm) in size and larger. Adapters shall have a working pressure of 250psi (1725 kPa) for union type and 175 psi (1205 kPa) for flanged type. The insulating gasket shall have an operating range of 40°F to 240°F (4.4°C to 115°C) and shall limit the galvanic corrosion to a maximum of 1% of the short circuit current.
- B. Dielectric adapters shall be:
 - 1. Capital
 - 2. Clearflow
 - 3. Crane
 - 4. Ebco
 - 5. Watts

2.2 THERMOMETERS AND TEST WELLS

A. Thermometers:

1. Thermometers shall be the red-reading mercury-filled adjustable angle type. Thermometers shall be adjustable to any angle through a 180° arc and shall be provided with a locking device.
2. Thermometers shall have V-cast aluminum case with baked enamel finish and 9-inch (225mm) scale. Thermometers shall be provided with separable sockets and where installed on insulated pipes, sockets shall be extension neck type to provide for 2" (50mm) thick insulation.
3. Thermometer scale range shall be:
 - a. Hot Water Heating Systems 30-300°F (0° to 150°C)
 - b. Chilled Water System 0-100°F (-20°C to 40°C)
 - c. Condenser Water System 0-160°F (-20°C to 70°C)
 - d. Domestic Water Systems 30-240°F (0°C to 100°C)
 - e. Loop Water System 30-130°F (0°C to 50°C)
 - f. Dual Temperature Water System 0 to 240°F (-20°C to 100°C)
4. Thermometers shall be:
 - a. Trerice; Adjustable Angle Series Type BX
 - b. Weiss; Vari-Angle Series Type BS
 - c. Weksler; Adjust-Angle Series Type AA-5

B. Test Wells

1. Test wells shall be for use with engraved stem thermometers. Test wells shall be brass and shall be provided with cap and chain with gasket for sealing when not in use.
2. Wells installed in insulated pipes shall be extension neck type to provide for 2" (50mm) thick insulation.

C. Test wells shall be:

1. Trerice
2. Weiss
3. Weksler

2.3 PRESSURE GAUGE AND GAUGE COCKS

A. Pressure Gauges

1. Gauges shall be flangeless type and shall have 4-1/2 inch (110mm) dials, cast aluminum cases, stainless steel rotary gear movements, phosphor bronze bourdon tubes, forged brass rod sockets and tips, 1/2% accuracy of scale range, Plexiglas dial covers, safety blowout disc and 1/4 (6mm) inch lower connections.
2. Gauges in pump suction line shall be the compound type. Gauges in all other locations and discharge shall be the plain pressure type.
3. Range for pressure gauges shall be selected so that the normal operating point for each application falls in the approximate midpoint of the gauge range. Shop drawings shall indicate ranges.
4. Gauges shall be:
 - a. Weiss; Series PG
 - b. Trerice; No. 500X Series
 - c. Weksler; Type AA14

B. Gauge Cocks:

1. Gauge cocks shall be brass lever handle type. Gauge cocks shall be:
 - a. Weiss; Type LC
 - b. Trerice; No. 880
 - c. Weksler; Type A

2.4 TEMPERATURE/PRESSURE TEST FITTINGS

- ### A. Fittings shall be the combination temperature pressure test type with brass body, self sealing EPDM gasket, threaded connections, insulation extension and cap. Temperature/Pressure Test Fittings shall be:

1. Fairfax
2. Pete's Plug
3. Sisco
4. Watts

PART 3 - EXECUTION

3.1 GENERAL

- A. All equipment shall be installed where indicated on the drawings and shall be installed in accordance with manufacturer's instructions.
- B. Unless otherwise indicated on the drawings, thermometers and pressure gauges shall be installed no higher than 8 feet (2.5m) above finished floor. Final position of each thermometer and pressure gauge shall be such that it is readable from the floor.
- C. Dielectric adapters shall be installed between copper and iron pipe connections and between ferrous and non-ferrous metal piping or equipment.
- D. Test wells shall be installed above the horizontal so as to hold oil and wells shall be filled with oil.
- E. Pressure gauges shall be connected to the piping system with threaded brass pipe and screwed brass fittings. Install gauge cock on inlet pipe to gauge. All gauges used on services exceeding 200°F (94°C) shall be mounted on a brass pigtail siphon.

END OF SECTION

SECTION 230523

GENERAL DUTY VALVES FOR HVAC PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Work Included
 - 1. Valves for chilled water system
 - 2. Miscellaneous valves.

1.3 SUBMITTALS

- A. General: All submittals shall comply with the requirements of Division 1 - GENERAL REQUIREMENTS and Section 230500 COMMON WORK RESULTS FOR HVAC.
- B. Product Data: Data shall be submitted on the following items:
 - 1. Valves.

1.4 QUALITY ASSURANCE

- A. Standards
 - 1. American Society of Mechanical Engineers (ASME):
 - a. Boiler and Pressure Vessel Code, Section 1, Rules for Construction of Power Boilers.
 - 2. American Society for Testing and Materials (ASTM):
 - a. Standard A47, Specification for Ferritic Malleable Iron Castings.
 - b. Standard A48, Specification for Gray Iron Castings
 - c. Standard A126, Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings
 - d. Standard A197, Specification for Cupola Malleable Iron.
 - e. Standard A220, Specification for Pearlitic Malleable Iron
 - f. Standard A536, Specification for Ductile Iron Castings.
 - g. Standard B61, Specification for Steam or Valve Bronze Castings.
 - h. Standard B62, Specification for Composition Bronze or Ounce Metal Castings.
 - i. Standard B162, Specification for Nickel Plate, Sheet, and Strip.
 - j. Standard B584, Specification for Copper Alloy Sand Castings for General Application.
 - 3. Manufacturer's Standardization Society (MSS)
 - a. SP-67 Butterfly Valves
 - b. SP-70 Cast Iron Gate Valves, Flanged and Threaded Ends
 - c. SP-71 Cast Iron Swing Check Valves, Flanged and Threaded Ends
 - d. SP-80 Bronze Gate, Globe, Angle and Check Valves
 - e. SP-85 Cast Iron Globe and Angle Valves - Flanged and Threaded Ends

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Valves received and stored on the job site shall be stored in dry storage spaces, (e.g. building, a storage trailer, or shed). Items shall be stored on wooden shipping skids or pallets. Under no condition shall the units be stored in such a way that metal components are in direct contact with the ground or floor slabs.
- B. Where it is not practical to store items within an enclosure, items may be stored in shipping cartons on wooden pallets.

- C. Valves shall be covered with 6 mil polyethylene sheet taped in place to protect the equipment from damage and the weather.

PART 2 - PRODUCTS

2.1 GENERAL

- A. Valves shall have name or trademark of manufacturer and working pressure cast or stamped on valve body.
- B. Gate Valves, globe valves, and swing check valves shall be the product of a single manufacturer.
- C. All valves requiring packing shall be designed and constructed to allow repacking under pressure.
- D. Valve discs shall be the manufacturer's standard material for the service in which the valve is used unless otherwise indicated under the individual type valve specification.
- E. Valve hand wheels shall be malleable iron, steel, or cast iron and shall conform to ASTM A197.
- F. Valves shall be manufactured in the United States.

2.2 BUTTERFLY VALVES

- A. Type BF2 - Valves 2 1/2" (63mm) through 12" (300mm) in size shall be 200 psig (1720 kPa) WOG quarter turn type designed for dead-end service conforming to MSS SP-67. Body shall be ASTM A126 cast iron with tapped lugs, extension neck, bronze alloy disc, type 316 stainless steel stem, bronze stem bushing, EPDM O-ring stem seals, and EPDM seat sleeve. Seat sleeve shall be designed such that it serves as the flange seal and no separate gasket is required. Valves 6"(150mm) and smaller shall be lever operated. Valves 8"(200mm) and larger shall be gear operated. Valves shall be:
 - 1. Centerline; Series LD
 - 2. Crane; No. 14
 - 3. Demco; NE-LUG Series
 - 4. Keystone; Fig. 122
 - 5. Nibco; LD-2000
 - 6. Stockham; LG-712
 - 7. Watts; Series BF-03
- B. Type BF4 - Valves 2-1/2" (63mm) through 12" (300mm) shall be 200 psig (1720 kPa) WOG quarter turn type conforming to MSS SP-67. Body shall be ASTM A536 ductile iron or ASTM A126 cast iron with extension neck, EPDM coated ductile iron disc, stainless steel stem, and EPDM O-ring stem seals. Valves shall be:
 - 1. Anvil; 7700 Series
 - 2. Victaulic; VIC-300 Series
 - 3. Nibco; GD-4765
- C. Valves 2" (50mm) to 6"(150mm) shall be lever operated. Valves 8"(200mm) and larger shall be gear operated.

2.3 GLOBE VALVES

- A. Type GB4 - Valves 2-1/2" (63mm) through 16"(400mm) shall be class 125 outside screw and yoke, rising stem type conforming to MSS SP-85. Body and bonnet shall be ASTM A126 cast iron with flanged ends, bronze trim, bronze disc, bronze packing gland, Teflon impregnated packing, and malleable or cast iron hand wheel. Valves shall be:
1. Crane; No. 351
 2. Hammond; No. IR116
 3. Lunkenheimer; No. 1123
 4. Milwaukee; No. F-2981
 5. Nibco; No. F-718-B
 6. Powell; No. 241
 7. Stockham; No. G-512
 8. Walworth; No. 8906F

2.4 PLUG VALVES

- A. Type PV2 - Valves 2-1/2" (63mm) through 4"(100mm) shall be 175 psig (1205 kPa) WOG lubricated short pattern type. Body shall be ASTM A126 cast iron with flanged ends, Teflon coated full port steel plug, and wrench operator. Valve shall be:
1. Powell; No. 2201
 2. Rockwell; No. 143
 3. Walworth; No. 1797F
- B. Type PV3 - Valves 6" (150mm) through 12" (300mm) shall be 200 psig (1375 kPa) WOG lubricated short pattern type. Body shall be ASTM A126 cast iron with flanged ends, Teflon coated full port steel plug, and wrench operator. Valves shall be:
1. Powell; No. 2201
 2. Rockwell; No. 143
 3. Walworth; No. 1718F
- C. Type PV4 - Valves 3" (75mm) through 12" (300mm) shall be 175 psig (1205 kPa) WOG lubricated type. Body shall be ASTM A126 cast iron with grooved ends, Teflon coated ductile iron plug, and wrench operator. Plug port shall be minimum 81% free opening. Valves shall be: Victaulic No. 365.

2.5 METERED BALANCING VALVES

- A. Type MB1 - Valves 4" (100mm) and smaller shall be 175 psig (1205 kPa) WOG combination balancing and shut-off type. Valve body shall be bronze ASTM B62 with threaded ends, bronze ball or plug disc, bronze stem, integral meter connection taps with shutoff cocks, and calibrated nameplate and flow indicator. Error of flow indicator and meter reading shall be a maximum of 2% of full scale. Valves shall be:
1. Watts; Series CSM
 2. Bell & Gossett; Circuit Setter
 3. Illinois; 6000 Series
 4. Mepco; Model MBV
 5. Presco; B-Plus
 6. Sarco; Balanced Master
 7. Taco; Circuit Setter
 8. Tour & Anderson; Model STAD/STAS (1/2" (13mm)-2" (50mm))
 9. Model STAF (above 2" (50mm))
 10. Model STAG (grooved - 2 1/2" (63mm) - 12" (300mm))
- B. Meter kit shall be portable readout type designed for service with the valves supplied. Meter kit shall include differential pressure meter, two 10 foot (3000mm) hoses (2 colors), shutoff and vent valves, and carrying case. Meter kit shall be:

1. Watts; Series PG
2. Bell & Gossett; Series RO
3. Illinois; Series PG
4. Mepco; Part no. 150S07A7
5. Presco; GMD Meter
6. Sarco; Model S-831
7. Taco; Model No. 789
8. Tour & Anderson; CBI Meter

- C. Type MB2 - Automatic flow control valves 4" (100mm) and smaller shall be 400 psig (2760 kPa) at 250 degrees F (121 degrees C) factory set combination balancing and shut-off type. Valve body shall be forged brass with sweat and thread configuration, integral ball valve with regulator, steel handle with vinyl grip, integral meter connection taps with shut-off cocks, and calibrated nameplate and flow indicator. Flow cartridge shall be removable from the valve body to provide access for gpm changes, inspection and cleaning without breaking the main piping. The internal flow cartridge shall be permanently marked with the GPM and spring range. Body of valve shall be factory tagged with unit and flow. The internal wear of the surfaces of the valve cartridge shall be stainless steel. Error of flow shall be a maximum of 5%. Pressure drop across valve shall not exceed 5 ft (15 kPa). Valves shall be:

1. Autoflow
2. Bell & Gossett
3. Griswold
4. Hays

2.6 CHECK VALVES

- A. Type CV4 - Valves 2-1/2" (63mm) through 14" shall be class 125 horizontal swing type conforming to MSS SP-71. Body and cap shall be ASTM A126 cast iron with flanged ends, bolted cap, and bronze or cast iron disc. Valve shall be:
1. Crane; No. 373
 2. Hammond; No. IR1124
 3. Lunkenheimer; NO. 1790
 4. Milwaukee; No. F-2974
 5. Nibco; No. F-918-B
 6. Powell; No. 559
 7. Stockham; No. G-931
 8. Walworth; No. 8928F
- B. Type CV6 - Valves 3" through 24" shall be class 125 silent globe type. Body shall be ASTM A48 cast iron with flanged ends, bronze trim, and stainless steel spring. Valve design shall provide an open area in the body equal to not less than 110% of the corresponding pipe area. Valve shall be:
1. APCO; 6000 Series
 2. CPV; Globe Type
 3. Kelflex; K-check
 4. Metraflex; Globe Type
 5. Mueller Steam Co.; No. 105M-AP
 6. Nibco; No. F-910
- C. Type CV7 - Valves 2-1/2" (63mm) through 12" (300mm) shall be 300 psig (2065 kPa) silent butterfly type. Body shall be ASTM A536 ductile iron, ASTM A220 pearlitic malleable iron, or ASTM A47 malleable iron with grooved ends, bronze alloy, ductile iron or stainless steel disc, stainless steel spring, stainless steel hinge pin, and EPDM O-ring seals. Valve shall be:
1. Anvil; No. 7800 Series
 2. Victaulic; No. 716/779

PART 3 - EXECUTION

3.1 VALVE SERVICE

- A. Valve types specified hereinbefore shall be used on the systems and services as outlined below and shown on the drawings.
1. Valves 2-1/2" (63mm) and larger:

SYSTEM	SHUT-OFF <u>SERVICE</u>	BALANCING <u>SERVICE</u>	CHECK <u>SERVICE</u>
a. Chilled Water	BF2, BF4	BF2, BF4, GB4, PV2,PV3,PV4, MB2,MB1	CV4, CV6 Pump Discharge, CV7

3.2 INSTALLATION

- A. All valves in horizontal lines shall be installed with the stem horizontal or above. Valve handwheels shall be oriented when installed to provide accessibility for operations.
- B. Flanged butterfly valves shall be installed between ASA 150 lb. (1035 kPa) raised face steel slip-on weld flanges.
- C. Non-slam check valves shall be installed between ASA 150 lb. (1035 kPa) flat face steel slip-on weld flanges.
- D. Where indicated on the drawings, valves shall be provided with chain operator and valve shall include manufacturer's standard cast-iron chain wheel with roller guides and with link chains with connecting ends; chain length shall be such that the bottom of the chain loop is 5'-0"(1500mm) above the finish floor of the building.
- E. Where indicated on the drawings provide T-wrench operator for valves located in pits.
- F. Provide wrenches for each size plug valve.
- G. Provide meter kit for metered balancing valves.

END OF SECTION

SECTION 230529

HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Work Included
 - 1. Hangers and supporting devices for all mechanical piping.

1.3 SUBMITTALS

- A. General: All submittals shall comply with the requirements of Division 1 - GENERAL REQUIREMENTS and Section 230500 COMMON WORK RESULTS FOR HVAC.
- B. Product Data: Data shall be submitted on the following items:
 - 1. Hangers and supporting devices to be used.

1.4 QUALITY ASSURANCE

- A. Standards
 - 1. American Society for Testing Materials (ASTM):
 - a. Standard E84, Surface Burning Characteristics of Building Materials.
 - b. Standard A446, Specification for steel sheet, zinc coated (galvanized) by the hot dip process, structural (physical quality), edited.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Hangers and support accessories and equipment curbs and rails received and stored on the job site shall be stored in dry storage spaces, (e.g. building, trailer, or shed) whenever possible. Hangers and support accessories shall be stored on wooden rails, wooden pallets, or shipping skids. Under no condition shall the hangers and support accessories be stored in such a way that metal components are in direct contact with the ground or floor slabs.
- B. Where it is not practical to store items within an enclosure, hangers and support accessories may be stored on wooden rails, wooden pallets, or shipping skids outside.
- C. Hangers and support accessories and equipment curbs and rails shall be covered with 6 mil polyethylene sheet (taped in place) to protect the equipment from damage and the weather.

PART 2 - PRODUCTS

2.1 GENERAL

- A. Provide all hangers and rods, turnbuckles, angles, channels and other structural supports to support the piping systems.

- B. Pipe hangers, hanger rods, trapeze type hangers, upper attachments and other supports shall be selected based on pipe size (plus insulation of pipes specified to be insulated) and the weight of the medium being transported or the medium used for testing, whichever is heavier.
- C. Rods for pipe hangers shall be carbon steel. Standard hanger rod sizes shall be:

Pipe Size	Diameter
1. 4" - 5" (100mm - 125mm)	5/8"(16mm)
2. 6" (150mm)	3/4"(20mm)
- D. All ferrous metal pipe hangers, except copper plated hangers, and concrete inserts shall be provided with a factory applied coat of rust inhibiting paint.
- E. Pipe hangers for suspending the following horizontal insulated piping shall be sized to fit around the pipe, pipe insulation and pipe insulation protective shields:
 - 1. Chilled water piping.
- F. All supporting equipment with the exception of springs in spring isolation hangers shall be designed with a minimum factor of safety of five based on the ultimate tensile strength of the material.

2.2 PIPE SUPPORTS FOR SUSPENDED HORIZONTAL PIPING

- A. Pipe support for suspended horizontal piping shall be the following:

SYSTEM	PIPE MATERIAL	PIPE SIZE	HANGER NUMBER
1. Chilled Water	Steel	All Sizes	I
2. Chilled Water	Copper	All Sizes	IV

- B. Hanger numbers listed in schedule above shall be the following types:
 - 1. Hanger Number I: Clevis hanger, steel.

- C. Hanger numbers listed above shall be:

	<u>I</u>	<u>IV</u>
1. B-Line Systems	B3100	B3104CT
2. Carpenter & Patterson	100	100CT
3. Anvil	260	CT-65
4. Erico	400	402

- D. Upper Attachments

- 1. Steel Construction
 - a. For suspending pipes from steel beams, upper attachments shall be beam clamps and shall be:
 - 1) B-Line Systems; Fig. B3055
 - 2) Carpenter & Paterson; Fig. 268
 - 3) Anvil Fig. 133
 - b. For suspending pipes from bottom chord of steel bar joists, upper attachments shall be C-clamps with retaining clips and shall be:
 - 1) B-Line Systems; Figs. B351, B3362 and B3363
 - 2) Carpenter & Paterson; Figs. 238 and 22
 - 3) Anvil; Figs. 87 and 89
 - 4) Erico; No. 255 and 255C
 - c. For suspending pipes from the top chord of steel bar joists, upper attachments shall be top-of-beam C-clamps and shall be:
 - 1) B-Line Systems; Fig. B3034
 - 2) Carpenter & Paterson; Fig. 192

- 3) Anvil; Fig. 92
- 4) Erico; No. 300
2. Concrete Construction
 - a. Existing Construction
 - 1) For suspending pipes in concrete construction, upper attachments shall be electro-galvanized concrete anchors. Anchors shall be flush-mount, threaded type requiring separate drilling. Anchors shall be:
 - a) Erico, No. 345-R
 - b) B-Line Systems; ADI Series
 - c) Carpenter & Paterson; Fig. 514

2.3 PIPE SUPPORTS FOR FLOOR SUPPORTED HORIZONTAL PIPING

A. General

1. Pipe supports for horizontal piping supported on concrete floors and on concrete bases shall be adjustable pipe saddle support with U-bolt and screwed floor flange. Bolt floor flange to floor and bases utilizing all bolt holes. Adjustable pipe saddle supports shall be steel and shall be:
 - a. B-Line Systems; Fig. B3090 and B3088
 - b. Carpenter & Paterson; Fig. 125SP
 - c. Erico; No. 724
2. Pipe supports for horizontal piping in trench below floor level shall be adjustable pipe roller stands. Base shall be bolted to the trench floor utilizing all bolt holes. Adjustable pipe roller stands shall be steel and cast iron and shall be:
 - a. B-Line Systems; Fig. B3118SL
 - b. Carpenter & Paterson; Fig. 40
 - c. Anvil; Fig. 274
 - d. Erico; No. 619

2.4 PIPE SUPPORTS FOR VERTICAL PIPING

A. Supports for vertical piping shall be riser clamps sized to fit directly around the pipe.

1. Riser clamps shall be steel and shall be:
 - a. B-Line Systems; Fig. B3373
 - b. Carpenter & Paterson; Fig. 126
 - c. Anvil; Fig. 261
 - d. Erico; No. 510
2. Offset pipe clamps shall be steel and shall be:
 - a. B-Line Systems; Fig. B3148
 - b. Carpenter & Paterson; Fig. 179
 - c. Anvil; Fig. 103
 - d. Erico; No. 700
3. Clamps for copper tubing shall be copper plated.

2.5 PIPE INSULATION PROTECTIVE SHIELDS AND SADDLES FOR HORIZONTAL PIPING

A. Shields shall be galvanized sheet metal type. Shields shall be 180 degrees type at all pipe hangers. Shields shall be 360 degrees type on trapeze hangers, pipe racks, and on floor supported horizontal pipes. Shields sizes shall be:

- | | |
|---------------------------------------|--|
| 1. Pipes 2 in. (50mm) and smaller -- | 18 gage x 12" long (1.3 mm x 300mm long) |
| 2. Pipes 2-1/2 in. thru 6" (150mm) -- | 16 gage x 18" long(1.5mm x 450mm long) |
| 3. Pipes 8 in. (200mm) and larger -- | 14 gage x 24" long(2.0mm x 600mm long) |

B. Saddles shall be steel and shall be:

	Insulation Thickness					
	1" (25mm)	1-1/2" (37mm)	2" (50mm)	2-1/2" (63mm)	3" (75mm)	4" (100mm)
1. B-Line Systems	B3160	B3161	B3162	B3163	B3164	B3165
2. Carpenter & Patterson	351	352	353	354	355	356
3. Anvil	160	161	162	163	164	165
4. Erico	630	631	632	633	634	635

2.6 FACTORY FABRICATED FRAMING CHANNELS AND FITTINGS

- A. Factory fabricated framing channels and fittings shall be used for:
 - 1. Constructing pipe racks for supporting multiple horizontal pipes where indicated on the drawings.
 - 2. Constructing trapeze type hangers for suspending multiple horizontal pipes where indicated on the drawings.
 - 3. Securing vertical exposed gas service drops for gas outlets and equipment.
- B. Framing channels and fittings shall be provided with factory applied baked enamel finish.
- C. Galvanized pipe clamps, including bolts and nuts, shall be provided with the framing channels and shall be used for securing pipes to channels. Pipe roller supports shall include rollers, 1/2 inch (13mm) diameter axle, nuts and angle brackets. Pipe clamps on insulated pipes shall fit around pipe, pipe insulation and pipe insulation protection shield. Pipe roller supports on insulated pipes shall be sized to fit around pipe saddles.
- D. Framing channels and fittings shall be:
 - 1. B-Line Systems; Strut System
 - 2. Erico; Strut System
 - 3. Unistrut; Metal Framing System
 - 4. Anvil; Power Strut

PART 3 - EXECUTION

3.1 HORIZONTAL PIPE SUPPORT INSTALLATION

- A. Spacing of hangers and supports shall be as follows:
 - 1. Copper Tubing:

<u>Nominal Tubing Size</u>	<u>Maximum Spacing of Supports - Feet</u>
a. 3/4" (20mm) & smaller	5 (1600mm)
b. 1 in. through 3 in. (25mm-75mm)	6 (1800mm)
c. 4 in. (100mm) and larger	12 (3600mm)

- 2. Steel Pipe:

<u>Nominal Pipe Size</u>	<u>Maximum Spacing of Supports - Feet</u>
a. Up thru 1-1/4 in. (32mm)	6 (1800mm)
b. 1-1/2" thru 2-1/2"(37mm-62mm)	8 (2400mm)
c. 3 in. and 4 in. (75 mm & 100 mm)	12 (3600mm)
d. 5 in. thru 8 in. (125mm - 200 mm)	16 (4800mm)
e. 10 in. (250mm) and larger	20 (6000mm)

- 3. PVC Pipe: All sizes; 4'-0" (1200mm).

- B. Additional hangers shall be provided adjacent to all valves and fittings size 8" (200mm) and larger.
- C. Intermediate pipe supports shall be provided between building structural members so as not to exceed maximum support spacing hereinbefore specified.
 - 1. In filler type concrete construction, intermediate angle supports shall be fastened to concrete joists or beams. In no case shall angle supports be fastened in floor slabs or in roof slabs. Intermediate supports shall be fastened to concrete with concrete inserts or concrete anchors.
 - 2. In steel construction, intermediate supports shall be welded to steel beams and to steel joists. In no case shall supports be attached to roof purlins, roof decks, or permanent metal forms.

3.2 UNDERGROUND PIPING

- A. Piping in earth shall be laid on a firm bed for its entire length.

3.3 VERTICAL PIPE SUPPORT INSTALLATION

- A. Supports for all pipes shall fit directly around the pipe. On insulated pipes, the support shall be insulated and provided with vapor barrier as specified for pipe insulation in Section 230700 HVAC INSULATION.
- B. Vertical pipes passing through floors shall be provided with a riser clamp at each floor. Where opening in floor is sleeved, riser clamps shall have steel lugs, 1/4" thick x 2" high x 1-1/2" long (6mm thick x 50mm high x 37mm long), welded to the clamp arms so that clamp does not come in contact with the pipe sleeve; the lugs shall support the clamp from the floor. Where floor opening does not have a sleeve, a 3 inch (75) high concrete curb shall be installed around the opening.
- C. Where distance between floors is greater than 15 ft. (4500mm) or where drop within one floor level is more than 15 ft. (4500mm), vertical pipes shall be provided with offset pipe clamps anchored to walls at the approximate midpoint between floors.
- D. Copper tubing supported by channel framing shall be provided with a lead sleeve to isolate the pipe from the framing channel and the pipe clamp.

3.4 CONCRETE INSERTS AND ANCHORS

- A. In filler type concrete construction, inserts and anchors shall be installed in joists or beams only. Install inserts in sides of joists or beams.
- B. In framed type concrete construction, inserts and anchors shall be installed no closer than 6 inches (150mm) to edge of slab.

3.5 SHIELD AND SADDLE INSTALLATION

- A. Shields shall be installed at all pipe hangers in horizontal insulated chilled water piping.

END OF SECTION

SECTION 230533

HEAT TRACING FOR HVAC PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Work Included:
 - 1. Heat Tape

1.3 SUBMITTALS

- A. General: All submittals shall comply with the requirements of Division 1 - GENERAL REQUIREMENTS and Section 230500 COMMON WORK RESULTS FOR HVAC.
- B. Product Data: Data shall be submitted on the following items:
 - 1. Heat Tape
- C. Operation and Maintenance Data: Data shall be provided on the following items:
 - 1. Heat Tape

1.4 QUALITY ASSURANCE

- A. Standards:
 - 1. National Electrical Code (NEC)
 - 2. Underwriter's Laboratories (UL)

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Electric heating equipment received and stored on the job site shall be stored in dry storage spaces, (e.g. building, trailer, or shed) whenever possible. Electric heating equipment shall be stored in shipping cartons on wooden rails, or wooden pallets. Under no condition shall the electric heating equipment be stored in such a way that metal components are in direct contact with the ground or floor slabs.
- B. Where it is not practical to store items within an enclosure, electric heating equipment may be stored on wooden rails or wooden pallets outside.
- C. Electric heating equipment shall be covered with 6 mil polyethylene sheet (taped in place) to protect the equipment from damage and the weather.

PART 2 - PRODUCTS

2.1 HEAT TAPE

- A. Heat tape shall be self-regulating resistance type heating cables with a metallic braid and outer jacket. Heat tape shall be UL approved and rated at 8 watts per lineal foot. Heat tape shall be:
 - 1. Thermon
 - 2. Raychem
 - 3. Cromalox

PART 3 - EXECUTION

3.1 INSTALLATION

A. Heat Tape:

1. Install heat tape under insulation on piping aboveground and exterior to the building.
2. Heating tape shall not cross over itself. Heating tape shall be permanently connected to junction boxes provided on the electrical drawings.
3. Heating tape shall be tested prior to installation of covering insulation.
4. Heating tape shall be installed in accordance with manufacturer's recommendations.

END OF SECTION

SECTION 230553

IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Work Included:
 - 1. Valve Tags
 - 2. Pipe Bands

1.3 SUBMITTALS

- A. General: All submittals shall comply with the requirements of Division 1 - GENERAL REQUIREMENTS, and Section 230500 COMMON WORK RESULTS FOR HVAC.
- B. Product Data: Data shall be submitted on the following items:
 - 1. Valve Tags
 - 2. Pipe Bands

1.4 QUALITY ASSURANCE

- A. Standards
 - 1. American National Standards Institute (ANSI):
 - a. Standard A13.1, The Scheme for Identification of Piping Systems.
 - 2. National Fire Protection Association (NFPA)
 - a. Standard 45, Fire Protection for Laboratories Using Chemicals.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Tapes, labels, paint received and stored on the job site shall be stored in dry storage spaces, (e.g. building, a storage trailer, or shed). Under no condition shall the units be stored in such a way that metal components are in direct contact with the ground.
- B. Tapes, labels, paint shall be covered with 6 mil (.4mm) polyethylene sheet (taped in place) to protect the equipment from damage and the weather.

PART 2 - PRODUCTS

2.1 GENERAL

- A. Pipe identification shall comply with ANSI A13.1.

2.2 VALVE TAGS

- A. Valve tags shall be 19 gauge (1.2 mm) minimum brass with 1-1/4" (30 mm) minimum height and width. Identification letters 1/4" (6mm) high and numbers 1/2" (12mm) high shall be stamped in tag and shall be filled with black enamel paint. Valve tags shall be:
 - 1. Emedco; CB/W Series
 - 2. Seton; Valve Tags
 - 3. Brady; Valve Tags

4. Marking Services; Valve Tags

B. Valve tag shape and designations shall be:

<u>System</u>	<u>Identification Numbers</u>	<u>Tag Shape</u>
1. Chilled Water	CH - 1, 2, 3, . . .	Round or Square

2.3 PIPE MARKINGS

A. Pipe identification bands shall be snap-on type with clear polyester exterior surface. Bands shall include directional flow arrows and legends. Identification bands on pipe or coverings 5-1/2" (138mm) or less in diameter shall be sized to fit around pipe and overlap self. Identification bands on pipe or covering 6" (150 mm) or more in diameter shall have stainless steel spring fasteners. Pipe identification bands shall be:

1. Seton/Setmark; SNA/STR Series
2. Brady; Snap-on Series
3. Brimar Industries; System #1
4. Marking Services; MS-970 Series

B. Pipe identification shall be pressure sensitive tape with banding tape flow arrows.

C. Bands shall be color and background as indicated below.

<u>Pipe</u>	<u>Band Color</u>	<u>Lettering</u>	<u>Lettering Color</u>
1. Chilled Water Supply	Green	CHILLED WATER SUPPLY	White
2. Chilled Water Return	Green	CHILLED WATER RETURN	White

D. Band width and lettering size shall be as follows:

<u>Pipe or Pipe Covering Diameter (inches)(mm)</u>	<u>Band Width (inches)(mm)</u>	<u>Lettering Size (inches)(mm)</u>
1. 3/4 to 2 (20 mm to 50 mm)	8 (200 mm)	3/4 (20 mm)
2. 2-1/2 to 6 (60 mm to 150 mm)	12 (300 mm)	1-1/4 (30 mm)
3. 8 to 10 (200 mm to 250 mm)	24 (600 mm)	1-3/4 (40 mm)
4. Over 10 (250 mm)	32 (800 mm)	3-1/2 (80 mm)

2.4 TAPE

A. Identification tape shall be vinyl pressure sensitive type with adhesive backing. Tape width shall be a minimum of 2"(50 mm). Tape shall be color to match pipe identification band background. Tape shall be:

1. Emedco; T100 Series
2. Seton; PST Series
3. Brady; Tape
4. Marking Services; MS-900

2.5 CABLE TIES

A. Cable ties for valve tag attached shall be self-locking nylon ties. Cable ties shall be:

1. Thomas & Betts; Ty-Rap-Nylon
2. Ideal; Double Lock Cable (Plain Head)
3. Efcor; Sure-Ty Self-Locking Cable Ties

2.6 VALVE CHART

- A. Valve chart shall be typed listing of all valve tags. List shall include identification number, valve location in system (e.g., water heater, chilled water pump, etc.) and its function (e.g., shut-off, balancing, drain, etc.). Chart shall be mounted in a aluminum frame with glass or plastic cover. Chart shall be turned over to owner.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Valve tags shall be installed at all shut-off, balancing, metering, and drain valves. Valve tags shall be attached to the handwheel with cable ties.
- B. Pipe identification bands shall be installed on piping at each valve, each piece of equipment, each change of direction, wall penetration, each branch take-off, and at a maximum spacing of 20 feet (6.5M) on exposed straight run piping
- C. Plastic pipe bands shall be wrapped around pipe or pipe covering under pressure so that no gaps or wrinkles occur. Bands on pipe or pipe covering 6" (150 mm) or smaller shall overlap and adhere to themselves. Bands on pipe or pipe covering larger than 6" (150 mm) shall be further secured at both ends with tape. Tape shall overlap and adhere to itself.

END OF SECTION

SECTION 230593

TESTING, ADJUSTING AND BALANCING FOR HVAC

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Work Included
 - 1. Performance Testing
 - 2. Balancing
- B. Description
 - 1. The Contractor shall obtain the services of an independent test and balance agency who shall performance test and balance the following systems:
 - a. Chilled water

1.3 SUBMITTALS

- A. General: All submittals shall comply with the requirements of Division 1 - GENERAL REQUIREMENTS and Section 230500 COMMON WORK RESULTS FOR HVAC.
- B. Product Data: Data shall be submitted on the following:
 - 1. Balance procedure
 - 2. Balance forms
- C. Certificates: Certificates shall be submitted on the following:
 - 1. Test equipment calibration including date of last calibration.
 - 2. Certificate of membership in AABC or NEBB.
- D. Reports: Reports shall be submitted on the following:
- E. Field balance report.

1.4 QUALITY ASSURANCE

- A. Standards
 - 1. American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE):
 - a. Fundamentals.
 - 2. Associated Air Balance Council (AABC):
 - a. National Standards for Field Measurements and Instrumentation, Total System Balance, Air Distribution - Hydronic Systems - Air Pollution - Sound Vibration.
 - 3. National Environmental Balancing Bureau (NEBB):
 - a. Procedural Standards for Testing - Balancing - Adjusting of Environmental Systems.
- B. Qualification of Testers:
 - 1. The balancing personnel shall be familiar with and perform the balancing in accordance with AABC MN-1-1989 or NEBB-1998 procedures using forms of appropriate organization.
 - 2. The balancing firm shall be a certified member of AABC or NEBB.
 - 3. The independent test and balance company shall have a minimum of five years experience as an independent test and balance company.

PART 2 - PRODUCTS

2.1 EQUIPMENT

- A. Instruments used for balancing shall have been calibrated within 6 months prior to the balancing of the systems.
- B. All instruments required to balance the system shall be provided at the Contractor's expense.

PART 3 - EXECUTION

3.1 GENERAL BALANCING

- A. Water
 - 1. Adjust and balance water systems indicated hereinbefore to obtain design flow rates for system as a whole and for each component individually. Use flow measuring devices and/or pressure gauges.
 - 2. Coils with two - way control valves shall have valve positioned full open; coil pressure drop shall be adjusted to required value.
 - 3. Coils with three - way control valves shall have valve positioned full open to coil; coil pressure drop shall be adjusted to required value. Three - way control valve shall then be positioned to full by-pass; by-pass pressure drop shall be adjusted to match coil drop.
- B. Final readings shall be set with -5% to +10% of design conditions.

3.2 REPORT

- A. The report of performance testing and balancing shall include data listed below:
 - 1. Name and address of project, name and address of Contractor, dates of all tests, name and telephone number of test engineer.
 - 2. Pumps:
 - a. System and/or pump number.
 - b. Manufacturer, size and model.
 - c. Motor manufacturer, horsepower, voltage, phase, RPM, type, and amperage nameplate rating.
 - d. Scheduled data on drawings or in specifications.
 - e. Discharge and suction pressures.
 - f. Flow.
 - g. Amperage.
 - h. Brake horsepower.
 - 3. Chillers:
 - a. Chiller number.
 - b. Manufacturer, size, model number and serial number.
 - c. Motor horsepower, voltage, phase, type, amperage, nameplate rating.
 - d. Scheduled data on drawings or in specifications.
 - e. Chilled water flow.
 - f. Chilled water entering and leaving pressures.
 - g. Chilled water entering and leaving temperatures.
 - h. Amperage.
 - i. Compressor KW/ton refrigeration.
- B. Any deviations from design data shall be explained in the report - possible reasons for and solutions to.
- C. Report shall be signed and dated by balance engineer.
- D. Test and balance shall not be performed until system installation is complete.

- E. Permanently mark the settings of all valves, dampers and other adjustment devices in a manner that will allow the settings to be restored. If a balancing device is provided with a memory stop, it shall be set and locked

END OF SECTION

SECTION 230700
HVAC INSULATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Work Included:
 - 1. Pipe Insulation

1.3 SUBMITTALS

- A. General: All submittals shall comply with the requirements of Division 1 - GENERAL REQUIREMENTS and Section 230500 COMMON WORK RESULTS FOR HVAC .
- B. Product Data: Data shall be submitted on the following items:
 - 1. Insulation
 - 2. Field Applied Jacketing
- C. Certificates: Certificates shall be submitted on the following:
 - 1. Certificates of compliance to the specified standards.

1.4 QUALITY ASSURANCE

- A. Standards
 - 1. American Society for Testing and Materials (ASTM):
 - a. Standard E84, Surface Burning Characteristics of Building Materials.
 - b. Standard C423, Standard Test Method for Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method
 - c. Standard C547, Mineral Fiber Performed Pipe Insulation
 - d. Standard C533 Calcium Silicate Block and Pipe Thermal Insulation.
 - e. Standard C534, Preformed Flexible Elastomeric Cellular Thermal Insulation.
 - f. Standard C552, Cellular Glass Thermal Insulation
 - g. Standard C553, Mineral Fiber Blanket and Felt Insulation
 - h. Standard C591 Standard Specification for Unfaced Preformed Rigid Cellular Polyisocyanurate Thermal Insulation
 - i. Standard C612, Mineral Fiber Block and Board Thermal Insulation.
 - j. Standard C755 Standard Practice for Selection of Vapor Retarders for Thermal Insulation
 - k. Standard C795, Thermal Insulation for Use in Contact with Austenitic Stainless Steel
 - l. Standard C916, Standard Specification for Adhesives for Duct Thermal Insulation
 - m. Standard C1071 Thermal and Acoustical Insulation (Mineral Fiber, Duct Lining Materials)
 - n. Standard C1290 Specification for Flexible Fibrous Glass Blanket Insulation Used to Externally Insulate HVAC Ducts
 - o. Standard 1136 Standard Specification for Flexible, Low Permiance Vapor Retarders for Thermal Insulation
 - p. Standard 1393, Perpendicularly Oriented Mineral Fiber Roll and Sheet Thermal Insulation for Pipes and Tanks
 - q. Standard D635, Standard Test Method for Rate of Burning and/or Extent and Time of Burning of Plastics in a Horizontal Position
 - r. Standard G21, Practice for Determining Resistance of Synthetic Polymeric Material to Fungi

2. National Fire Protection Association (NFPA):
 - a. Standard 255, Test Methods, Surface Burning Characteristics of Building Materials.
 - b. Standard 96, Ventilation Control and Fire Protection of Commercial Cooking Operations.
3. Underwriters' Laboratories (UL):
 - a. Standard 723, Surface Burning Characteristics of Building Materials.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Insulation received and stored on the job site shall be stored in dry storage spaces, (e.g. building, trailer, or shed) whenever possible. Insulation shall be stored on wooden rails, wooden pallets, or shipping skids. Under no condition shall the insulation be stored in such a way that components are in direct contact with the ground or floor slabs.
- B. Where it is not practical to store items within an enclosure, insulation may be stored on wooden rails, wooden pallets, or shipping skids outside.
- C. Insulation shall be covered with 6 mil polyethylene sheet (taped in place) to protect the equipment from damage and the weather. UV sensitive material such as PVC and PVDC insulation material shall be protected from sunlight to avoid exposure to UV light from the sun.

PART 2 - PRODUCTS

2.1 FLAME AND SMOKE RATING

- A. Insulation material, adhesives, jackets, and tapes specified herein shall comply with ASTM E84, NFPA 255, and UL 723 for:
 1. Maximum flame spread rating: 25
 2. Maximum smoke developed rating: 50, unless indicated otherwise hereinafter.
 3. Compliance shall be for insulation, adhesive, and jacket or facing.

2.2 FOAMGLAS PIPE INSULATION

- A. Insulation shall be closed cell, foamed glass type designed for use on surfaces up to 900°F (482°C).
- B. Insulation shall have a minimum density of 8 lb./Cu. Ft.(128 Kg/m³) and a maximum conductivity ('K' value) of 0.33 Btu/In. per Sq. Ft. per °F per hour (0.00020W/cm² °C) at 75°F (24°C) mean temperature.
- C. Insulation shall be provided with a factory applied aluminum foil and Kraft paper vapor barrier.
- D. Insulation shall be:
 1. Pittsburgh Corning
 2. ASC Industries; Foamglas
 3. Cell-U-foam
- E. Insulation thickness shall be 2 inches (50mm).

2.3 ADHESIVES

- A. Insulation cement shall be:
 1. Fibrex; FBX Super Blend
 2. ROCKWOOD MFG. CO.; Delta-Maid One Shot
- B. Fire Retardant Adhesive for blanket and liner insulation shall be conform to ASTM C 916 and shall be:
 1. Childers; CP-56
 2. Foster; 85-60
 3. King; 11-400
 4. Mon-Eco; 22-65

5. Viamco; 795

2.4 FABRICS

- A. Reinforcing fabric shall be 10 by 20 or 10 by 10 white glass on nylon fabric.

2.5 COATINGS

- A. Vapor barrier coating (white) shall be:

1. Childers; Chil-Perm CP-30
2. Epolux; Calaler 650
3. Foster; Tite Fit 30-35
4. King ; ---
5. Mon-Eco ; 55-10

- B. Breather Coating (white) shall be:

1. Childers; Chil-Seal CP-50A
2. EPOLUX; Cadalag 336
3. Foster; Seal Fas 30-36
4. King ; 11-275
5. Mon-Eco ; 11-07
6. Vimasco; 713

- C. Asphalt mastic shall be:

1. Foster; 60-25
2. Lion Oil Co.; Seal-Kote
3. Pittsburgh Corning; Pittcoat 300

- D. Fire resistive, vapor barrier, water proof mastic (grey) shall be:

1. Childers; CP-10/11 AF
2. Epolux; Cadolon 500
3. Foster; Monolar 60-39
4. King ; ---
5. Mon-Eco ; 55-50
6. Vimasco; WC-5FR

- E. Asphalt based Aluminum paint shall be as recommended by insulation manufacturer.

2.6 FASTENERS AND TAPES

- A. Securing wire shall be 16 gauge stainless steel.

- B. Metal weld pins shall be 12 gauge galvanized steel.

- C. Metal stick pins shall be 12 gauge galvanized steel with perforated base plate.

- D. Foil reinforced Kraft tape; 3" (75mm) wide shall be:

1. Compac; 122-2
2. Fasson; 0821
3. Venture; 1525 CW
4. 3M; 898
5. Nashua; FSK

- E. Steel bands shall be 1/2" x 0.020" (13mm x 0.5mm) thick stainless steel.

- F. Wire mesh shall be 1" (25mm) wide galvanized steel.

2.7 FIELD APPLIED COVERS AND JACKETING

- A. Polyvinyl Chloride (PVC)
 - 1. PVC fitting and valve covers shall be factory preformed for the shape used for.
 - 2. PVC jacketing shall be cut and curled and sized for pipe installed on.
 - 3. PVC installed on covers and jacketing shall have a minimum thickness of 20 mil.
 - 4. PVC covers and jacketing shall be:
 - a. Speedline Corp.
 - b. Johns Manville; Zeston 2000 PVC
 - c. Proto; PVC Covers

- B. Aluminum
 - 1. Aluminum jacketing shall be 0.016 inch (0.4mm) thick with smooth finish.
 - 2. Aluminum fitting covers shall be 0.024 inch (0.6mm) thick with smooth finish.

PART 3 - EXECUTION

3.1 GENERAL INSTALLATION

- A. Do not apply insulation which has become wet.
- B. Do not use staples for securing any insulation.
- C. Apply insulation only on clean, dry surfaces.
- D. Continue insulation through wall and ceiling openings and sleeves, except terminate duct insulation at fire dampers and at flexible duct connections at air handling units.
- E. Provide continuous unbroken vapor seal on all cold surfaces where vapor jackets are used.
- F. Insulate and vapor seal supports that are secured to cold surfaces to prevent condensation.
- G. Do not insulate unions, except in chilled water lines.
- H. Seal off ends of insulation on chilled water pipe lines with white vapor barrier coating at valves, flanges, and fittings and on straight runs of piping not to exceed 21 ft. (6400mm). Coatings shall be applied to butt ends of insulation and lapped over vapor barrier jacket and pipe.
- I. Fill pipe insulation protective saddles with same insulation as adjoining pipe insulation.
- J. Perform work at ambient and equivalent temperatures as recommended by the adhesive manufacturer.

3.2 FOAMGLAS PIPE INSULATION

- A. Insulate the following:
 - 1. Chilled water lines
 - a. Aboveground piping exposed to the weather, outside building. Extend insulation one foot below finished grade or 6 inches (150mm) within building as applicable.
 - 2. Underground chilled water piping not in preinsulated piping systems.
- B. Butt all joints. Adhere butting sections to each other with asphalt mastic.
- C. Secure insulation in place with steel wire 18" (450mm) on center maximum.
- D. Insulate all fittings with mitered sections of Foamglas, asphalt mastic and hold in place with wire.

- E. On underground lines apply tack coat of asphalt mastic over all insulation surfaces at minimum rate of 4 gal. /100 sq. ft. (0.62 m³/l) or 1/16" (1.6mm) thick wet film. Embed glass membrane into wet tack coat. Smooth membrane to avoid wrinkles. Overlap seams 2" (50mm) minimum. Apply asphalt mastic finish coat to entire membrane surface at minimum rate of 8 gallons/100 sq. ft. (0.31 m³/l) or 1/8" (3.2mm) thick wet film. Allow one hour minimum between successive coats. Total mastic minimum thickness shall be at least 122 mils (3mm).
- F. As an option to paragraph E. above, Pittwrap, or equal, shall be provided and installed in accordance with manufacturer's instructions.
- G. Apply aluminum jacketing and aluminum fitting covers on all aboveground lines. Longitudinal joints shall be positioned on the bottom.
- H. Oversize (to next larger size) insulation on piping provided with heating tape. Fill void between pipe and insulation by wrapping Fiberglas blanket insulation held in place with spirally wrapped wire loops at 12" (300mm) on center maximum.
- I. Foamglas inserts (min. 180° section) at pipe hangers and supports in Fiberglass pipe insulation, of same thickness as adjoining insulation and a minimum length of 12 inches (300mm). Vapor seal as specified for insulation on fittings, valves and flanges.

END OF SECTION

SECTION 232113
HYDRONIC PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Work Included
 - 1. Chilled water piping

1.3 SUBMITTALS

- A. General: All submittals shall comply with the requirements of Division 1 - GENERAL REQUIREMENTS and Section 230500 COMMON WORK RESULTS FOR HVAC.
- B. Product Data: Data shall be submitted on the following items:
 - 1. Manufacturer's notarized certificates of conformance to specified standards for pipe, fittings, and flanges.
- C. Certificates: Provide copies of certificates for the following:
 - 1. Welder's Qualification

1.4 QUALITY ASSURANCE

- A. Standards
 - 1. American National Standards Institute (ANSI):
 - a. Standard B16.1, Cast Iron Pipe Flanges and Flanged Fittings, 25, 125, and 800 pound.
 - b. Standard B16.3, Malleable Iron Screwed Fittings, 150 and 300 pound.
 - c. Standard B16.5, Steel Pipe Flanges, Flanged Valves and Fittings including ratings for Class 150, 300, 400, 600, 900, 1500 and 2500.
 - d. Standard B16.18, Cast Copper Alloy Solder Joint Pressure Fittings.
 - e. Standard B16.21, Nonmetallic Flat Gaskets for Pipe Flanges.
 - f. Standard B16.22, Wrought Copper and Copper Alloy Solder Joint Pressure Fittings.
 - g. Standard B31.1, Power Piping and Addenda.
 - h. Standard C606, Standard for Grooved and Shouldered Joints.
 - 2. American Society for Testing and Materials (ASTM):
 - a. Standard A47, Ferritic Malleable Iron Castings.
 - b. Standard A53, Pipe, Steel, Black and Hot-Dipped Zinc-Coated, Welded and Seamless.
 - c. Standard A135, Electric Resistance Welded Steel Pipe.
 - d. Standard A183, Carbon Steel Track Bolts and Nuts.
 - e. Standard A234, Pipe Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and Elevated Temperatures.
 - f. Standard A307, Carbon Steel Externally Threaded Standard Fasteners.
 - g. Standard A312, Seamless and Welded Austenitic Stainless Steel Pipe.
 - h. Standard A351, Castings, Austenitic, Austenitic - Ferritic for Pressure Containing Parts.
 - i. Standard ASTM A403, Wrought Austenitic Stainless Steel Piping Fittings.
 - j. Standard ASTM A513, Electro - Resistance Welded Carbon and Alloy Steel Mechanical Tubing.
 - k. Standard ASTM A536, Ductile Iron Castings.
 - l. Standard A743, Castings, Iron - Chromium, Iron - Chromium - Nickel, and Nickel Base Corrosion Resistant for General Applications.

- m. Standard B88, Specification for Seamless Copper Water Tube.
- n. Standard B280, Specification for Seamless Copper Tubes for Air Conditioning and Refrigeration Field Service.
- 3. Federal Specifications (Fed. Spec.):
 - a. Specification WW - U - 516C, Union, Brass or Bronze, Threaded Pipe Connections and Solder - Joint Tube Connections.
 - b. Specification WW - U - 531E, Unions, Pipe Steel or Malleable Iron; Threaded Connections.

B. Qualifications of Manufacturers

- 1. All pipe and fittings shall be of domestic manufacturer.

C. Qualifications of Welders

- 1. All welders employed for the work shall be qualified under the requirements of ANSI B31.1.0, Section 127.5.
- 2. Evidence of welders' qualifications shall be submitted to the Architect before any welds are made.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. The interior of all pipe and fittings shall be kept free from dirt and foreign matter at all times.

PART 2 - PRODUCTS

2.1 PIPE AND FITTINGS

- A. Pipe and fitting material options for mechanical systems shall be as indicated in table below:

<u>SERVICE</u>	<u>PIPE MATERIAL TYPE</u>
1. Chilled Water	2

- B. Pipe and fittings options indicated above shall be the material indicated in table below:

<u>MATERIAL TYPE</u>	<u>PIPE SIZE</u>	<u>PIPE TYPE</u>	<u>PIPE SPEC</u>	<u>FITTING TYPE</u>	<u>FITTING SPEC</u>
2	2-1/2" - 10" (62mm) – 250mm) Inclusive	Sch. 40 black steel, GRB ERW	ASTM A53 ERW	Standard Weight butt welding type	ASTM A234

2.2 FLANGES

- A. Flanges shall be faced true and provided with 1/16" (1.6mm) ring type gasket conforming to ANSI B16.21. Flanges will have raised or flat face to mate with adjacent flanges or valves, fittings, and equipment.
 - 1. Flanges in threaded pipe lines shall be 125 or 250 lbs. (860 kPa or 1720 kPa) cast iron screwed flanges conforming to ANSI B16.1.
 - 2. Flanges in welded pipe lines shall be 150 or 300 lbs. (1035 kPa or 2065 kPa) steel slip-on or weld neck type welding flanges conforming to ANSI B16.5.
 - 3. Flange bolts shall be carbon steel, standard bolt sets and nuts shall be carbon steel hexagon type. Steel for bolts and nuts shall conform to ASTM A307, Grade A for use with steel flanges and Grade B for use with cast-iron flanges.
 - 4. Flange class shall be selected to match valve or equipment connection requirement.

- B. Unions in steel pipe shall be 150 lbs. (1035 kPa) malleable iron type, screwed, Fed. Spec. WW-U-531E. Unions in copper tubing shall be wrought or cast bronze, Fed. Spec. WW-U-516C, solder end joints.
 - 1. Unions provided between copper and ferrous pipe connections shall be the insulated type to separate dissimilar metal connections in piping systems and prevent galvanic corrosion. Temperature rating shall be equal to or exceed the maximum temperature of respective system in which the union is installed.

2.3 GROOVED COUPLINGS

- A. Grooved end couplings shall consist of two or more bolted coupling sections which enclose a resilient gasket and mate with pipe or fitting grooved ends. Coupling sections shall be constructed of ductile, ASTM A 536, or malleable, ASTM A47, iron with factory applied rust inhibiting paint finish. Coupling design shall be self-restrained such that the coupling feet (keys) engage the pipe or fitting groove for the entire joint circumference and are restricted to the pipe or fitting groove when bolts are tightened.
- B. Gasket for water service shall be EPDM, ASTM D2000, designed for operating temperatures from -30°F (-35° C) to +230°F(110°C).
- C. Bolts shall be heat treated, track head steel bolts, ASTM A183 with a minimum tensile strength of 110,000 psi (758423 kPa) and electroplated zinc finish.
- D. Grooved end couplings for use on copper systems shall be rigid "zero deflection" design with 300 psi (2069kPa) minimum working pressure and copper finish. Couplings shall be:
 - 1. Victaulic; Style 606
 - 2. Anvil; Fig. 7400
- E. Grooved end couplings for steel systems shall be rigid "zero-deflection" design with 750 psi (5171kPa) minimum working pressure. Coupling shall be:
 - 1. Victaulic; Style 07
 - 2. Anvil; Fig. 7401
 - 3. Guston Bacon
- F. Grooved end couplings for steel systems shall be flexible design allowing for pipe deflection without leakage. Coupling shall have 1000 psi (6895 kPa) minimum working pressure. Coupling shall be:
 - 1. 1000 psi (6895kPa):
 - a. Victaulic; Style 77
 - b. Anvil; Fig. 7001
 - c. Guston Bacon

2.4 ASPHALT MASTIC

- A. Asphalt mastic for underground piping shall be:
 - 1. Foster; 60-25
 - 2. Insul-Coustic; IC-320
 - 3. Lison-Oil Co.; Seal Kote

PART 3 - EXECUTION

3.1 PIPE INSTALLATION

- A. Pipes shall have burrs removed by reaming.
- B. Changes in direction of piping shall be made with fittings.
- C. Changes in pipe sizes in horizontal pipelines shall be made with eccentric reducing couplings, except reducing tees and reducing elbows will be allowed for connections for pressure gauges and gauge cocks, for thermometers and test wells, and for pipe mounted insertion-type temperature control devices.

1. In chilled water lines, eccentric reducing couplings shall be installed with the flat side on top to maintain the top of the pipeline flush.
 2. Reducing tees, reducing elbows and concentric reducing couplings will be allowed for changing pipe sizes in vertical risers, except in pump suction lines eccentric reducing couplings only will be allowed.
- D. Above ground chilled water horizontal supply and return lines shall be installed level.
- E. Open ends of pipe lines shall be plugged during installation to keep dirt and foreign material out of the system.
- F. All elbows 2-1/2" (62mm) and larger at pump suction connections shall be the long radius type.
- G. All steel piping installed underground shall be cleaned of rust, grease and scale. After cleaning, the pipe shall be provided with a coat of oxide chromate primer and then finished with an asphalt mastic protective coating. Asphalt mastic shall be applied at a coverage of not less than 8 gallons (30 L) per 100 sq. ft. (9.3 sq. M) (1/8"(3mm) thick wet film).
- H. Branch lines for water lines shall take off below centerline of mains.
- I. Branch lines for steam piping shall take off from top of mains using swing joints.
- J. Pipe and tubing specified to be grooved shall have grooves formed in accordance with the manufacturer's published instructions.

3.2 PIPE JOINTS

- A. Screw Joints for Steel Pipe: After cutting and before threading, pipe shall be reamed and shall have burrs removed. Threading shall be made with tapered threads. Screw joints shall be made up with Teflon paste or tape applied to male threads only. Caulking of threaded joints to stop or prevent leaks will not be permitted.
- B. Welded joints shall be fusion welded. Changes in direction of piping shall be made with welding fittings only. Mitering or notching pipe to form elbows and tees will not be permitted.
1. Branch take-offs at 90 degrees from mains shall be made with welding tee fittings, except where main size is larger than 2 inches (50mm) factory fabricated forged steel shaped fittings may be used in lieu of welding tees if the main is two pipe sizes or more larger than the branch takeoff; shaped fittings shall be weldolets for branch sizes 2-1/2" (62mm) and larger, and threadolets for branch sizes 2" (50mm) and smaller.
 2. Branch takeoffs at 45 degrees to mains shall be made with factory fabricated latrolets.
 3. Defective welds shall be removed and replaced at no additional cost to the Owner. Repairing of defective welds by adding new material over the defects or by peening will not be permitted.
- C. Grooved Mechanical Pipe Joints: Grooved mechanical pipe joints shall be installed in accordance with the coupling manufacturer's latest published recommendations with regard to intended service, maximum pressure rating, and maximum allowable end load and temperature range.

END OF SECTION

SECTION 232113A

HYDRONIC PIPING (UNDERGROUND PRE-INSULATED PIPING SYSTEMS)

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Extent of each type of Underground Preinsulated Piping Systems is indicated on drawings and by provisions of this section.

- B. Work Included:
 - 1. Underground chilled water piping.

1.3 SUBMITTALS

- A. General: All submittals shall comply with the requirements of Division 1 - GENERAL REQUIREMENTS and Section 230500 COMMON WORK RESULTS FOR HVAC.

- B. Product Data: Data shall be submitted for the following:
 - 1. List of installations.
 - 2. Piping system.
 - 3. Installation instructions.

- C. Shop Drawings: Drawings shall be submitted for the following:
 - 1. Layout of the piping system.
 - 2. Branch take-off details.
 - 3. Floor and wall seals.
 - 4. Anchor and thrust block details.

- D. Certificates: Certificates shall be submitted for the following:
 - 1. Manufacturer's acceptance of installation [including photographs of joints].

1.4 QUALITY ASSURANCE

- A. Standards
 - 1. American Society for Testing and Materials (ASTM):
 - a. Standards A53, Pipe, Steel, Black and Hot Dipped Zinc Coated Welded and Seamless.
 - b. Standard A234, Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and Elevated Temperatures.
 - c. Standard B88, Seamless Copper Water Tube.
 - d. Standard D1784, Rigid Poly Vinyl Chloride (PVC) Compounds and Chlorinated Poly Vinyl Chloride (CPVC) Compounds.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Piping received and stored on the job site shall be stored on wooden supports or pallets. Under no condition shall the piping be stored in such a way that metal components are in direct contact with the ground.

- B. Piping stored on the job site shall be covered with 6 mil polyethylene sheet, taped in place, to protect it from damage and the weather.

PART 2 - PRODUCTS

2.1 UNDERGROUND PIPING SYSTEMS

A. General

- 1. All underground pre-insulated piping systems shall be the product of one manufacturer.
- 2. The manufacturer shall have not less than five (5) installations of this type in operation for a continuous period of one (1) year. A list of five such installations shall be submitted with the shop drawings.
- 3. Manufacturers shall be:
 - a. Ric-Will, Inc.
 - b. Perma Pipe, Inc.
 - c. Thermal Pipe Systems, Inc. (TPS)
 - d. Rovanco
 - e. Thermacor Process, Inc.

B. Piping Systems

- 1. The piping systems shall be factory fabricated, pre-insulated, and jacketed for underground installation.
- 2. Carrier Pipe
 - a. Chilled water piping shall be polyvinyl chloride (PVC) pressure pipe, ASTM D1784, Type 1, Guard T. Joints shall be O-ring compression type. Fittings shall be PVC with gasketed bell joints.
- 3. Insulation
 - a. Insulation shall be:
 - 1) Type: Polyurethane Foam
 - 2) K Factor: 0.14 BTU/(HR) (SQ. FT.) (F/IN)
 - 3) Density: 2.0 LB/Cubic Foot (32 Kg/Cubic Meter) Min.
 - 4) Closed Cell Content: 90% (minimum)
 - 5) Minimum Thickness:
 - a) Pipe Size, In.:: 1"; 1-1/4"-3"; 4"-6"; 8"
 - b) Thickness, In.:: 1"; 1-1/2"; 2"; 2-1/2"
 - c) (Pipe Size, mm.:: 25; 32-75; 100-150; 200
 - d) Thickness, mm.:: 25; 40; 50; 65)
 - b. The insulation shall be formed between the pipe and jacket and shall be bonded to the carrier pipe surfaces.
- 4. Outer Casing
 - a. The outer casing pipe shall be high density polyethylene (HDPE) manufactured in accordance with ASTM D-1248. The minimum wall thickness shall be 150 mils. The jacket closures shall be a cylindrical form with a single longitudinal split and shall be the same thickness as the casing. Outer casing shall be oversized for expansion loops and legs to allow free movement of the carrier pipe.
- 5. Fittings
 - a. Fittings shall be factory assembled as specified above for carrier pipe including insulation and outer casing.

PART 3 - EXECUTION

3.1 EXCAVATION, TRENCHING AND BACKFILLING

- A. Excavation, trenching and backfilling shall be specified in Section 230500 COMMON WORK RESULTS FOR HVAC, except that sand shall be used for backfill materials for 6"(150mm) below, above and to the sides of the system.

3.2 INSTALLATION

- A. All materials shall be unloaded, stored and installed in accordance with the recommendations of the manufacturer to conform with the contract documents.
- B. Where pre-insulated piping passes through metal sleeves in walls and floors, the insulation and jacket system shall extend continuously through such sleeves.
- C. Open ends of pipe shall be capped during installation to keep dirt and other foreign material out of the system.
- D. Expansion loops and bends shall be provided in accordance with the system manufacturer's standard where shown on the drawings.
- E. Welded joints shall be fusion welded. Changes in direction of piping shall be made with welding fittings. Mitering or notching to form elbows and tees shall not be permitted.
- F. Joints between pipe sections and joints between conduit pipe and fittings shall be made in accordance with the manufacturer's written instructions. Joints shall include closure sleeve, insulation, and coatings or wrapping as applicable. Joint materials shall be the product of the system manufacturer and shall be the same product as specified for the system.
- G. The vapor barrier jacket shall have the vapor barrier extended continuously across all joints.
- H. Anchors and thrust blocks shall be installed in accordance with manufacturer's recommendations.

3.3 TESTING

- A. Prior to closure of field joints, the carrier pipe shall be hydrostatically tested at 1-1/2 times the system operating pressure or 150 psig (1035 kPa), whichever is greater, for a period of not less than 2 hours. No loss in pressure will be permitted. Any defective sections shall be replaced and any defective welds repaired. Systems shall be retested until systems are tight.
- B. Materials, equipment, and labor required to test the systems shall be the responsibility of the Contractor.

3.4 CERTIFICATION

- A. During the testing period, a factory representative of the system manufacturer shall be present to witness each test. If systems are tested in stages, the factory representative's presence shall be required at each stage.
- B. Prior to backfilling, a factory representative shall review the installation for deficiencies. Any deficiencies found shall be corrected by the Contractor. No backfilling shall occur until written certification of acceptable installation is provided by the manufacturer to the Architect.

- C. Prior to backfilling, a factory representative shall review and photograph all field joints in pipe and jacket. Photographs shall be made with a digital camera. Hard copies of the photographs and a copy of the digital file shall be submitted with the manufacturer's certification of acceptance.

END OF SECTION