

SECTION 20 01 00 – BASIC PLUMBING AND HVAC REQUIREMENTS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General Conditions and Division 01 Specification Sections, apply to this Section.
- B. Specifications throughout all Divisions of the Project Manual are directly applicable to this Section, and this Section is directly applicable to them.

1.02 SUMMARY

- A. Basic and supplemental requirements common to Fire Suppression, Plumbing and HVAC Work.

1.03 REFERENCE STANDARDS

- A. The latest published edition of a reference shall be applicable to this Project unless identified by a specific edition date.
- B. All reference amendments adopted prior to the effective date of this Contract shall be applicable to this Project.
- C. All materials, installation and workmanship shall comply with the applicable requirements and standards addressed within the Contract Documents.

1.04 DEFINITIONS

- A. These definitions are included to clarify the direction and intention of these Specifications. For further clarification, contact the Architect/Engineer.
 - 1. Concealed / Exposed: "Concealed" areas are those areas that cannot be seen by the building occupants. "Exposed" areas are all areas, which are exposed to view by the building occupants, including under counters, inside cabinets and closets, plus all mechanical rooms. "Exterior" areas are those that are outside the building exterior envelope and exposed to the outdoors.
 - 2. Furnish: The term "furnish" is used to mean "supply and deliver to the Project Site, ready for unloading, unpacking, assembly, installation, and similar operations.
 - 3. Install: The term "install" is used to describe operations at Project Site including the actual "unloading, unpacking, assembly, erection, placing, anchoring, applying, working to dimension, finishing, curing, protecting, cleaning, and similar operations.
 - 4. Provide: The term "provide" means "to furnish and install, complete and ready for the intended use.

1.05 QUALITY ASSURANCE

- A. Plumbing and HVAC systems shall be coordinated with other systems and trades to include but not be limited to: Electrical systems, fire alarm, security systems, transport systems, telephone and data systems.
- B. Verification of Dimensions: The Contractor shall be responsible for the coordination and proper relation of Contractor's Work to the building structure and to the Work of all trades. The Contractor shall visit the premises and become thoroughly familiar with all details of the Work and working conditions, to verify all dimensions in the field, and to advise the Architect/Engineer of any discrepancy before performing any Work. Adjustments to the Work required in order to facilitate a coordinated installation shall be made at no additional cost to the Owner or the Architect/Engineer.
- C. All dimensional information related to new structures shall be taken from the appropriate Drawings. All dimensional information related to existing facilities shall be taken from actual measurements made by the Contractor on the Site.
- D. The Drawings are subject to the requirements of Reference Standards, structural and architectural conditions. The Contractor shall carefully investigate structural and finish conditions and shall coordinate the separate trades in order to avoid interference between the various phases of Work. Work shall be organized and laid out so that it will be concealed in furred chases and suspended ceilings, etc., in finished portions of the building, unless specifically noted to be exposed. All exposed Work shall be installed parallel or perpendicular to the lines of the building unless otherwise noted.
- E. When the Drawings do not give exact details as to the elevation of pipe and ducts, the Contractor shall physically arrange the systems to fit in the space available at the elevations intended with proper grades for the functioning of the system involved. Piping and duct systems are generally intended to be installed true and square to the building construction, and located as high as possible against the structure in a neat and workmanlike manner. The Drawings do not show all required offsets, control lines, pilot lines and other location details. Work shall be concealed in all finished areas.
- F. Where core drilling of floor or wall penetrations is required, Work shall be performed in accordance with Division 03 Specifications. Where applicable Division 03 Specifications are not included in the Project, core drilling shall be in accordance with generally accepted standards, and be performed by licensed personnel where applicable.
- G. Certify in writing that neither the Contractor nor any of Contractor's subcontractors or suppliers will supply any materials that contain any asbestos in any form for this Project.

1.06 DELIVERY, STORAGE AND HANDLING

- A. All equipment, ductwork, and materials shall be delivered to the Project Site clean and sealed for protection.
- B. Take particular care not to damage the existing construction in performing Work. All finished floors, step treads and finished surfaces shall be covered to prevent any damage by workers or their tools and equipment during the construction of the Project.

- C. Equipment and materials shall be protected from rust and dust/debris both before and after installation. Any equipment or materials found in a rusty condition at the time of final inspection must be cleaned of rust and repainted as specified elsewhere in these Specifications.
- D. All material affected by weather shall be covered and protected to keep the material free from damage while material is being transported to the Site and while stored at the Project Site.
- E. During the execution of the Work, open ends of all piping and conduit, and all openings in equipment shall be closed when Work is not in progress, and shall be capped and sealed prior to completion of final connections, so as to prevent the entrance of foreign matter.
- F. All equipment shall be protected during the execution of the Work. All ductwork and equipment shall be sealed with heavy plastic and tape to prevent build-up of dust and debris.
- G. All ductwork and air handling equipment shall be wiped down with a damp cloth immediately before installation to ensure complete removal of accumulated dusts and foreign matter.
- H. All plumbing fixtures shall be protected and covered to prohibit usage. All drains shall be covered until placed in service to prevent the entrance of foreign matter.

PART 2 - PRODUCTS

2.01 GENERAL

- A. All materials shall meet or exceed all applicable referenced standards, federal, state and local requirements, and conform to codes and ordinances of authorities having jurisdiction.
- B. All equipment installed shall have local representation, local factory authorized service, and a local stock of repair parts.
- C. Responsibility for furnishing proper equipment and/or material and ensuring that equipment and/or material is installed as intended by the manufacturer, rests entirely upon the Contractor. Contractor shall request advice and supervisory assistance from the representative of specific manufacturers during the installation.
- D. All materials, unless otherwise specified, shall be new, free from all defects, suitable for the intended use and of the best quality of their respective kinds. Materials and equipment shall be installed in accordance with the manufacturer's recommendations and the best standard practice for the type of Work involved. All Work shall be executed by mechanics skilled in their respective trades, and the installations shall provide a neat, precise appearance. Materials and/or equipment damaged in shipment or otherwise damaged prior to installation shall not be repaired at the job Site but shall be replaced with new materials and/or equipment.
- E. Materials and equipment manufactured domestically are preferred when possible. Materials and equipment that are not available from a domestic manufacturer may be by a non-domestic manufacturer provided they fully comply with Contract Documents.
- F. Prevention of Rust: Standard factory finish will be acceptable on equipment specified by model number; otherwise, surfaces of ferrous metal shall be given a rust inhibiting coating.

2.02 NAMEPLATES

- A. Each major component of equipment shall have the manufacturer's name, address, and catalog number on a plate securely attached to the item of equipment. All data on nameplates shall be legible at the time of Final Inspection.
- B. Nameplates shall be black laminated rigid phenolic with white core. Nameplate minimum size shall be 1 inch high by 3 inches long with 3/16-inch-high engraved white letters.
- C. Nameplate Fasteners: Fasten nameplates to the front of equipment only by means of stainless steel self-tapping screws. Stick-ons or adhesives will not be allowed unless the NEMA enclosure rating is compromised, then only epoxy adhesive shall be used to attach nameplates.
- D. Nameplate Information: In general, the following information is to be provided for the types of electrical components or enclosures supplied with equipment.
 - 1. Individual Starters, Contactors, Disconnect Switches, and Similar Equipment: Identify the device, and voltage characteristics source and load served.

2.03 WALL, FLOOR AND CEILING PLATES (ESCUTCHEONS)

- A. Except as otherwise noted, provide stainless steel or chrome plated brass floor and ceiling plates around all pipes, ducts, conduits, etc., passing exposed through walls, floors or ceilings, in any spaces except underfloor and plenum spaces.
- B. Plates shall be sized to fit snugly against the outside of the pipe or against the insulation on lines that are insulated and positively secured to such pipe or insulation.
- C. For finished ceiling installation, secure escutcheons to ceiling with escutcheon fasteners.
- D. Plates will not be required for piping where pipe sleeves extend 3/4-inch or more above finished floor.
- E. Round and rectangular ducts shall have closure plates (not chrome plated) made to fit accurately at all floor, wall and ceiling penetrations.

2.04 ROOF PENETRATIONS AND FLASHING

- A. Pipe, conduit and duct sleeves, pitch pockets and flashings compatible with the roofing installation shall be provided and installed for all roof penetrations by a contractor qualified in such Work. Installation shall comply with the Contract Documents and with FM General Data Sheets 1-28, 1-29, 1-31 & 1-49 along with the FM approval guide.

PART 3 - EXECUTION

3.01 PREPARATION

- A. Cooperate with trades of adjacent, related or affected materials or operations, and with trades performing continuations of this Work in order to effect timely and accurate placing of Work and to coordinate, in proper and correct sequence, the Work of such trades.

- B. The size of equipment indicated on the Drawings is based on the dimensions of a particular manufacturer. While other manufacturers may be acceptable, it is the responsibility of the Contractor to determine that the equipment proposed will fit in the space. Fabrication Drawings shall be prepared when required by the Architect/Engineer or Owner to indicate a suitable arrangement.
- C. All equipment shall be installed in a manner to permit access to all surfaces. All valves, motors, drives, filters, and other accessory items shall be installed in a position to allow removal for service without disassembly of another part.
- D. Space Requirements:
 - 1. Consider space limitations imposed by contiguous Work in location of equipment and material. Do not provide equipment or material which is not suitable in this respect.
 - 2. Make changes in material and equipment locations of up to five (5) feet, to allow for field conditions prior to actual installation, and as directed by the Architect/Engineer at no additional cost to the Owner.
- E. Contractor shall note that the electrical design and Drawings are based on the equipment scheduled and indicated on the Drawings. Should any equipment be provided requiring changes to the electrical design, the required electrical changes shall be made at no cost to the Owner.
- F. Connections for equipment other than Divisions 22, 23:
 - 1. Rough-in and provide all gas, air, water, steam, sewer, etc. connections to all fixtures, equipment, machinery, etc., furnished by the Owner and/or other trades in accordance with detailed rough-in Drawings provided by the equipment suppliers, by actual measurements of the equipment connections, or as detailed.
 - 2. After the equipment is set in place, make all final connections and provide all required pipe, fittings, valves, traps, etc.
 - 3. Provide all backflow preventers and air gap fittings required, using approved devices. In each service line connected to an item of equipment or piece of machinery, provide a shutoff valve. On each drain not provided with a trap, provide a suitable trap.
 - 4. Provide all ductwork, transition pieces, etc., required for a complete installation of vent hoods, fume hoods, etc.

3.02 INSTALLATION

- A. Installation shall meet or exceed all applicable federal, state and local requirements, referenced standards and conform to codes and ordinances of authorities having jurisdiction.
- B. All installation shall be in accordance with manufacturer's published recommendations.
- C. Piping may be run exposed in rooms typically without ceilings such as mechanical rooms, janitor's closets, tight against pan soffits in exposed "tee" structures, or storage spaces, but only where necessary. Shutoff and isolation valves shall be easily accessible.

- D. All pipe, conduits, etc., shall be cut accurately to measurements established at the building and shall be worked into place without springing or forcing. All ducts, pipes and conduits run exposed in machinery and equipment rooms shall be installed parallel to the building lines, except that piping shall be sloped to obtain the proper pitch. Piping and ducts run in furred ceilings, etc., shall be similarly installed, except as otherwise shown. All pipe openings shall be kept closed until the systems are closed with final connections.
- E. Prior to the installation of any ceiling material, gypsum, plaster or acoustical board, the Contractor shall notify Owner's Project Manager so that arrangement can be made for an inspection of the above-ceiling area about to be "sealed" off. The Contractor shall provide written notification to the Owner at least five (5) calendar days prior to the inspection.
- F. Precedence of Materials:
1. The Specifications determine the nature and setting of materials and equipment. The Drawings establish quantities, dimensions and details.
 2. If interference is encountered, the following installation precedence of materials shall guide the Contractor to determine which trade shall be given the "Right of Way":
 - a. Building lines
 - b. Structural members
 - c. Structural support frames supporting ceiling equipment
 - d. Electric tracked vehicle system
 - e. Pneumatic trash and linen system
 - f. Pneumatic tube system
 - g. Soil and drain piping
 - h. Vent piping
 - i. Supply, return and outside air ductwork
 - j. Exhaust ductwork
 - k. HVAC water and steam piping
 - l. Condensate piping
 - m. Fire protection piping
 - n. Natural gas piping
 - o. Medical/Laboratory gases
 - p. Domestic water (cold and hot, softened, treated)
 - q. Refrigerant piping

r. Electrical conduit

3. Coordinate fire suppression, plumbing and HVAC systems with transport systems as required to maintain transport system right-of-way.

3.03 TESTING

- A. When any piece of mechanical equipment is operable and it is to the advantage of the Contractor to operate the equipment, Contractor may do so, provided that Contractor properly supervises the operation, and has the Owner's written permission to do so. The warranty period shall, however, not commence until such time as the equipment is operated for the beneficial use of the Owner, or date of Substantial Completion, whichever occurs first.
- B. Regardless of whether or not the equipment has or has not been operated, the Contractor shall properly clean the equipment, install clean filter media, properly adjust, and complete all deficiency list items before final acceptance by the Owner. The date of acceptance and performance certification will be the same date.
- C. Before the Work is accepted, an authorized representative of the manufacturer of the installed materials and/or equipment shall personally inspect the installation and operation of manufacturer's materials and/or equipment to determine that materials and/or equipment are properly installed and in proper operating order. The qualifications of the manufacturer's representative shall be appropriate to the technical requirements of the installation. The qualifications of the manufacturer's representative shall be submitted to the Owner for approval. The decision of the Owner concerning the appropriateness of the manufacturer's representative shall be final. Testing and checking shall be accomplished during the course of the Work where required by Work being concealed, and at the completion of the Work. In addition, the Contractor shall submit to the Architect/Engineer a signed statement from each manufacturer's representative certifying as follows: **"I certify that the materials and/or equipment listed below have been personally inspected by the undersigned authorized manufacturer's representative and is properly installed and operating in accordance with the manufacturer's recommendations."**
- D. Check inspections shall include piping, equipment, heating, air conditioning, insulation, ventilating equipment, controls, mechanical equipment and such other items hereinafter specified or specifically designated by the Architect/Engineer.
- E. The Contractor shall execute, at no additional cost to the Owner, any tests required by the Owner or the National Fire Protection Association, ASTM, etc. Standards listed. The Contractor shall provide all equipment, materials and labor for making such tests. The Owner will pay reasonable amounts of fuel and electrical energy costs for system tests. Fuel and electrical energy costs for system adjustment and tests, which follow Substantial Completion by the Owner, will be borne by the Owner.
- F. Notify the Owner's Project Manager and the Architect/Engineer in writing at least seven (7) calendar days prior to each test and prior to other Specification requirements requiring Owner and Architect/Engineer to observe and/or approve tests.

- G. All tests shall have pertinent data logged by the Contractor at the time of testing. Data shall include date, time, personnel performing, observing and inspecting, description of the test and extent of system tested, test conditions, test results, specified results and other pertinent data. Data shall be delivered to the Architect/Engineer as specified under "Requirements for Final Acceptance." The Contractor or Contractor's authorized job superintendent shall legibly sign all Test Log entries.
- H. Refer to Commissioning Specification Sections for additional Start-up, prefunctional and operational checkout, and for functional performance test procedures.

3.04 TRAINING

- A. Operating and Maintenance Manuals and instruction shall be provided as specified under the Division 01 Section entitled "Project Closeout Procedures."
- B. Specific training and operating instructions for individual equipment components shall be as specified in the individual Specification Sections.

END OF SECTION 20 01 00

SECTION 20 07 19 – PIPING INSULATION

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General Conditions and Division 01 Specification Sections, apply to this Section.
- B. Specifications throughout all Divisions of the Project Manual are directly applicable to this Section, and this Section is directly applicable to them.

1.02 SUMMARY

- A. Perform all Work required to provide and install piping insulation, jackets and accessories indicated by the Contract Documents with supplementary items necessary for proper installation.

1.03 REFERENCE STANDARDS

- A. The latest published edition of a reference shall be applicable to this Project unless identified by a specific edition date.
- B. All reference amendments adopted prior to the effective date of this Contract shall be applicable to this Project.
- C. All materials, installation and Workmanship shall comply with the applicable requirements and standards addressed within the following references:
 - 1. ASTM B209 - Aluminum and Aluminum-Alloy Sheet and Plate.
 - 2. ASTM C168 - Terminology Relating to Thermal Insulation Materials.
 - 3. ASTM C177 - Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded- Hot-Plate Apparatus.
 - 4. ASTM C195 - Mineral Fiber Thermal Insulating Cement.
 - 5. ASTM C335 - Steady-State Heat Transfer Properties of Horizontal Pipe Insulation.
 - 6. ASTM C449 - Mineral Fiber Hydraulic-Setting Thermal Insulating and Finishing Cement.
 - 7. ASTM C518 - Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus.
 - 8. ASTM C534 - Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form.
 - 9. ASTM C547 - Mineral Fiber Pipe Insulation.
 - 10. ASTM C552 - Cellular Glass Thermal Insulation.

11. ASTM C578 - Rigid, Cellular Polystyrene Thermal Insulation.
12. ASTM C585 - Inner and Outer Diameters of Rigid Thermal Insulation for Nominal Sizes of Pipe and Tubing (NPS System).
13. ASTM C591 - Unfaced Preformed Rigid Cellular Polyisocyanurate Thermal Insulation.
14. ASTM C610 - Molded Expanded Perlite Block and Pipe Thermal Insulation.
15. ASTM C921 - Jackets for Thermal Insulation.
16. ASTM C1126 - Faced or Unfaced Rigid Cellular Phenolic Thermal Insulation.
17. ASTM D696 - Standard Test Method for Coefficient of Linear Thermal Expansion of Plastics Between -30°C and 30°C With a Vitreous Silica Dilatometer.
18. ASTM D1056 - Flexible Cellular Materials - Sponge or Expanded Rubber.
19. ASTM D1667 - Flexible Cellular Materials - Vinyl Chloride Polymers and Copolymers (Closed Cell Foam).
20. ASTM D2842 - Water Absorption of Rigid Cellular Plastics.
21. ASTM C795 - Insulation For Use Over Austenitic Steel.
22. ASTM E84 - Surface Burning Characteristics of Building Materials.
23. ASTM E96 - Water Vapor Transmission of Materials.
24. NFPA 255 - Surface Burning Characteristics of Building Materials.
25. UL 723 - Surface Burning Characteristics of Building Materials.
26. ASTM D5590 - Standard Test Method for Determining the Resistance of Paint Films and Related Coatings to Fungal Defacement by Accelerated Four-Week Agar Plate Assay

1.04 DEFINITIONS

- A. Concealed: Areas that cannot be seen by the building occupants.
- B. Interior Exposed: Areas that are exposed to view by the building occupants, including equipment rooms.
- C. Interior: Areas inside the building exterior envelope that are not exposed to the outdoors.
- D. Exterior: Areas outside the building exterior envelope that are exposed to the outdoors, including building crawl spaces and loading dock areas.

1.05 QUALITY ASSURANCE

- A. All piping requiring insulation shall be insulated as specified herein and as required for a complete system. In each case, the insulation shall be equivalent to that specified and materials applied and finished as described in these Specifications.

- B. All insulation, jacket, adhesives, mastics, sealers, etc., utilized in the fabrication of these systems shall meet NFPA for fire resistant ratings (maximum of 25 flame spread and 50 smoke developed ratings) and shall be approved by the insulation manufacturer for guaranteed performances when incorporated into their insulation system, unless a specific product is specified for a specific application and is stated as an exception to this requirement.
 - 1. Certificates to this effect shall be submitted along with Contractor's submittal data for this Section of the Specifications.
 - 2. No material shall be used that, when tested by the ASTM E84-89 test method, is found to melt, drip or delaminate to such a degree that the continuity of the flame front is destroyed, thereby resulting in an artificially low flame spread rating.
- C. Application Company Qualifications: Company performing the Work of this Section shall have minimum three (3) years experience specializing in the trade.
- D. All insulation shall be applied by mechanics skilled in this particular Work and regularly engaged in such occupation.
- E. All insulation shall be applied in strict accordance with these Specifications and with factory printed recommendations on items not herein mentioned. Unsightly, inadequate, or sloppy Work will not be acceptable.

1.06 SUBMITTALS

- A. Product Data:
 - 1. Provide product description, list of materials, "k" value, "R" value, mean temperature range, and thickness for each service and location.
 - 2. Samples: When requested, submit three (3) samples of any representative size illustrating each insulation type
- B. Operation and Maintenance Data:
 - 1. Indicate procedures that ensure acceptable standards will be achieved. Submit certificates to this effect.

1.07 DELIVERY, STORAGE AND HANDLING

- A. Deliver materials to the Project Site in original factory packaging, labeled with manufacturer's identification including product thermal ratings and thickness.
- B. Store insulation in original wrapping and protect from weather and construction traffic. Protect insulation against dirt, water, chemical, and mechanical damage.
- C. Maintain ambient temperatures and conditions required by manufacturers of adhesives, mastics and insulation cements.

PART 2 - PRODUCTS

2.01 GENERAL

- A. All materials shall meet or exceed all applicable referenced standards, federal, state and local requirements, and conform to codes and ordinances of authorities having jurisdiction.

2.02 MANUFACTURERS

A. Insulation:

1. Owens-Corning (Type P1).
2. Certainteed Corporation (Type P1).
3. Johns Manville Corporation (Type P1).
4. Knauf Corporation (Type P1).
5. Dow Chemical Company (Type P2).
6. Armstrong/Armacell (Armaflex) (Type P3).
7. RBX Industries/Rubatex (Type P3).
8. Industrial Insulation Group, LLC (Type P4).
9. Resolco International by (Insul-Phen) (Type P5).
10. KingSpan Tarec (Kooltherm 37-60) (Type P5C and P5D).
11. FOAMGLAS (Cellular Glass) by Pittsburgh Corning (Type P6).

B. Jackets:

1. Childers Products Company
2. PABCO
3. RPR Products, Inc.
4. Venture Clad Corporation
5. Foster Vapor Fas 62-05
6. Foamglas

C. Coatings, Sealants, and Adhesives:

1. Foster
2. Childers

2.03 INSULATION

- A. Type P1: Fiberglass preformed insulation; ASTM C 547; minimum 3.0 lb/cu ft density, ASTM C335, 'k' value of 0.23 at 75 degrees F; noncombustible.
- B. Type P2: Molded closed cell polyisocyanurate insulation; ASTM E96, maximum water vapor transmission rating of 0.005 Perm-In; ASTM C518, 'k' value of 0.20 at 75 degrees F; ASTM D2842, water absorption value of 0.05 lb/ft².
- C. Type P3: Closed cell elastomeric, flexible, insulation; ASTM E96; maximum vapor transmission rating of 0.20 perms; ASTM C 518; 'k' value of 0.27 at 75 degrees F.
- D. Type P4: Mineral Wool; ASTM C 547; preformed, high temperature insulation; 'k' value of 0.35 at 300 degrees F.
- E. Type P5: Phenolic closed cell, ASTM C1126 rigid foam, 2.2 lbs. nominal density, CFC free; ASTM C518, 'k' value of 0.13 at 75 degrees F. (Note material thickness limit is 3 inches as tested in accordance with ASTM E84).
- F. Type P5A: Phenolic closed cell insulation; ASTM E96, maximum water vapor transmission rating of 0.02 Perm-In; ASTM C1126 rigid foam, 3.75 lbs. nominal density, CFC free; ASTM C518, 'k' value of 0.16 at 75 degrees F. (Note material thickness limit is 3 inches as tested in accordance with ASTM E84).
- G. Type P5B: Phenolic closed cell insulation; ASTM E96, maximum water vapor transmission rating of 0.02 Perm-In; ASTM C1126 rigid foam, 5.0 lbs. nominal density, CFC free; ASTM C518, 'k' value of 0.21 at 75 degrees F. (Note material thickness limit is 3 inches as tested in accordance with ASTM E84).
- H. Type P5C: Phenolic closed cell insulation; ASTM E96, maximum water vapor transmission rating of 0.01 Perm-In; ASTM C1126 rigid foam, 2.3 lbs/cu.ft. nominal density, CFC free; ASTM C518, 'k' value of .146 Btu·in/hr·ft²·°F at 77 degrees F.
- I. Type P5D: Phenolic closed cell insulation; ASTM E96, maximum water vapor transmission rating of 0.01 Perm-In; ASTM C1126 rigid foam, 3.75 lbs/cu.ft. nominal density, CFC free; ASTM C518, 'k' value of .20 Btu·in/hr·ft²·°F at 77 degrees F
- J. Type P6: Cellular Glass, ASTM C552, 7.5 lbs./cu.ft, density, ASTM E96 (Wet Cup Method) 0.00 water vapor perm , ASTM C518 'k' value of 0.29 at 75 degrees F.

2.04 JACKETS

- A. Factory Applied Jackets:
 - 1. White kraft bonded to reinforced foil vapor barrier with self-sealing adhesive joints.
 - 2. ASJ White, triple-ply laminate polypropylene, mold resistant, metalized polyester vapor barrier film backing: Venture 1555U or Insulrap 30 Vapor Barrier I-30.
- B. Field Applied Jackets:

1. PVC Jackets: UL listed 25/50 rated per ASTM E 84, UV resistant, minimum insulation thickness 0.020 inches for pipe outside diameters up to 18 inches and 0.030 inches for pipe outside diameters 18 inches and above. Standard manufactured PVC cover fittings cover system consisting of one-piece, pre-molded, PVC covers with fiberglass inserts manufactured from 20-mils thick, high-impact, ultraviolet-resistant. Use ultraviolet resistant adhesive as recommended by the manufacturer.
2. Reinforcing Mesh: Glass Fiber Childers Chil-Glas #10 or synthetic 9X8 mesh with minimum weight of 0.9 ounces per square yard.
3. Aluminum Jackets: ASTM B 209; 0.020 inch thick; smooth finish with factory applied moisture barrier.
4. Stainless Steel Jackets: Type 304 stainless steel; 0.010 inch thick; smooth finish.
5. VentureClad 1577CW or Foster Vapor Fas 62-05, zero permeability and mold resistant jacket material, 5-ply laminate with 5-6 mil film with adhesive on one side. Jacketing laminated film must have UV coating for additional exterior protection. Product shall be used with phenolic closed cell insulation where Type 5A and 5B insulation is installed on existing chilled water piping being repaired or being modified.

2.05 COATINGS, SEALANTS, AND ADHESIVES

- A. Insulating Cement: ASTM C 195; hydraulic setting mineral wool; Ryder One-Coat.
- B. Sealants: Foster 95-50; Childers CP-70 or CP-76
 1. Apply at valves, fittings and where insulation is terminated. Brush-apply sealant to end of insulation and continue along pipe surface.
 2. Below-ambient closed cell pipe insulation (Type P5, P5A, P5B): apply sealant on all longitudinal and butt insulation joints to prevent moisture transmission.
- C. Adhesives: Use to adhere the longitudinal lap seam of vapor barrier jackets and at butt joints between insulation or fitting covers. Provide Childers CP-82 or Foster 85-20/85-60 as general purpose adhesive. For use with calcium silicate or expanded perlite insulation, use Childers CP-97 or Foster 81-27 fibrous adhesive when adhering pipe saddles and shields to the insulation.
- D. Primers: For proper bonding with lagging adhesive/canvas provide light coat of Childers CP-50 AMV1 or Foster 30-36 diluted 50 percent with water over insulation or Pittcoat 300 primer thinned with mineral spirits to cover insulating cements prior to finish coating.
- E. Coatings and Mastics:
 1. Vapor barrier coating for indoor, below-ambient applications: Foster 30-80 or Childers CP-38 on all elbows, fittings, and valves. Coating shall adhere to MIL-C-19565C, Type II and shall be QPL listed.
 2. Weather barrier/breather mastics for above-ambient piping applications: Childers CP-10/CP-11 or Foster 46-50.

3. High humidity applications: Foster 30-80 AF or Childers CP-137 AF fungus/mold resistant coating that meets ASTM D 5590 with zero growth rating.
4. Exterior applications: Childers CP 30LO (must be covered by metal jacketing), Childers CP-45 Encacel V, or Foster 60-95 Monolar for insulated elbows/fittings, longitudinal seams, and butt joints of vapor barrier jackets or glass cloth jackets.
5. Finish coat over closed cell elastomeric: Foster 30-64 or Armstrong "Finish" acrylic finish.
6. Canvas Finishes:
 - a. Apply lagging adhesive to prevent mildew for securing canvas. Apply anti-fungal lagging adhesive that adheres to ASTM D 5590 with zero growth rating. (Foster 30-36AF, Childers CP-137AF) Do not use wheat paste.
 - b. Exterior Applications: cover all canvas insulation with a fire-retardant weather barrier mastic. On canvas jacketed systems where seam joints at fittings are rough, cover with an application of insulating cement and smooth with a trowel before the canvas is applied with adhesive. Canvas shall be free of wrinkles and have a smooth, neat appearance.
- F. Reinforcing Mesh: Childers Chil-Glas #10 or Foster Mast-a-Fab 9x8 reinforcing mesh with coatings and mastics.
- G. Lagging Adhesives/Coatings: Childers CP-50A HV2 or Foster 30-36 for adhering canvas and glass cloths over thermal insulation installed indoors. Adhesive shall adhere to MIL-A-3316C Class I, Grade A.
 - a. High humidity applications (unconditioned space): Foster 30-36 AF or Childers CP-137 AF fungus/mold resistant coating that meets ASTM D 5590 with zero growth rating. Coating shall adhere to MIL-C-19565C, Type II and must be QPL listed.

2.06 APPLICATIONS

- A. Interior Exposed Applications (Equipment Rooms):
 1. Type P1 and P2 Insulation: Factory applied ASJ white kraft foil vapor barrier. Finish with canvas jacket or Childers Chil-Glas #10 glass membrane with Childers CP-50A HV2 or Foster 30-36. Verify jacket is suitable for applications.
 - a. High humidity applications (unconditioned space): Foster 30-36 AF or Childers CP-137 AF fungus/mold resistant coating. Finish coat is not required.
 2. Type P3 Insulation: Finish coat is not required.
 3. Type P4 Insulation: Lightly coat insulation with lagging adhesive diluted 50% with water for proper bonding with canvas/lagging adhesive. Cover with a canvas jacket and non-diluted Childers CP-50A HV2 or Foster 30-60 lagging adhesive.
 - a. High humidity applications (unconditioned space): Foster 30-36 AF or Childers CP-137 AF fungus/mold resistant coating. Finish coat is not required.
 4. Type P5 Insulation: Factory applied ASJ white kraft foil vapor barrier.

5. Type P5 and P5A Insulation: VentureClad jacket on piping where condensation can occur or where installed on existing chilled water piping, chilled water condensate drain piping, and roof storm drain piping that transports cold rain water from the building roof.
 6. Type P6 Insulation: Provide triple-ply laminate polypropylene, mold resistant with a metal foil and polyester vapor barrier film backing.
 - a. Below-ambient piping: Coat all ASJ seams with Foster 30-80 or Childers CP-38 vapor barrier coating. Coat all elbows, fittings, and valves with same vapor barrier coating and Foster Mast-a-Fab or Childers Chil-Glas #10 reinforcing mesh.
 - b. Above-ambient piping: Provide Pittcoat 404, Foster 46-50, or Childers CP-10/11 or pre-molded PVC covers per manufacturer's recommendations.
 - c. High humidity applications (unconditioned space): Foster 30-36 AF or Childers CP-137 AF fungus/mold resistant coating.
 7. All exposed insulated piping within six (6) feet of the floor shall be protected with aluminum or stainless steel jacket to protect insulation from being torn or punctured.
- B. Exterior Applications:
1. Insulate piping system as indicated under Interior Exposed Applications, prior to final jacket installation.
 2. Provide electric heat tracing for all exterior small bore piping 2 inches and smaller where water may be susceptible to freezing due to intermittent flow conditions.
 3. Final jacket cover shall be aluminum or stainless steel having integral moisture barrier with seams located at 2 or 10 o'clock position of horizontal piping. All laps shall be minimum 2 inches. Apply Foster 95-44 or Childers CP-76 metal jacketing sealant on all laps to prevent water transmission.
 4. Type P1 Insulation: For above-ambient piping, finish with Childers Chil-Glas #10 or 9X8 reinforcing mesh and Childers CP-10/CP-11, or Foster 46-50 weather barrier/breather mastic, prior to final jacket installation.
 5. P6 Insulation Above-ground: Provide (50 mil thickness) self-sealing non-metallic, bituminous compound reinforced with glass fiber membrane with 1 mil aluminum top film jacketing for both chilled water and hot water piping (PITWRAP CW Plus). Provide metal jacket where material is exposed to ultraviolet rays.
 6. P6 Insulation Underground: Provide factory applied (50 mil thicknesses) self-sealing membrane bituminous compound reinforced with glass fiber for chilled water piping (PITWRAP IW 50 or Foster C.I. Wrap 50mil). Metal jacket not required for buried pipe.

2.07 INSERTS, SUPPORTS AND SHIELDS

- A. Application: Piping ½ inch diameter or larger for all systems except direct buried.

- B. Shields shall be made of galvanized steel or made of black iron painted on both sides with a minimum two coats of aluminum paint. Minimum metal shield sizes shall be as listed within the following table. Provide thicker/longer shields where recommended by insulation manufacturer's published product installation data:

Nominal IPS (inches)	Minimum Metal Thickness (gage)	Minimum Length (inches)
1/2 to 1 1/4	18	12
1 1/2 to 2	16	12
2 1/2 to 8	14	18
10	12	24

- C. Provide MSS SP-58, Type 39 protection saddles, if insulation without vapor barrier is indicated. Install MSS SP-58, Type 40 protective shields on cold piping with vapor barrier.
- D. Inserts for shields shall be manufactured of 7.5 lb/cu. ft. density cellular glass or 5.0 lb/cu. ft. density cellular, phenolic insulating material suitable for the planned temperature range. Provide factory fabricated inserts with integral galvanized pipe saddles. Inserts shall be the same thickness as the adjacent insulation.
- E. Depending on the type of pipe support design, stainless steel bands or aluminum bands may be required to keep shield material next to the jacketing material.
1. Insulation Bands: 3/4 inch wide; 0.007 inch thick galvanized steel when exposed to interior environment, 0.010 inch thick stainless steel or 0.015 inch thick aluminum when exposed to humid interior environment or outside environment.
 2. Metal Jacket Bands: 3/8 inch wide; 0.015 inch thick aluminum or 0.010 inch thick stainless steel to match jacket.

PART 3 - EXECUTION

3.01 PREPARATION

- A. Verify that piping has been inspected at the welds and pressure tested before applying paint and insulation materials.
- B. Thoroughly clean all surfaces to be insulated as required to remove all oil, grease, loose scale, rust, and foreign matter. Piping shall be completely dry at the time of application of primer paint. Painting on piping where condensation is occurring on the pipe surface is strictly prohibited.
- C. Provide primer coat on all steel piping field welds. Painting shall be completed and approved prior to installation of insulation. Paint shall be applied in accordance with the paint manufacturer's instructions, environment, and pipe surface temperatures.

3.02 INSTALLATION

- A. Installation shall meet or exceed all applicable federal, state and local requirements, referenced standards and conform to codes and ordinances of authorities having jurisdiction.

- B. Installation of insulation and jacket materials shall be in accordance with manufacturer's published instructions.
- C. Handle and install materials in accordance with manufacturer's instructions in the absence of specific instructions herein.
- D. On exposed piping, locate insulation cover seams with the ridge of the lap joint is directed down.
- E. Exposed Insulated piping within six feet of the floor shall be protected with an aluminum or stainless jacket material to protect the insulation.
- F. Insulate fittings, joints and valves with molded insulation of the same material and thickness as adjoining pipe. Open voids and cracks insulation shall be kept at a minimum when placing insulation on abnormal or irregular shapes. Use closed cell or recommended fill material as instructed by the insulation manufacturer to close openings. Fiberglass insulation shall not be used as a fill material on chilled water piping or fittings. Vapor seal all cold piping ASJ seams and elbows/fittings with vapor barrier coating and reinforcing mesh.
- G. Continue insulation through walls, sleeves, pipe hangers, floors, and other pipe penetrations.
- H. Provide dams in insulation at intervals not to exceed 20 feet on cold piping systems to prevent migration of condensation or fluid leaks. Indicate visually where the dams are located for maintenance personnel to identify and also provide dams at butt joints of insulation at fittings, flanges, valves, and hangers.
- I. Where insulation is required, insulate entire system including fittings, valves, flanges and strainers. Use closed cell insulation on cold piping system flexible connections, expansion joints and unions, bevel and seal ends of insulation and continue sealant or coating a minimum of 4 inches along the piping, unless stated otherwise. On all closed-cell insulation, cold piping, use insulation joint sealant on all longitudinal and butt joints
- J. For hot piping conveying fluids 180 degrees F or less, do not insulate flanges and unions at equipment, but bevel and seal ends of insulation. Continue sealant or coating a minimum of 4 inches along the piping.
- K. On heating piping systems conveying fluids over 180 degrees F with unions, flanges, valves, strainers and equipment that are anticipated to be removed for maintenance, the insulation shall terminate (beveled to pipe) just prior to the flange or union with vapor barrier sealed to pipe. The tapered segment of insulation shall not interfere with the removal of unions flange bolts or equipment. The unions, flanges, valves and strainers shall be insulated with removable insulated covers with toggle catches or Velcro straps
- L. All sections of molded pipe covering shall be firmly butted together. Where an insulation covering is applied, it shall lap the adjoining section of insulation by at least three inches (3 inches). Where insulation terminates, it shall be neatly beveled and finished. All materials used shall be fire retardant or nonflammable.
- M. Where vapor barriers are required, the vapor barrier shall be on the outside. Extreme care shall be taken that the vapor barrier is unbroken. Joints, etc., shall be sealed with vapor barrier coating. Where insulation with a vapor barrier terminates, seal off with vapor barrier continuous to the surface being insulated. Ends shall not be left raw.

- N. Where pipe chases are tight, adequate provision shall be made at the rough-in stage using offset fittings or other means (except springing the pipe) to ensure that insulation can be applied throughout the length of the pipe.
- O. When installing phenolic insulation provide a 5 lb. density insert of same thickness and contour as adjoining 3.75 lb. density insulation, between the support shield and piping, and under the finish jacket, on piping 1½ inch diameter or larger, to prevent insulation from sagging at support points. Provide inserts for 180-degree arc and not less than 2 inches more than the length of the pipe support shield or minimum 12 inches long (whichever is greater). Pipe support shield shall be adhered to insulation with a UL approved adhesive that meets E-84 requirements.
- P. Seal all insulation at supports, protrusions and interruptions. Maintain vapor barrier with finish coat.
- Q. Shields:
 - 1. Install between pipe hangers or pipe hanger rolls and inserts. Curved metal shields shall be used between the hangers or support points and at the bottom of insulated pipe.
 - 2. Hangers shall support the load of the insulated pipe section on the outside of the insulation and shall not be in direct contact with the pipe.
 - 3. Manufacturer shall be responsible to size the length of shield required to prevent insulation from breaking.
 - 4. Provide rigid insulation at each support point, a minimum of 2 inches longer than shield length.
 - 5. Curved metal shields shall be designed to limit the bearing stress on the insulation to 35 psi and shall be curved to fit up to mid-perimeter of the insulated pipe.

3.03 PIPING INSULATION APPLICATION AND THICKNESS SCHEDULE

- A. In no case shall installed piping insulation have insulation thicknesses that are less than what is required by local energy codes and ASHRAE 90.1 (whichever is more stringent), based on comparable insulation conductivity values at the specified mean rating temperature.
- B. Type 5A and 5B insulation is only used where it is being replaced on existing pipe and thickness of the replacement insulation shall match the existing insulation thickness.

Piping Systems	Location	Type	Pipe Size	Insulation Thickness
Domestic Cold Water, Soft Water, Make-Up Water (NOTE: Insulation is not required where piping is exposed within equipment rooms.)	Interior Concealed	P1	1-1/2" & Smaller	1/2"
			2" to 4"	1/2"
			6" & Larger	1/2"
	Interior Exposed	P5	1-1/2" & Smaller	3/4"
			2" to 4"	3/4"
			6" & Larger	1"
Interior	P6	1-1/2" & Smaller	1"	

Piping Systems	Location	Type	Pipe Size	Insulation Thickness
Domestic Cold Water, Soft Water, Make-Up Water	Exposed		2" to 4	1"
			6" & Larger	1-1/2"
	Exterior	P5	All Sizes	1"
		P6	4" & Smaller	1"
	6" & Larger		1-1/2"	
Domestic Hot Water, Tempered Water (Maximum 200 Degrees F)	Interior Concealed	P1	2" & Smaller	1"
			2-1/2" & Larger	1-1/2"
	Interior Exposed	P5	1-1/2" & Smaller	3/4"
			2" to 4"	1"
		P6	6" & Larger	1-1/2"
			4" & Smaller	1"
		6" & Larger	1-1/2"	
	Exterior	P5	All Sizes	1-1/2"
P6		All Sizes	1-1/2"	
Fire Protection Water (40 Degrees F – Nominal)	Exterior	P5	4" and Smaller	3/4"
			6" and Larger	1"
		P6	4" and Smaller	1-1/2"
			6" and Larger	3
Underside of all Roof / Overflow Drain Bodies and related horizontal roof drain lines to vertical leader	Interior Exposed	P5	2" to 4"	3/4"
			6" and Larger	1"
		P6	2" to 4"	1"
			6" and Larger	1-1/2"
	Interior Concealed	P1	2" to 4"	1/2"
			6" and Larger	1/2"
Floor Drain Bodies and related horizontal Sanitary Drain Lines above floor that receive cold condensate drainage.	Interior Exposed	P5	2" to 4"	3/4"
			6" and Larger	1"
		P6	2" to 4"	1"
			6" and Larger	1-1/2"
	Interior Concealed	P1	2" to 4"	1/2"
			6" and Larger	1/2"
Cold Condensate Drain Lines	Interior	P5	All Sizes	3/4"
			P6	4" and Smaller
				6" & Larger
		Interior Concealed	P3	All Sizes
	P6		All Sizes	1"
	Building Heating Hot Water (Maximum 160 Degrees F)	Interior Exposed	P5	2-1/2" and Smaller
3" and Larger				1-1/2"
P5			2-1/2" and Smaller	1-1/2"
			3" and Larger	3"

Piping Systems	Location	Type	Pipe Size	Insulation Thickness
Building Heating Hot Water (Maximum 160 Degrees F)	Interior Concealed Interior Concealed	P1	2-1/2" and Smaller	1-1/2"
			3" and Larger	2-1/2"
		P5	2-1/2" and Smaller	1"
			3" and Larger	1-1/2"
	P6	2-1/2" and Smaller	1-1/2"	
		3" and Larger	2"	
	Exterior	P2	2-1/2" and Smaller	1"
			3" and Larger	1-1/2"
P5	2-1/2" and Smaller	1-1/2"		
	3" and Larger	2"		
Chilled Water (Includes Process Chilled Water)	Interior	P6	4" and Smaller	1-1/2"
			6" and Larger	2"
	Exterior	P6	4" and Smaller	2"
			6" and Larger	3-1/2"
Refrigerant Suction Piping (35 Degrees F – Nominal)	All	P3	2-1/2" and Smaller	3/4"
Non Tempered Domestic Hot Water (Maximum 180 Degrees F)	All	P1	1" and Smaller	1"
			1-1/2" to 2-1/2"	1-1/2"
			3" to 6"	2"
			8" and Larger	2-1/2"
Engine Exhaust	All	P4	Less than 1"	2-1/2"
			1" to 3"	3"
			4" and Larger	4"
Low Pressure Steam, Boiler Feedwater, Steam Condensate Return, Compresses Air Discharge, Boiler Blowdown (201 Degrees F to 250 Degrees F)	All	P1	2-1/2" and Smaller	2"
			3" to 6"	3"
			8" and Larger	3-1/2"
		P4	Less than 1-1/2"	1-1/2"
1-1/2" & Larger	2"			
Medium Temp. Hot Water and Steam (251 Degrees F to 350 Degrees F)	All	P4	Less than 1"	1-1/2"
			1" to 1-1/2"	2-1/2"
			1-1/2" and Larger	3"
High Temp. Hot Water (351 Degrees F to 400 Degrees F) and Steam (351 Degrees F to 600 Degrees F)	All	P4	Less than 1"	2-1/2"
			1" to 4"	3"
			4" and Larger	4"
Brine Systems, Cryogenics (Minus 30 Degrees F to 0 Degrees F)	All	P5	3" and Smaller	2"
			4" and Larger	3"
		P6	4" and Smaller	2-1/2"
			6" and Larger	4"
Brine Systems, Cryogenics (0 Degrees F to 34 Degrees F) Brine Systems, Cryogenics	All	P5	4" and Smaller	1"
			6" and Larger	1-1/2"
		P6	4" and Smaller	1-1/2"

Piping Systems	Location	Type	Pipe Size	Insulation Thickness
(0 Degrees F to 34 Degrees F)			6" and Larger	2"

END OF SECTION 20 07 19

SECTION 23 22 13 – STEAM AND STEAM CONDENSATE PIPING

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General Conditions and Division 01 Specification Sections, apply to this Section.
- B. Specifications throughout all Divisions of the Project Manual are directly applicable to this Section, and this Section is directly applicable to them.

1.02 SUMMARY

- A. Perform all Work required to provide and install steam and condensate pipe, valves and fittings indicated by the Contract Documents with supplementary items necessary for the proper installation of the steam and condensate piping systems.

1.03 REFERENCE STANDARDS

- A. The latest published edition of a reference shall be applicable to this Project unless identified by a specific edition date.
- B. All reference amendments adopted prior to the effective date of this Contract shall be applicable to this Project.
- C. All materials, installation and workmanship shall comply with the applicable requirements and standards addressed within the following references and as noted in this Section:
 - 1. ANSI/ASME SEC 9 - Welding and Brazing Qualifications.
 - 2. ANSI/ASME SEC B31.9 - Building Services Piping.
 - 3. ANSI/AWS D10.12 – Guide for Welding Mild Steel Pipe.
 - 4. ASTM A234 – Pipe Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service.
 - 5. ASME B36.1 – Standardization of dimensions of welded and seamless wrought steel pipe for high or low temperatures and pressures.

1.04 QUALITY ASSURANCE

- A. Valve manufacturer's name and pressure rating shall be marked on valve body.
- B. All valves of the same type shall be provided from same manufacturer.
- C. All fittings of the same type (threaded or welding) shall be provided from same manufacturer.
- D. All flanges shall be from same manufacturer.

- E. Welding Materials and Procedures: Conform to Chapter V, ANSI/ASME SEC B31.9 and applicable state labor regulations.
- F. Welders Certification: In accordance with ANSI/AWS D10.12.

1.05 SUBMITTALS

A. Product Data:

- 1. Include data on pipe materials, pipe fittings, valves, and accessories.

B. Record Documents:

- 1. Include welder's certification of compliance with ANSI/AWS D10.12 and ANSI/ASME B31.9.
- 2. Submittal data for all fittings and flanges shall include a letter signed by an official of the manufacturing company certifying compliance with these Specifications.

PART 2 - PRODUCTS

2.01 GENERAL

- A. All materials shall meet or exceed all applicable referenced standards, federal, state and local requirements, and conform to codes and ordinances of authorities having jurisdiction.
- B. Wall, Floor and Ceiling Plates:
 - 1. Provide chrome-plated brass floor and ceiling plates.
- C. Piping System Classification:
 - 1. Piping systems designed for steam pressure below 25 psig are low-pressure steam systems. Piping systems designed for steam pressures from 25 psig up to and including 125 psig are medium-pressure steam. Systems 126 psig and above are high-pressure steam.
 - 2. Distribution piping complying with Thermal Energy Cooperative (TECO) requirements is considered high-pressure steam.
- D. Piping Materials:
 - 1. Sizes as scheduled and shown on the Drawings are nominal pipe sizes unless otherwise indicated.
 - 2. All pipe and fittings shall be manufactured by a domestic company.
 - 3. All brass and bronze piping components shall have no more than 15 percent zinc content.

E. Threaded Fittings:

1. All threaded fittings shall be USA factory made wrought carbon or alloy steel threaded fittings conforming to ASTM A234 or malleable iron threaded fittings conforming to ASME/ANSI B16.3.
2. Manufacturers: Grinnell, Tube Turn, Weld Bend Hackney, Taylor Forge, Ladish Company.
3. Each fitting shall be stamped as specified by ANSI B16.3.

F. Welded Fittings:

1. All weld fittings shall be USA factory made wrought carbon steel, butt welded fittings conforming to ASTM A234 or ASME B16.9.
2. Manufacturers: Grinnell, Tube Turn, Weld Burn Hackney, Taylor Forge, Ladish Company.
3. Each fitting shall be stamped as specified by ANSI B31.9.

G. Flanges:

1. All 150 lb. and 300 lb. ANSI flanges shall be weld neck and shall be domestically manufactured, forged carbon steel, conforming to ANSI B16.5 and ASTM A1-191 Grade I or II or A-105 as made by Tube Turn, Hackney or Ladish Company. Slip on flanges shall not be used. Complete test reports may be required for any fitting selected at random.
2. Flanges shall have the manufacturer's trademark permanently identified in accordance with MSS SP-25.
3. Bolts used shall be carbon steel bolts with semi-finished hexagon nuts of American Standard Heavy dimensions. All-thread rods are not an acceptable substitute for flange bolts. Bolts shall have a tensile strength of 60,000 psi and an elastic limit of 30,000 psi.
4. All flanges shall have gaskets. Place gasket between flanges of flanged joints. Gaskets shall fit within the bolt circle on raised face flanges and shall be full face on flat face flanges.

H. Gaskets:

1. Gaskets shall be placed between the flanges of all flange joints. Such gaskets shall be ring form gaskets fitting within the bolt circle of their respective flanges.
2. All gaskets used on steam system shall be Flexitallic Style CG, AP1061 spiral wound 30455 with Grafoil fill as manufactured by Garlock or approved equal, regardless of pipe size and pressure.
3. The inside diameter of such gaskets shall conform to the nominal pipe size and the outside diameter shall be such that the gasket extends outward to the studs or bolts employed in the flanged joint.

2.02 PIPE

A. High Pressure Steam and Trapped Condensate Piping:

1. Pipe 2 inches and smaller: Carbon steel, ASTM A53, Grade B, seamless, Schedule 80.
 - a. Fittings: Forged steel, ASTM A105, socket weld, 300 lb.
 - b. Joints: Socket weld.
 - c. Unions: Forged steel, ASTM A105, socket weld, 3000 lb., stainless steel seats.
 - d. Gaskets: Flexitallic Style CG, API 601 spiral wound 304SS with Grafoil Fill or accepted substitution.
 - e. Cathodic Protection Gaskets: 1/16 inch thick Sealon by Ameriflex. Specify OD and ID of pipe and flanges. Bolt holes to be ¼ inch oversized.
2. Pipe 2-1/2 inches and larger: Carbon steel, ASTM A53, Grade B, seamless; standard weight for steam, and ERW schedule 80 for condensate.
 - a. Fittings: Carbon steel, ASTM A234 WPB, seamless welding fittings, standard weight for steam, Schedule 80 for condensate.
 - b. Joints: Butt weld.
 - c. Flanges: 300 lb., ANSI forged carbon steel, ASTM A181 Class 70, weld neck raised face.
 - d. Gaskets: Flexitallic Style CG, API 601 spiral wound 304SS with Grafoil Fill or accepted substitution.
 - e. Cathodic Protection Gaskets: 1/8 inch thick Sealon by Ameriflex. Specify OD and ID of pipe and flanges. Bolt holes to be ¼ inch oversized.

B. Medium Pressure Steam and Trapped Condensate Piping:

1. Pipe 2 inches and smaller: Carbon steel, ASTM A53, Grade B, seamless, Schedule 80.
 - a. Fittings: 125 lb., cast iron, screwed, conforming to ANSI B16.4. Thread-o-lets may be used when the branch line is 1/3 the main size or less.
 - b. Joints: Screwed.
 - c. Unions: Class 300 malleable iron.
2. Pipe 2-1/2 inches and larger: Carbon steel, ASTM A53, Grade B, seamless, standard weight for steam, and ERW schedule 80 for condensate.
 - a. Fittings: ASTM A234, Grade WPB, ANSI B16.9; butt welding type, standard weight for steam, Schedule 80 for trapped condensate. Thread-o-lets may be used when the branch line is one-third the main size or less.
 - b. Joints: Butt weld.

- c. Flanges: Class 150, ANSI B16.5, forged carbon steel, raised face. Materials in accord with ASTM A105, Grade II weld neck.

C. Low Pressure Steam and Trapped Condensate Piping:

1. Pipe 2 inches and smaller: Carbon steel, ASTM A53, Grade B seamless, Schedule 40 for steam, Schedule 80 for condensate.
 - a. Fittings: 125 pound black cast iron. Thread-o-lets may be used when the branch line is one-third the main size or less.
 - b. Joints: Threaded.
 - c. Unions: Class 300 malleable iron.
2. Pipe 2-1/2 inches and larger: Carbon steel, ASTM A53, Grade B, seamless, standard weight for steam, and ERW schedule 80 for condensate.
 - a. Fittings: Butt weld, conforming to ASTM A234, Grade WPB, ANSI B16.9, standard weight for steam, Schedule 80 for trapped condensate.
 - b. Joints: Butt weld.
 - c. Flanges: Class 150, ANSI B16.5, forged steel, raised face. Materials in accord with ASTM A105, Grade II, weld neck.

D. Condensate Piping (Building) – Return and Pumped Return:

1. All piping shall be ERW extra strong black steel piping.
2. Fittings on piping 2-1/2 inches and larger shall be extra heavy butt welding type. Flanges shall be 150 lb. welding neck type. Extra strong Weld-o-lets, Thread-o-lets or shaped nipples may be used only when takeoff is one-third or less nominal size of main.
3. Screwed fittings around traps and for piping 2 inches and smaller shall be 125 lb. black cast iron (300 lb. for unions).

E. Equipment Drain Piping:

1. All factory fabricated or field erected steam equipment or apparatus that require drains shall be connected with adequately sloped drain line routed to a floor drain.
2. All drain piping shall be one-inch minimum diameter or larger as indicated on the Drawings or required by equipment. Such piping shall be standard weight galvanized steel pipe with galvanized malleable iron screw tees at each change in direction; or Type K, hard drawn copper tubing with threaded joints and fittings.
3. Install screw plug in unused openings for access to rod and clean.

PART 3 - EXECUTION

3.01 PREPARATION

- A. Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.
- B. Remove scale and dirt on inside and outside before assembly. All piping shall be clean when it is installed. Before installation it shall be checked, upended, swabbed if necessary, and all rust or dirt from storage or from lying on the ground shall be removed.
- C. Prepare piping connections to equipment with flanges or unions.
- D. After completion, fill, clean and treat systems.

3.02 WELDING OF STEAM SYSTEM PIPING

- A. Steam and condensate piping and fittings shall be welded and fabricated in accordance with the latest edition of ASME/ANSI the latest editions of Standards B31.9 for all systems. Machine beveling in shop is preferred. Field beveling may be done by flame cutting to recognized standards.
- B. Ensure complete penetration of deposited metal with base metal. Provide filler metal suitable for use with base metal. Keep inside of fittings free from globules of weld metal. All welded pipe joints shall be made by the fusion welding process, employing a metallic arc or gas welding process. All pipe shall have the ends beveled 37-1/2 degrees and all joints shall be aligned true before welding. Except as specified otherwise, all changes in direction, intersection of lines, reduction in pipe size and the like shall be made with factory-fabricated welding fittings. Mitering of pipe to form elbows, notching of straight runs to form tees, or any similar construction is not permitted.
- C. Align piping and equipment so that no part is offset more than 1/16-inch. Set all fittings and joints square and true, and preserve alignment during welding operation. Use of alignment rods inside pipe is prohibited.
- D. No weld shall project into the pipe so as to restrict it. Tack welds, if used, must be of the same material and made by the same procedure as the completed weld. Otherwise, remove tack welds during welding operation.
- E. Remove all split, bent, flattened or otherwise damaged piping from the Project Site.
- F. Remove dirt, scale and other foreign matter from the inside of piping, by swabbing or flushing, prior to the connection of piping sections, fittings, valves or equipment.
- G. Schedule 40 pipe shall be welded with not less than three passes including one stringer/root, one filler and one lacer. Schedule 80 pipe shall be welded with not less than four passes including one stringer/root, two filler and one lacer. In all cases, however, the weld must be filled before the cap weld is added.

3.03 INSTALLATION

- A. Installation shall meet or exceed all applicable federal, state and local requirements, referenced standards and conform to codes and ordinances of authorities having jurisdiction.

- B. All installation shall be in accordance with manufacturer's published recommendations.
- C. Pipe Installation:
1. Direct connection of a steam exhaust, blowoff or drip pipe shall not be made with the building drainage system. Discharge into the building drainage system shall be at a temperature not higher than 140 degrees F. When higher temperatures exist, approved cooling methods shall be provided.
 2. All the various piping systems shall be made up straight and true and routed in an orderly manner, plumb and parallel to the building structure. Install piping to conserve building space. Coordinate location with other trades and do not interfere with use of space for other work.
 3. Piping shall follow as closely as possible the routes shown on Drawings, which take into consideration conditions to be met at the Project Site.
 4. Should any unforeseen conditions arise, lines shall be changed or rerouted after proper approval has been obtained.
 5. All piping shall be installed with due regard to expansion and contraction and to prevent excessive strain and stress in the piping, in connections, or in equipment to which the lines are connected.
 6. Group piping whenever practical at common elevations.
 7. Slope piping and arrange system to drain at low points. Use eccentric reducers to maintain bottom of pipe level.
 8. Where pipe support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc rich primer to welding.
 9. Provide clearance for installation of insulation, and access to valves and fittings.
 10. Prepare pipe, fittings, supports, and accessories for finish painting.
 11. Procedure of Assembling Screw Pipe Fittings:
 - a. All screw joints shall be made with taper threads, properly cut.
 - b. Joints shall be made tight with Teflon-based compound appropriate to the medium, material, and temperature range of the system. Teflon tape is not permitted.
 - c. Compound shall be applied to the pipe threads only and not to fittings.
 - d. When threads are cut on pipes, the ends shall be carefully reamed to remove any burrs.
 - e. Before installing pipe that has been cut and threaded, lengths of pipe shall be upended and hammered to remove all shavings and foreign material.

D. Valve Installation:

1. Locate all valves such that the removal of their bonnets is possible. All flanged valves shown in horizontal lines with the valve stem in a horizontal position shall be positioned so the valve stem is inclined one bolt hole above the horizontal position. Screw pattern valves placed in horizontal lines shall be installed with their valve stems at a minimum 30 degree angle above the horizontal position. All valves must be true and straight at the time the system is tested and inspected for final acceptance. Install valves as nearly as possible to the locations indicated in the Drawings. Any change in valve location must be so indicated on the Record Drawings.
2. Equipment, valves, expansion joints, relief devices, strainers, etc., must be removed or isolated during the test if the pressure/force ratings of the devices are not as high as that specified for the test. Piping shall be drained and protected any time ambient temperature is below freezing.
3. Where leaks occur, the pipe shall be repaired and the tests repeated. No leaks shall be corrected by peening. Defective piping and joints shall be removed and replaced.
4. Provide access where valves and fittings are not exposed. Coordinate size and location of access doors with architectural drawings.
5. At the end of one year, period spot checks will be made and should the valve packing show signs of hardening or causing stem corrosion, all valves supplied by the manufacturer shall be repacked by the Contractor, at no expense to the Owner, with a packing material selected by the Owner.

3.04 CLEANING AND FLUSHING OF STEAM SYSTEMS

A. General:

1. Thoroughly clean steam and condensate systems before placing into operation to rid systems of rust, dirt, piping compound, mill scale, oil, grease, any and all other material foreign to water being circulated.
2. Exercise extreme care during construction to prevent dirt and other foreign matter from entering pipe or other parts of systems. Pipe stored on the project shall have open ends capped and equipment shall have openings fully protected. Before erection, each piece of pipe, fitting, or valve shall be visually examined and dirt removed.
3. Chemicals, feeding devices and water technician services shall be furnished by a single reputable manufacturer who will be responsible for the complete cleaning and flushing of the systems. Provide only chemical products that are acceptable under State and local pollution control regulations.
4. Add a temporary line with drain and isolate the building steam and condensate piping from the campus/building distribution piping to allow for proper circulation and cleaning of new piping in the new or modified building system.

5. Clean systems with a chemical compound specifically formulated for the purpose of removing the above listed foreign matter. These chemicals shall be injected to the systems, circulated and completely flushed out. Repeat the process if required. After each flushing, remove and thoroughly clean all strainers.
6. Final connection shall not be made to the campus/building loop system until the Chemical Contractor has filed with the Owner's representatives, a report stating that the systems are clean.

B. MD ANDERSON Systems:

1. Clean piping systems thoroughly. Purge pipe of construction debris and contamination before placing the systems in service. Provide whatever temporary connections are required for cleaning, purging and circulating.
2. Install temporary strainers in front of pumps, tanks, water still, solenoid valves, control valves and other equipment where permanent strainers are not indicated. Where permanent strainers are indicated, assure that the strainers are installed and screens are in place and are cleaned. Keep temporary strainers in service until the equipment has been tested, then replace straining element with a new strainer and clean and deliver the old straining elements to Owner. Fit strainers with a line size blow-off valve.
3. Circulate a chemical cleaner in steam and condensate piping system to remove mill scale, grease, oil and silt. Circulate chemical cleaner for 48 hours, flush system and replace with clean water. Dispose of chemical solution in accordance with local codes. When the chemical cleaning is complete, remove, clean and reinstall all permanent screens. Notify Owner so that the reinstallation of clean strainer screens may be witnessed.

3.05 TESTING

A. Weldings:

1. All welds are subject to inspection, visual and/or x-ray, for compliance with Specifications. The Owner will, at the Owner's option, provide employees or employ a testing laboratory for the purposes of performing said inspections and/or x-ray testing. Initial visual and x-ray inspections will be provided by the Owner. Contractor shall be responsible for all labor, material and travel expenses involved in the re-inspection and retesting of any welds found to be unacceptable. In addition, Contractor shall be responsible for the costs involved in any and all additional testing required or recommended by ASME/ANSI Standards B31.9 and B31.3 due to the discovery of poor, unacceptable or rejected welds.
2. Welds lacking penetration, containing excessive porosity or cracks, or are found to be unacceptable for any reason, must be removed and replaced with an original quality weld as specified herein. All qualifying tests, welding and stress relieving procedures shall, moreover, be in accord with Standard Qualification for Welding Procedures, Welders and Welding Operators, Appendix A, Section 6 of the Code, current edition.

B. Pipe Pressure:

1. Equipment, valves, vents, expansion joints, pressure reducing stations, etc., must be removed or isolated from test pressure and/or forces if the devices are not rated for the test pressures. All water must be drained from all steam system piping and devices after test completion. Piping shall be drained and protected any time the ambient is below freezing.
2. The following lines shall be tested at the stated pressure for the length of time noted:

Line	Testing Medium	Testing Pressure (psig)	Time in Hours
Steam M.P. & L.P.	Water	150	24
Steam Condensate M.P.	Water	150	24
Steam Condensate H.P. Pumped	Water	150	24
Condensate Return	Water	150	24

3. Where leaks occur, repair pipe and repeat tests. No leaks shall be corrected by peening. Remove and replace defective piping and joints.

END OF SECTION 23 22 13

SECTION 23 22 30 – STEAM AND STEAM CONDENSATE SPECIALTIES

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. Specifications throughout all Divisions of the Project Manual are directly applicable to this Section, and this Section is directly applicable to them.

1.02 SUMMARY

- A. Perform all Work required to provide and install the following steam specialties indicated by the Contract Documents with supplementary items necessary for their proper installation.
 - 1. Blowdown separator.
 - 2. Drain after cooler.
 - 3. Temperature actuated water regulating valve.
 - 4. Exhaust head.

1.03 REFERENCE STANDARDS

- A. The latest published edition of a reference shall be applicable to this Project unless identified by a specific edition date.
- B. All reference amendments adopted prior to the effective date of this Contract shall be applicable to this Project.
- C. All materials, installation and workmanship shall comply with the applicable requirements and standards addressed within the following references:
 - 1. ASTM A105 - Forgings, Carbon Steel, for Piping Components.
 - 2. ASTM A216 - Steel Casings, Carbon, Suitable for Fusion Welding, for High Temperature Service.
 - 3. ASTM A395 - Ferritic Ductile Iron Pressure-Retaining Castings for Use at Elevated Temperatures.
 - 4. ASME B31.9 - Building Services Piping.

1.04 QUALITY ASSURANCE

- A. All specialties of the same type shall be provided from the same manufacturer.
- B. Manufacturer's name and pressure rating marked on body of each device.

1.05 SUBMITTALS

A. Product Data:

1. Submit Shop Drawings and product data on all steam specialties.

B. Record Documents:

1. Shop Drawing submittal of traps shall contain an itemized list with a tabulation of the load, trap type and trap size.

PART 2 - PRODUCTS

2.01 GENERAL

- A. All materials shall meet or exceed all applicable referenced standards, federal, state and local requirements, and conform to codes and ordinances of authorities having jurisdiction.

2.02 MANUFACTURERS

A. Blowdown Separator and Drain Aftercooler

1. Penn Separator.
2. Lattner.

B. Temperature Actuated Water Regulating Valve

1. Sterling.
2. Lattner.

C. Exhaust Head:

1. Factory Direct Pipeline Products
2. Eaton Filtration

2.03 BLOWDOWN SEPARATOR AND DRAIN AFTERCOOLER

- A. Boiler sight blow-down Separator 1" inlet, 2" drain, 2" vent, operating at 150 psig. The separator is to be 8" diameter and a Welded Carbon Steel Vessel Designed and "UM" Stamped to ASME code for 250 psig @ 450 Deg. F. Select a plate thickness 5/16", and National Board "U" Stamp as required for location of installation. Connections are threaded, type include a tangential inlet with stainless steel striking plate at point of impingement, a centrally located steam vent for clean quiet release of steam to atmosphere, and bottom drain fitted with a stainless steel spiral baffle. The exterior to be a shop primer finish. Furnish and install the separator with three angle legs for floor.
- B. Furnish and install as show on plans for automatic control of drain water temperature to 140 deg. F. An automatic aftercooler fitting model, a temperature regulator valve fitting sized for cooling water at (40) psig. Include a pressure reducing valve if required to limit cooling water pressure to a maximum 60 psig, strainer, and 2" dial bimetal thermometer.

2.04 TEMPERATURE ACTUATED WATER REGULATING VALVE

- A. Thermostatic cooling control valve to evenly regulate cooling water to cool condensate from blow-down tank. Valve shall be self-modulating, temperature actuated and self-powered.
- B. Control from 40° to 275°F (outlet to be less than 140°F).
- C. Sturdy brass alloy body and valve parts.
- D. Heavy duty, direct acting bellows.
- E. Buna-N seat disc.
- F. Replaceable seat beds.
- G. 125 PSI
- H. 100°F - 175°F temperature range (adjustable).
- I. 5/8" x 8-1/9" with 3/4" union connection temperature bulb.

2.05 EXHAUST HEAD

- A. Heads designed to separate entrained water from exhaust air prior to being discharged directly into the atmosphere. Designed to remove more than 99% of liquids and solids over 10 microns in size from the discharged flow.
- B. The moisture laden gas, air, steam enters at the inlet of the exhaust head where it is directed into a centrifugal upward motion.
- C. Cast iron.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Installation shall meet or exceed all applicable federal, state and local requirements, referenced standards and conform to codes and ordinances of authorities having jurisdiction.
- B. Install specialties in accordance with manufacturer's instructions.
- C. Blow-down separator to be installed on a three legged stand on floor.
- D. Coordinate the location with all steam piping and boiler appurtenances that require access.
- E. Install exhaust heads per City of Houston wind requirements.

END OF SECTION 23 22 30