



UNIVERSITY OF KENTUCKY Purchasing Division

INVITATION FOR BIDS

CCK-2483-20

ADDENDUM # 5

10/15/2020

ATTENTION: This is not an order. Read all instructions, terms and conditions carefully.

IMPORTANT: BID AND ADDENDUM MUST BE RECEIVED BY 10/22/2020 @ 3:00 P.M. LEXINGTON, KY TIME

Bidder must acknowledge receipt of this and any addendum as stated in the Invitation for Bids.

1. Please refer to and incorporate within the offer, the attached documents for Addendum #5.

OFFICIAL APPROVAL
UNIVERSITY OF KENTUCKY

Procurement Manager / (859) 323-5405

SIGNATURE

Typed or Printed Name

Addendum 005



Affiliated Engineers, Inc.

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CHICAGO, IL 60603
PHONE 312-977-2800

UK Construct Research Building #2 Phase 3 - Design Release 1 – Fit-Out		005	
Project	Lexington , KY	Addendum Number 15576-06	
Project Location	Champlin	AEI Project Number	
To		Client Project Number 10/15/2020	
		Date	
Bid Due Date		Page 1 of 1	
		Page	Typist

This addendum is issued to modify or interpret previously issued documents by additions, deletions, clarifications, or corrections. It forms a part of the previously issued documents.

This addendum may include revised pages and drawings, which shall be inserted before the corresponding page or drawings in the previously issued documents. Revised pages and drawings are identified by the corresponding addendum number and date

SPECIFICATIONS

23 2116 Pipe and Pipe Fittings

- Specification has been updated to clarify material for chilled and hot water piping. Piping larger than 2-1/2" up to 4" shall be copper piping with brazed joints. Steel pipe for sizes up to 4" is no longer allowed.

DRAWINGS

No Drawings are included as part of this Addendum

END OF ADDENDUM

SECTION 23 2116 PIPE AND PIPE FITTINGS

PART 1 - GENERAL

1.1 RELATED WORK

- A. Section 20 0529 - Mechanical Supporting Devices
- B. Section 23 0594 - Water Systems Test Adjust Balance
- C. Section 23 0902 - Control Valves and Damper (Valves)
- D. Section 23 0903 - Control Instrumentation (Wells, Taps or In-line Devices)
- E. Section 23 2118 - Valves
- F. Section 23 2120 - Piping Specialties

1.2 REFERENCE

- A. Work under this Section is subject to requirements of Contract Documents including General Conditions, Supplementary Conditions, and sections under Division 01 General Requirements.

1.3 DESCRIPTION

- A. This Section includes pipe and pipe fitting specifications and installation requirements for heating and cooling systems.
- B. Specification of an item in this or any other sections shall not relieve Contractor from providing all items, articles, materials, operations, methods, labor, equipment and incidentals necessary for a complete and functional system.
- C. Use only new material, free of defects, rust and scale, and guarantee for services intended.
- D. Use material meeting the latest revision of ASTM specifications as listed in this specification.
- E. Follow local codes if they require other types of pipe or joints.
- F. Use only long radius elbows having centerline radius of 1.5 pipe diameters unless otherwise indicated.
- G. Manufacturer, pressure class, size and heat code of each fitting and flange shall be permanently identified on its body in accordance with MSS SP-25.
- H. Where size for a pipe segment is not indicated, the pipe segment size shall be equal to the largest pipe segment to which it is connected. Transition to smaller size shall occur on the side of fitting where smaller size is indicated.
- I. Unless otherwise indicated, fittings and accessories connected to pipe shall be of the same material as the pipe.

- J. Unless otherwise indicated, construct piping for highest pressures and temperatures in respective system in accordance with the latest revision of the applicable Sections of ASME Code for pressure piping, ASME B31 including the following:
1. B31.9 Building Services Piping
 2. B31.9 Building Service Piping for building heating and distribution steam and condensate piping for 15 psig or less, or hot water heating system for 30 psig or less
 3. B31.1 Power Piping
 4. B31.3 Process Piping
- K. Non-metallic piping is acceptable only for services indicated. It is not acceptable in occupied spaces and ventilation plenum spaces.

1.4 SUBMITTALS

- A. Shop Drawings for each piping system for all pipe sizes including, but not limited to, the following:
1. Name of system
 2. Pipe; ASTM number, grade if known, type, wall thickness, material
 3. Fittings; ASME number, grade if known, class, type, wall thickness, material
 4. Joint type
 5. Flanges; ASTM number, grade, class, type, material
 6. Bolts and nuts; material
 7. Thread joint sealants; material
 8. Flange gaskets; material, rating
 9. Unions; ASTM number, type, material, rating
 10. Type of welding
 11. Welding Quality Control Program
 12. Test pressure and media
 13. Pipe flushing/cleaning plan
 14. Pipe cleaning method
 15. All other appropriate data
- B. Submit pipe certification as specified under Pipe Certification in this Section.
- C. Submit required documents as specified under Pipe Welding in this Section.
- D. Provide Flushing and Cleaning Plan:
1. Submit pipe flushing/cleaning plan for water, fluid, steam and condensate systems for approval. Plan shall detail methods for compliance with requirements of this section, including:
 - a. Flushing and cleaning procedure narratives.
 - b. Size, power source, and connection points of contractor provided pumps that will be used for flushing and cleaning.
 - c. If Contractor proposes to utilize project system pumps, method of protecting pumps from damage and developing required velocity of section of piping to be flushed.
 - d. Method of sectionalizing piping to obtain required velocity.
 - e. Minimum velocities at each section of pipe, clearly indicating any sections where 6 fps cannot be achieved.

- f. Location and means of temporary bypasses for coils, control valves and other equipment.
 - g. Flushing schedule and drawings or diagrams that will be used for inspection and sign off prior to and after procedure, at Owner's option.
2. Submit documents showing verification of flushing/cleaning following specified requirements and results.

E. LEED Submittal

1. Product Data for IEQ Credit 4.1: For solvent cements and adhesive primers, including printed statement of VOC content.

1.5 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. Furnish pipe with plastic end-caps/plugs on each end of pipe. Maintain end-caps/plugs through shipping, storage and handling to prevent pipe-end damage and eliminate dirt and construction debris from accumulating inside of pipe.
- B. Where possible, store materials inside and protect from weather. Where necessary to store outside, elevate well above grade and enclose with durable, waterproof wrapping.
- C. Before shipping, all carbon steel piping shall be free of rust and scale, and furnished with plastic end caps/plugs on each end of pipe.

1.6 PIPE WELDING

A. Procedure and Welding Qualification Records:

1. Submit Welding Procedure Specifications (WPSs) and their supporting Procedure Qualification Records (PQRs) to be used on the work to Engineer for review and approval prior to performing any welding. These documents shall meet requirements of ASME B31.1 and B31.9, as applicable.
2. Unless otherwise indicated, welding shall be done using only the following processes:
 - a. Shielded Metal Arc Welding (SMAW), also known as "stick" welding
 - b. Gas Tungsten Arc Welding (GTAW), also known as TIG and Heliarc welding
 - c. Gas Metal Arc Welding (GMAW), also known as MIG welding
 - d. Flux-Cored Arc Welding (FCAW), a variation of GMAW
 - e. Submerged Arc Welding (SAW)
3. Root pass must be applied by GTAW process with argon gas purge for high-pressure steam and condensate (400 psig and over) and high temperature hot water (450°F and over) services.
4. Root pass must be applied by only GTAW process with argon gas purge for stainless steel pipe.
5. Unless otherwise stated, fabrication, installation, inspection, examination and testing shall be in accordance with ASME B31.1 or B31.9, as applicable.
6. Backing rings (chill rings) or consumable inserts are not allowed, unless specifically requested by Owner or Engineer.

B. Quality Control Program:

1. Submit written quality control program for review and approval prior to implementing any welding on this project. Quality control program shall include the following as minimum:
 - a. Explanation of how Contractor will assure proper fitup for each weld.

- b. Explanation of how Contractor will document welds performed by individual welding operators for systems under ASME B31.1.
 - c. Explanation of how Contractor will assure that proper welding procedure is being followed.
 - d. Credentials of personnel responsible for required weld examinations.
- C. Weld Inspection and Examination:
1. Provide examination services for all welding for this Project. Examination shall be in accordance with requirements of ASME B31.1, Table 136.4 or B31.9, as applicable.
 2. Periodically, as welding progresses, submit report, signed by weld examiner, indicating status of project welding quality.
 3. Arrange with Owner's Inspector for observation of fitup and welding methods prior to implementing any welds, including shop welds, on this Project.
 4. In addition, Owner's Inspector will perform any additional observations deemed necessary before, during, or after fabrication to assure, to Owner's satisfaction, that proper welding is provided. Owner reserves the right to perform independent examination of welds. If Owner has any concern as a result of such examination Owner reserves the right to stop in progress welding work, without any cost to Owner, until resolution satisfactory to Owner is reached.
- D. Welder Qualifications:
1. Each welder and welding operator must qualify by passing required procedure test before performing any project welds. Submit copy of Manufacturer's Record of Welder or Welding Operator Qualification Tests (WPQS) as required by Section IX of ASME Boiler and Pressure Vessel Code for all welding procedures to be performed by welding operator.
 2. Welder qualifications must be current. If qualification test is more than 6 months old, provide record of welding continuity for each welder.
 3. Record of welding continuity is intended to show that welder has performed welding at least every 6 months since the date that welder qualification test was passed for the submitted welding procedure specification.
 4. Record of welding continuity shall include, at minimum, the following:
 - a. Welder's employer name and address
 - b. Date Welder Qualification Test was passed
 - c. Dates indicating welding continuity
 5. Welders shall be qualified as required by ASME B31.1 or B31.9, as applicable. In addition, there shall be an independent witness of welder tests. That witness shall be representative of independent testing laboratory, Authorized (Code) Inspector, Owner's or Engineer's Inspector or consultant approved by National Certified Pipe Welding Bureau.
 6. Welder qualifications must cover all pipe sizes and wall thickness used on this project. Test segments or coupons shall be appropriately selected for qualification. Test position shall be arranged in "6G position."
- E. Weld Record:
1. For welding within the scope of ASME B31.1 Power Piping, submit to Engineer for approval an administrative procedure for recording, locating, monitoring and maintaining quality of welds to be performed on the project. This quality control document record shall include but not be limited to:

- a. Drawings and schedules identifying location of each weld by individual number, identification of welder who performed each weld by individual welder's name, stamp number, date, and WPS used.

1.7 PIPE CERTIFICATION

- A. Certification is required for all pipe within scope of ASME B31.1. Submit certification papers, as outlined below, within 30 days of delivery of pipe to project site.
- B. Type E or S Pipe:
 1. Furnish manufacturer's mill certificates (material test report) including dimensions, heat numbers, chemical analysis and tensile test results for pipe shipped to project site.

PART 2 - PRODUCTS

2.1 LOW PRESSURE STEAM (15 PSIG AND LOWER)

- A. 1-1/2" and Smaller:
 1. Pipe: ASTM A53, Grade A or B, Type E or ASTM A106, Grade B, Schedule 40, carbon steel
 2. Fittings: ASME B16.3, Class 150 malleable iron, threaded
 3. Unions: ASME B16.39, malleable iron, Class 150. Refer to Unions and Flanges in this Section
- B. 2" and Larger:
 1. Pipe: ASTM A53, Grade A or B, Type E or ASTM A106, Grade B, Schedule 40, carbon steel
 2. Fittings: ASTM A234 Grade WPB/ASME B16.9, standard weight, seamless, carbon steel weld
 3. Flanges: Class 150. Refer to Unions and Flanges in this Section

2.2 LOW PRESSURE STEAM CONDENSATE (15 PSIG AND LOWER)

- A. 1-1/2" and Smaller:
 1. Pipe: ASTM A53, Grade B Type F, Schedule 80 extra strong, carbon steel
 2. Fittings: ASME B16.3, Class 300 malleable iron, threaded
 3. Unions: ASME B16.39, malleable iron, Class 300. Refer to Unions and Flanges in this Section
- B. 2" and Larger:
 1. Pipe: ASTM A53, Grade B, Type E or ASTM A106, Grade B, extra strong, schedule 80 carbon steel
 2. Fittings: ASTM A234 Grade WPB/ASME B16.9, extra strong, seamless, carbon steel weld
 3. Flanges: Class 150 250. Refer to Unions and Flanges in this Section

2.3 HIGH PRESSURE STEAM CONDENSATE

- A. 1-1/2" and Smaller:
 1. Pipe: ASTM A106, Grade B, extra strong, schedule 80, carbon steel
 2. Fittings: ASME B16.3, Class 300 malleable iron, threaded
 3. Unions: ASME B16.39, malleable iron, Class 300. Refer to Unions and Flanges in this Section
- B. 2" and Larger:
 1. Pipe: ASTM A106, Grade B, extra strong, Schedule 80, carbon steel

2. Fittings: ASTM A234, Grade WPB/ASME B16.9, extra strong, seamless, carbon steel weld fittings
3. Flanges: Class 300. Refer to Unions and Flanges in this Section

2.4 HIGH PRESSURE STEAM (16 PSIG AND ABOVE)

A. 1-1/2" and Smaller:

1. Pipe: ASTM A106, Grade B, schedule 40, extra strong, carbon steel
2. Fittings: ASME B16.3, Class 300 malleable iron, threaded
3. Unions: ASME B16.39, malleable iron, Class 300 ~~250~~. Refer to Unions and Flanges in this Section

B. 2" Thru 8":

1. Pipe: ASTM A106, Grade B, schedule 40, carbon steel
2. Fittings: ASTM A234 Grade WPB/ASME B16.9, schedule 40, seamless, carbon steel weld
3. Flanges: Class 300. Refer to Unions and Flanges in this Section

2.5 HEATING HOT WATER

A. 2-1/2" and Smaller:

1. Pipe: ASTM B88 seamless, Type L, hard temper copper tube
 2. Fittings: ASME B16.22, wrought copper solder joint
 3. Joint: ASTM B32, lead free solder, Bridgit, Silvabrite, Silverflow or Canfield
 4. Unions: ASME B16.18 cast copper alloy or ASME B16.22 wrought copper solder joint, Class 125. No unions to be used for line sizes 3/4" and smaller. Unions shall be used for line sizes over 1".
 5. Flanges: ASME B16.24, Class 250, cast copper alloy
 6. Use solder joints for valves and piping specialties in copper piping
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B. 3" through 4":

1. Pipe: ASTM B88 seamless, Type L, hard temper copper tube
2. Fittings: ASME B16.22, wrought copper solder joint
3. Joint: ASTM B32, Grade 4 of 5, brazed, brazing metal shall have melting point of approximately 675°C(1250°F) SilFos, Harris, or Canfield.
4. Flanges: ASME B16.24, Class 150, ASTM B61 or ASTM B62 cast copper alloy
5. Bolts and Nuts:
 - a. Type 316 stainless steel bolts conforming to ASTM A193, Grade B8M Class 1 or Class 2 with Type 316 stainless steel nuts conforming to ASTM A194, Grade 8M. Use 316 SS washers
6. Gaskets:
 - a. ASME B16.21 and ASTM F104 flat ring type, asbestos-free, compressed inorganic fiber with nitrile binder.
 - b. Gasket thickness 1/16"
 - c. Maximum Seating Stress (y) 3050 psi
 - d. Minimum Gasket Factor (m) 4.2
7. Use flanged joints for valves and piping specialties in copper piping

B-C. 35" and Larger:

1. Pipe: ASTM A53, Grade B, Type E or ASTM A106, Grade B, schedule 40, carbon steel
2. Fittings: ASTM A234 Grade WPB/ASME B16.9, schedule 40, seamless, carbon steel weld
3. Flanges: Class 250. Refer to Unions and Flanges in this Section

2.6 CHILLED WATER/MEDIUM TEMPERATURE CHILLED WATER

A. 2-1/2" and Smaller:

1. Pipe: ASTM B88 seamless, Type L, hard temper copper tube
2. Fittings: ASME B16.22, wrought copper solder joint
3. Joint: ASTM B32, lead free solder, Bridgit, Silvabrite, Silverflow or Canfield
4. Unions: ASME B16.18 cast copper alloy or ASME B16.22 wrought copper solder joint, Class 125. No unions to be used for lines sizes 3/4" and smaller. Unions shall be used for line sizes over 1".
5. Flanges: ASME B16.24, Class 250, cast copper alloy
6. Use solder joints for valves and piping specialties in copper piping.

B. 3" through 4":

1. Pipe: ASTM B88 seamless, Type L, hard temper copper tube
2. Fittings: ASME B16.22, wrought copper solder joint
3. Joint: ASTM B32, Grade 4 of 5, brazed, brazing metal shall have melting point of approximately 675°C(1250°F) SilFos, Harris, or Canfield.
4. Flanges: ASME B16.24, Class 150, ASTM B61 or ASTM B62 cast copper alloy
5. Bolts and Nuts:
 - a. Type 316 stainless steel bolts conforming to ASTM A193, Grade B8M Class 1 or Class 2 with Type 316 stainless steel nuts conforming to ASTM A194, Grade 8M. Use 316 SS washers
6. Gaskets:
 - a. ASME B16.21 and ASTM F104 flat ring type, asbestos-free, compressed inorganic fiber with nitrile binder.
 - b. Gasket thickness 1/16"
 - c. Maximum Seating Stress (y) 3050 psi
 - d. Minimum Gasket Factor (m) 4.2
7. Use flanged joints for valves and piping specialties in copper piping

B-C. 5" and Larger:

1. Pipe: ASTM A53, Grade B, Type E or ASTM A106, Grade B, schedule 40, carbon steel
2. Fittings: ASTM A234 Grade WPB/ASME B16.9, schedule 40, seamless, carbon steel weld
3. Flanges: Class 250. Refer to Unions and Flanges in this Section

C-D. All Chilled water piping systems to be designed for 250 PSIG working pressure, including pumps, valves, strainers, and fittings.

2.7 VENTS AND RELIEF VALVES

- A. Unless otherwise indicated, use pipe and pipe fittings as indicated for the system to which relief valve or vent is connected.
- B. ASTM A53, Type F, carbon steel pipe with schedule 40, carbon steel fittings may be used for steam vents smaller than 4".
- C. Use ASTM A53, Type E carbon steel pipe with ASTM A234 Grade WPB/ASME B16.9, schedule 40, seamless carbon steel weld fittings for refrigerant vent piping.

2.8 PRESSURE GAUGES AND TAPPINGS

- A. Use pipe and pipe fittings as indicated for the system to which pressure gauge or tapping is connected. Use "Threadolets", "Sockolets" or tee fittings for tappings. Refer to Part 3 under General for use of "Threadolets" and "Sockolets".
- B. Gauge pipe shall be 1/4" unless otherwise indicated.
- C. Gauge pipe shall be 1/2" for high pressure steam (101 psig and over) systems.

2.9 COOLING COIL CONDENSATE DRAIN

- A. Piping shall be one of the following, unless otherwise indicated on drawings:
 - 1. Pipe: ASTM B88, Type L₁ hard temper copper tubing
 - 2. Fittings: ASTM B16.22 wrought copper fittings
 - 3. Joint: ASTM B32, lead free solder, Bridgit or Silvabrite

2.10 DIELECTRIC UNIONS, FLANGES AND FITTINGS (STEEL PIPE TO COPPER PIPE)

- A. 2" and Smaller:
 - 1. Use bronze ball valves specified in Section 23 2118 for dielectric purpose.
 - 2. Dielectric fittings similar to Victaulic Style 647 or Clearflow Dielectric Waterway fittings may be used for pipe sizes 2" and smaller.
 - a. Clearflow fittings shall be ASTM A53 electro zinc-plated steel pipe with high temperature polyolefin polymer liner, suitable for continuous use at temperatures up to 230°F and pressures up to 300 psig.
- B. 2-1/2" through 4":
 - 1. Watts dielectric flange fittings Series LF 3100/LF 3110 with dielectric gasket, 175 psi at 180°F.
 - 2. Dielectric fittings similar to Victaulic Style 647 or Clearflow Dielectric Waterway fittings may be used in lieu of dielectric unions for pipe sizes 2-1/2" and larger.
 - a. Clearflow fittings shall be ASTM A53 electro zinc-plated steel pipe with high temperature polyolefin polymer liner, suitable for continuous use at temperatures up to 230°F and pressures up to 300 psig.

2.11 DIELECTRIC UNIONS, FLANGES AND FITTINGS (STEEL TO STEEL PIPE)

- A. 1" and Smaller: Similar to Epco model HA-B with dielectric gasket, 250 psi at 210°F

- B. 1-1/2" and Larger: Similar to Epco model W with bolt insulators, dielectric gasket, bolts and nuts, 175 psi at 210°F). Pikotek model VSC dielectric gasket with viton sealing element, G-10 sleeve and double washers, suitable to 350°F, may be used with specified flanges.

2.12 UNIONS AND FLANGES

A. Unions:

1. 2" and Smaller: Malleable iron, ASME B16.39 with ground joint, bronze or brass to iron. Provide black malleable iron for carbon steel piping and galvanized malleable iron for galvanized steel piping. Unless otherwise specified, pressure class and joint type of union shall be equal to that specified for fittings of respective piping service. Minimum pressure class of unions shall be Class 250.
2. 2" and Smaller: Forged steel, ASTM A105 Grade 2, ASME B16.11, 300 lb WOG with steel to steel seats. Joint type shall match that specified for fittings of respective piping service.

B. Flanges:

1. 2-1/2" and Larger: ASTM A105, ASME B16.5, hot forged steel, welding neck pattern. Slip-on pattern are not allowed. Bore dimension of welding neck flange shall match inside diameter of connected pipe.
2. Use raised face flanges for mating with other raised face flanges with self-centering flat ring gaskets. Use flat face flanges for mating with other flat face flanges with full face gaskets.
3. Flange pressure class indicated in respective piping service is minimum required. Mating flange pressure class shall match pressure class of connected device, such as valves and piping specialties.

C. Flange Gaskets:

1. General - Gasket material shall be asbestos free and suitable for pressures, temperatures and fluid of respective piping system. Non-metallic gaskets shall be in accordance with ASME B16.21 and ASTM F104.
2. Service Temperature (through 249°F) – Garlock, Klingersil or J.M. Clipper, similar to Garlock 5500. Gaskets similar to Garlock Style 3000 may be used for hydronic piping. Unless otherwise indicated or recommended by manufacturer, gaskets shall be compressed inorganic fiber with nitrile binder 1/16" thick for flanges 12" and smaller and 1/8" thick for flanges 14" and larger.
3. Service Temperature (250°F thru 800°F) - Flexitallic, Garlock, Lamos equal to Flexitallic Style CG, flexible graphite filler, 304 SS winding, carbon steel centering ring, 0.175" thickness.
4. Service Temperature (801°F thru 1500°F) - Flexitallic, Garlock, Lamos equal to Flexitallic Style CG, flexible graphite filler, 316 SS winding, carbon steel centering ring, 0.175" thickness.
5. Service Temperature (1501°F thru 1700°F) - Flexitallic, Garlock, Lamos equal to Flexitallic Style CG, flexible graphite filler, Inconel 600 winding, 316 SS centering ring, 0.175" thickness.

D. Bolting:

1. Bolts, bolt studs, nuts and washers shall have zinc plated finish.
2. Thread shall be in accordance with ASME B1.1, Class 2A tolerance for external threads and Class 2B tolerance for internal threads. Threads shall be coarse-thread series except that alloy steel bolting 1/8" and larger in diameter shall be 8 pitch thread series.
3. Threaded rods are not allowed as fastening elements.
4. For Class 150 and Class 300 flanges not exceeding 400°F temperature, use carbon steel bolts or stud bolts conforming to ASTM A307, Grade B with nuts conforming to ASTM A194.

- a. Bolts conforming to ASTM A307, Grade A may be used for piping governed by ASME B31.9.
5. For Class 400 and 600 flanges at 750°F or lower temperature, use alloy steel bolts or stud bolts conforming to ASTM A193, Grade B7 or B16, with nuts conforming to ASTM A194, Grade 2H.

2.13 THREADED JOINT SEALANTS

- A. Paste type for brush application or cord type. Products shall be non-toxic, chemically inert, non-hardening, rated for -50°F to 400°F and up to 10,000 psi (liquids) and 3000 psi (gases), certified by UL, CSA, and NSF.
- B. Use sealant similar to Loctite Model 54531 for piping handling oil or petroleum products.

2.14 WELD BRANCH OUTLET FITTINGS (WELDOLETS, THREADOLETS AND SOCKOLETS)

- A. Weld branch outlet fittings shall conform to MSS-SP-97, ASME B16.9 for weldolets, ASME B1.20.1 for threadolets and ASME B16.11 for sockolets.
- B. Materials shall match material of header piping and wall thickness of outlet or branch end shall match wall thickness of branch pipe.

PART 3 - EXECUTION

3.1 GENERAL

- A. Remove foreign materials before erection. Ream ends of piping to remove burrs.
- B. Install piping parallel to building walls and ceilings and at such heights so as not to obstruct any portion of window, doorway, stairway, or passageway. Install piping to allow adequate service space for equipment. Refer to drawings and/or manufacturer's recommendations. Install vertical piping plumb. Where interferences develop in field, offset or reroute piping as required to clear such interferences. In all cases, consult drawings for exact location of pipe spaces, ceiling heights, door and window openings or other architectural details before installing piping.
- C. Provide anchors, expansion joints, swing joints and expansion loops so that piping may expand and contract without damage to itself, equipment or building.
- D. Mitered elbows, welded branch connections, notched tees and "orange peel" reducers are not allowed. Unless specifically indicated, reducing flanges and reducing bushings are not allowed. Reducing bushings may be used for air vents and instrumentation connections.
- E. Unless otherwise indicated, use fittings as specified in Part 2 of this Section for elbows, tees, reducers, etc.
- F. "Weldolets" with outlet size 2-1/2" and larger and "Threadolets" or "Sockolets" with outlet size 2" and smaller may be used for branch connections up to one pipe size smaller than main. Use "Threadolets" where threaded fittings are specified and use "Sockolets" where socket weld fittings are specified. Install in accordance with PFI (Pipe Fabrication Institute) Standard ES49.
- G. Install drains throughout systems to permit complete drainage of entire system.
- H. Do not install piping over electrical panelboards, switchgear, switchboards or motor control centers.

- I. Install valves, control valves and piping specialties, including items furnished by others, as specified and/or detailed.
- J. Make connections to all equipment installed by others where that equipment requires piping services indicated in this Section.
- K. For piping within the scope of ASME B31.1 Power Piping, transfer piping material specification and "Heat Number" to each segment of pipe prior to cutting.

3.2 THREADED PIPE JOINTS

- A. Threads of pipe and fittings shall conform to ASME B1.20.1.
- B. Ream pipe ends after cutting and clean before erection. Apply thread sealants to cleaned male threads. Assemble joint to appropriate depth and remove any excess pipe joint compound from tightened joint.

3.3 FLANGED JOINTS

- A. Clean flange surfaces and align them parallel. Bolt holes of gaskets shall be cut slightly larger than bolt diameter. Gasket ID shall be slightly larger than flange ID.
- B. Position gasket concentrically so compression is equally distributed over entire gasket surface.
- C. Lubricate bolts and run nuts down by hand.
- D. By using torque wrench, tighten nuts in the proper sequence so gasket is compressed evenly, and to the appropriate torque specified by bolt manufacturer.
- E. Re-torque bolts 12 to 24 h after start up.

3.4 WELDED PIPE JOINTS

- A. Inspect pipe and pipe fittings for roundness before they are fit-up or set in place.
- B. Properly clean and prepare pipe base material before fit-up. Verify joint land and bevel.
- C. Preheat pipe base material as required by welding procedure specification. Temperature of pipe material must be minimum of 32°F before welding.
- D. Properly align and adjust joint as required by welding procedure and thickness of material. Verify tolerances after tacking sequence.
- E. Use weld material diameter as procedurally required for type and thickness of work being done.
- F. Use sufficient argon pre-purge and argon post-purge for GTAW processes. Post purge should be until weld is no longer glowing plus 5 seconds. Maintain purge for at least 2 layers of weld material.
- G. Properly store welding materials.
- H. Clean tacks before welding out. Remove slag after each pass by grinding to avoid slag inclusion.
- I. Weld reinforcement shall not exceed limits established in Chapter V of ASME B31.1.

- J. Brush each weld free of rust and paint with rust resistant product that matches piping surface color.
- K. For piping within scope of ASME B31.1, each weld shall be permanently marked by welder performing weld. Each welder shall sign and date field welding log record for all welds performed by welder as indicated in Part 1.
- L. Conduct radiographic test for sections or joints that cannot be tested by hydrostatic test methods (such as joints cut into existing piping systems) by qualified radiographic testing firm.

3.5 COPPER PIPE JOINTS

- A. Cutting of tubing shall not make tubing out of round. Ream cut tube ends to full inside diameter.
- B. Remove slivers and burrs remaining from tube cut by reaming and filing both pipe surfaces. Clean fitting and tube with emery or sand cloth. Remove residue from cleaning operation, apply flux and assemble joint. Use solder or brazing to secure joint as specified for specific piping service.

3.6 STEAM AND STEAM CONDENSATE

- A. Pitch steam mains down at 1" per 40 ft in direction of flow. Pitch runouts to terminal equipment and control valves at 1/2" per 1 ft for proper condensate drainage. Install drip traps at each rise and at horizontal termination of each steam main.
- B. Pitch steam condensate lines down at 1" per 20 ft in direction of flow.
- C. Unless otherwise indicated, use eccentric fittings for changes in horizontal pipe sizes with fittings installed for proper condensate drainage (bottom of pipe straight). Concentric fittings may be used for changes in vertical pipe sizes.
- D. For steam branch connections and runouts, use top or top 45° connection to main.
- E. For condensate branch connections to condensate mains, use top or top 45° connection to main.
- F. For condensate connections from steam mains, use bottom connection to main.
- G. Install minimum of 3 elbows in each pipe runout to terminal equipment to provide flexibility for expansion and contraction of piping system.

3.7 WATER SYSTEMS

- A. Unless otherwise indicated, install horizontal piping level. Install manual air vents at all high points where air may collect. If vent is not in accessible location, extend air vent piping to nearest code acceptable drain location with vent valve located at nearest accessible location to pipe.
- B. Main branches and runouts to terminal equipment may be made at top, top 45°, side or bottom 45° of main provided that there are drain valves suitably located for complete system drainage and manual air vents are located as described above.
- C. Unless otherwise indicated, use top or top 45° connection to main for upfeed risers, and use side or bottom 45° connection to main for downfeed risers. Bottom connection is not allowed.
- D. Use minimum of 3 elbows in each pipeline to terminal equipment to provide flexibility for expansion and contraction of piping systems. Offset pipe connections at equipment to allow for service, such as removal of terminal device.

- E. Unless otherwise indicated, use concentric fittings for changes in pipe sizes and for valves smaller than pipe sizes.
- F. Notch and dimple branch tubes. Braze joints. Apply heat properly so that pipe and tee do not distort. Remove distorted connections.

3.8 VENTS AND RELIEF VALVES

- A. Install vent and relief valve discharge lines as indicated on drawings, as detailed, and as specified for each specific valve or piping specialty item.

3.9 COOLING COIL CONDENSATE DRAIN

- A. Trap each cooling coil drain pan connection with trap seal of sufficient depth to prevent conditioned air from moving through piping. Extend drain piping to nearest code approved drain location. Construct trap with plugged tee for cleanout purposes.
- B. Pitch pipe down at 1/4" per one foot for proper drainage.

3.10 DIELECTRIC UNIONS AND FITTINGS

- A. Install dielectric unions, flanges or fittings in main and branch piping of water systems at each point where copper to steel pipe connection occurs. Dielectric unions or fittings shall not be used at terminal device connections.
- B. Concealed dielectric unions and fittings are not allowed.

3.11 UNIONS AND FLANGES

- A. Install union or flange at each automatic control valve and at each piping specialty or piece of equipment that requires tube pull or removal for maintenance, repair or replacement. If required, provide additional unions or flanges in order to facilitate removal of piping sections that interfere with tube pulls or equipment removal. Where valve is located at piece of equipment, provide flange or union connection on equipment side of valve.
- B. Concealed unions or flanges are not allowed.

3.12 PIPING SYSTEM PRESSURE TESTS

- A. Owner and/or Owner's representative may elect to witness pressure test. Notify Owner and/or Owner's representative at least 3 days in advance.
- B. Conduct pressure test prior to flushing and cleaning of piping systems.
- C. Conduct hydrostatic (HYDRO) test in accordance with ASME B31.1 137.4. Test pressure shall be in accordance with ASME B31.1, but shall not be lower than the minimum test pressure listed below.
- D. If leaks are found, repair with new materials and repeat test until leaks are eliminated. Caulking will not be acceptable.
- E. Pressure tests may be made of isolated portions of piping systems to facilitate general progress of installation. Any revisions made in piping systems require retesting of affected portions of piping systems.

- F. No systems shall be insulated until it has been successfully tested. If required for additional pressure load under test, provide temporary restraints at expansion joints or isolate them during test. Unless otherwise noted, minimum test time shall be 4 h plus such additional time as may be necessary to conduct examination for leakage.
- G. No pressure drop shall occur during test period. Any pressure drop during test period indicates leakage.
- H. Provide pumps, gauges, instruments, test equipment, temporary piping and personnel required for tests and provide removal of test equipment and draining of pipes after tests have been made.
- I. For hydrostatic tests, remove air from piping being tested by means of air vents. Measure and record test pressure at high point in system. Where test pressure at high point in system causes excessive pressure at low point in system due to static head, portions of piping system may be isolated and tested separately to avoid undue pressure. However, every portion of piping system must be tested at the specified minimum test pressure.
- J. Conduct pressure tests with parameters indicated below:

<u>System</u>	<u>Minimum Test Pressure</u>	<u>Remarks</u>
Low pressure steam and condensate	75 psig	HYDRO
High pressure steam and condensate		
16 thru 100 psig	150 psig	HYDRO
Heating hot water	100 psig	HYDRO
Chilled water/medium temperature chilled water	100 psig	HYDRO
Glycol water	100 psig	HYDRO

- K. Contractor shall provide all pumps, gauges, instruments; test equipment, flow meters, temporary piping and personnel required for tests and provide removal of test equipment and draining of pipes after tests have been made.
- L. If piping system is drained after testing and left empty or untreated for more than 3 days, add Nalco 2572 at recommended dosages for dry system lay-up.

3.13 FLUSHING AND CLEANING PIPING SYSTEMS

- A. Notify Owner and/or Owner’s representative at least 7 days in advance.
- B. Flush new water, fluid, steam and condensate systems thoroughly for 15 minutes or longer, as required to ensure removal of dirt and foreign matter from piping system. Bypass pumps and equipment and remove strainers from strainer bodies. Provide circulation by Contractor-supplied portable pumping apparatus.
- C. Provide temporary piping or hose to bypass coils, control valves, heat exchangers, other factory-cleaned equipment, and any component that may be damaged.

- D. Sectionalize system to obtain minimum velocity of 6 fps. Provide temporary piping to connect dead-end supply and return headers as necessary. Flush bottoms of risers.
- E. For pipes 18" and larger, maintain velocity as close as 6 fps possible, but not below 5 fps.
- F. After initial flushing of system, use portable pumping apparatus to circulate cold water detergent for water systems. Refer to Section 23 2514 - Chemical Treatment Systems for pipe cleaning.
- G. After initial flushing of system, use portable pumping apparatus for continuous 24 h minimum circulation of cold water detergent similar to Nalco 2567 cleaner. Flush detergent clear with continuous draining and raw water fill for additional 12 h or until all cleaner is removed from system. Replace strainers and reconnect permanent pumping apparatus and all apparatus bypassed.
- H. Refer to Section 23 2514 - Chemical Treatment Systems for water analysis – Issued under Core and Shell document package.
- I. Use oil when flushing hydraulic piping.
- J. Flush gas piping with clean, dry compressed air for one (1) h minimum. Open and clean drip legs. Repeat flushing until no debris is found in drip legs.
- K. Flush compressed air piping with clean, dry compressed air for one (1) h minimum. Open and clean drip legs. Repeat flushing until no debris is found in drip legs.

3.14 FLUSHING AND CLEANING CHILLED WATER PIPING SYSTEM

- A. Contractor shall visually inspect internal portion of each length of pipe during installation. Remove all dirt and foreign matter prior to installing additional lengths. After each major section of piping has been installed, it shall be cleaned and flushed utilizing a high pressure water "hydro-jet" process. The hydro-jet process involves passing a high pressure, high volume spray type cleaning head through the piping. The head is inserted in each section of piping and activated with full water pressure and flow. Through hydraulic force from directional spray nozzles the head propels itself forward up the pipe section. Once the head reaches the end of the pipe section it is retracted while maintaining maximum water pressure and flow. The length of the piping section shall be determined ahead of time so that the proper amount of travel can be tracked with calibrated markings on the spray head feed water hose or a meter on the hose reel. While traveling through the piping the pressurized water spray knocks debris loose and carries it back to the open end of the piping where it is collected and removed from the system. For each section of piping the process shall be performed a minimum of two times and shall be repeated until the water exiting the end of the pipe is clear and free of debris as determined by the Owner/Engineer.
- B. The hydro-jet equipment utilized shall be capable of providing a minimum of 50 gpm at 2000 psi.
- C. All cleaning and flushing shall be performed such that all debris will be pulled or flushed downhill.
- D. All cleaning and flushing shall be initiated from all low points in the system and shall terminate at the nearest adjacent high point in the system.
- E. Coordinate the limitations and requirements of hydro-jet process with the flushing subcontractor such that the piping is installed in a sequence and manner that allows every section of the new pipeline to be cleaned and flushed. Limitations may include maximum length of the pipe section, maximum number and/or degree of bends in the pipe section, maximum slope of the pipe section,

equipment and excavation access requirements, and the minimum size of the openings required in the piping to allow for insertion and retraction of the cleaning head.

- F. Contractor shall provide access at all low points through valves, tees, flanges, etc. to facilitate the cleaning and flushing process. If temporary fittings or piping is required, it shall be provided by the Contractor and removed by the Contractor after successful cleaning.
- G. After flushing and cleaning is completed, Contractor shall provide necessary pipe and fittings required to complete the piping system. Each cleaned section of piping shall be capped and protected to keep mud, debris, water, etc. from entering the piping. If a piping section is left open or unprotected, or is found to be contaminated, it shall be re-cleaned prior to being filled and activated at no cost to the Owner.
- H. Contractor shall provide all water for flushing and testing. Coordinated rental of fire hydrant meters with local Fire Department(s), or the University as required.
- I. Contractor shall provide all temporary piping from water source to piping system and shall provide means for conducting cleaning water from underground piping system to the appropriate sewer; i.e. pumps, piping, hoses, tanks, etc. Contractor to remove all temporary piping, pumps, hoses, etc. from site immediately after flushing has been completed.

3.15 INITIAL SYSTEM FILL AND VENT

- A. Fill and vent systems with proper working fluids.
- B. Use fluids chemically treated as specified in Section 23 2514 - Chemical Treatment Systems. – Issued under Core and Shell document package
- C. Glycol system shall be filled with treated glycol as specified in Section 23 2514 - Chemical Treatment Systems.

3.16 PIPE PAINTING

- A. Exposed exterior carbon steel, black iron or other ferrous pipe and fittings shall be prepared and painted by qualified painters using corrosion inhibitive paints. Pipe shall be prepared in accordance with paint manufacturer's instructions and primed (2 coats) and finish painted (2 coats). Paint type shall be approved by Architect/Engineer.
- B. Protect piping from weather and paint promptly to prevent corrosion.

END OF SECTION