UNIVERSITY OF MICHIGAN
ARCHITECTURE, ENGINEERING AND CONSTRUCTION

ARCHITECTURE & ENGINEERING
326 East Hoover, Mail Stop B
Ann Arbor, MI 48109-1002
Phone: 734-764-3414
Fax: 734-936-3334

BuildingName
The Description of the Project
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SPECIFICATION DIVISION 22

NUMBER SECTION DESCRIPTION

DIVISION 22 PLUMBING
SECTION 221113 - PIPING MATERIALS AND METHODS

END OF CONTENTS TABLE

DIVISION 22 PLUMBING
SECTION 221113 - PIPING MATERIALS AND METHODS

REVISIONS:

JUNE 2018: REVISED STRAINER MESH SIZES FOR WATER SERVICE PER HYDRONIC AND PLMB. MTT'S. D. KARLE

NOV. 2018: REMOVED SPEC FOR U.G. DUCTILE IRON PIPING FOR CHW AND REFERRED TO 3336100 FOR THAT SPEC. D. KARLE FOR HYDRONIC AND PLMB. MTT.

MARCH 2019: REVISED RO WATER CPVC PIPE ASTM NUMBERS TO CORRECTLY REFLECT SCHEDULE 80 PIPE. THE ORIGINAL ASTM NUMBER (D2846) WAS FOR COPPER TUBE SIZES WHICH ARE MADE IN SDR 11 ONLY. D. KARLE/A. WEIR FOR HYDRONIC AND PLMB. MTT.

JULY 2025 ADDED POLYPROPYLENE PIPING AS OPTION & NUMEROUS OTHER MODIFICATIONS

PART 1 - PART 1 - GENERAL

1.1 RELATED DOCUMENTS

INCLUDE PARAGRAPH 1.1.A AND B IN EVERY SPECIFICATION SECTION. EDIT RELATED SECTIONS 1.1.B TO MAKE IT PROJECT SPECIFIC.

A. Drawings and general provisions of the Contract, Standard General and Supplementary General Conditions, Division 1 Specification Sections, and other applicable Specification Sections, in particular the Related Sections listed below, apply to this Section.

B. Related 7.2 Mechanical Master Specifications Sections

1. Section 220500 - Common Work Results for Mechanical
2. Section 220548 - Vibration Control
3. Section 231123 - Facility Natural-Gas Piping
4. Section 232300 - Refrigerant Piping

C. Related 7.4 Site/Civil Master Specifications Sections

1. Section 336100 - Hydronic Utilities
2. Section 336320 - Utility Tunnels Domestic Hot Water Distribution System
3. Section 336330 - Utility Tunnels Steam & Condensate Distribution

1.2 SUMMARY

A. This Section specifies piping materials and installation methods for the piping systems listed in Part 2 and includes joining materials, piping specialties, and basic piping installation instructions.

1.3 SUBMITTALS

A. Product Data: Include manufacturer, catalog illustrations, model, rated capacities, performance, dimensions, component sizes, rough-in requirements, materials of construction, and operating and maintenance clearance requirements. Additionally include:

1. Provide a piping material schedule that indicates, by service, pipe material, pipe manufacturer, fitting type and manufacturer, joint type and manufacturer.
2. Solder and brazing material data sheets.
3. Grooved fittings, couplings, and accessories data sheets.
4. Data sheets for all products listed in this section including flanges, gaskets, unions, hangers, di-electric protection method, thermal hanger shield inserts, di-electric fittings, flexible metal hose, flexible connectors, and seal sleeve systems.
5. For underground pressurized and steam condensate piping systems, provide a simplified drawing of the piping system identifying pipe depth and slope, location and type of each joint and restraint, valve, and similar accessories, and dimensions of any expansion loops.

B. The Contractor shall submit the following for A/E review and approval:

1. Type and model for all manufactured pipe support components, including building attachments, hangers, insulation saddles and shields, expansion joints, anchors.
2. Locations of anchors, expansion bends and joints.
3. Locations of building attachments where deemed necessary.
4. Details and supporting calculation of additional supports.

QUALITY ASSURANCE: CENTRAL POWER PLANT AND TUNNEL PROJECTS: REVIEW WITH U-M DESIGN MANAGER IF PIPE, FITTINGS AND FLANGES SHOULD BE CERTIFIED AS SOURCED FROM DOMESTIC SUPPLIERS, GERMANY, ITALY, FRANCE, OR GREAT BRITAIN.

1.4 QUALITY ASSURANCE:

A. Manufacturers and Products: The products and manufacturers specified in this Section establish the standard of quality for the Work. Subject to compliance with all requirements, provide specified products from the manufacturers named in Part 2.

B. Reference Standards: Products in this section shall be built, tested, and installed in compliance with the specified quality assurance standards; latest editions, unless noted otherwise.

1. All piping, (including vacuum piping), unless noted otherwise, shall comply with ANSI Standard B31.9 - Building Service Piping.
2. All steam piping above 15 psig, and all steam condensate piping shall comply with ANSI Standard B31.1 - Power Piping.
3. National Sanitation Foundation NSF/ANSI-61, including Annex G (listed as ≤ 0.25% weighted average lead content) (and/or NSF/ANSI-372) and Annex F. Applies to any item in contact with domestic (potable) water.
4. U.S Safe Drinking Water Act (any item in contact with domestic (potable) water)

5. NFPA 54 - National Fuel Gas Code
6. AWWA C600 Standard for Installation of Ductile-Iron Water Mains and their Appurtenances.
7. AWWA C606 Grooved and Shouldered Joints.
8. Mill certifications indicating country of origin and compliance to ASTM/ANSI/NSF and other required compliance standards verified by independent third party based in the United States, shall be promptly provided whenever requested.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Store piping materials and accessories raised off the floor or ground on pallets and protected with coverings to prevent damage or contamination due to weather and construction activities. Provide temporary protective caps on pipe ends. Maintain caps installed at all times until just prior to assembly, and recap open pipe ends at the conclusion of each workday. Store in areas that prevent damage due to freezing and extreme temperatures or sunlight. Arrange coverings to provide air circulation to avoid damage from condensation or chemical build-up. Protect from damage, dirt and debris at all times.

1.6 WARRANTY

A. Provide a complete warranty for parts and labor for a minimum of one year from the date of Substantial Completion.

PART 2 - PRODUCTS

2.1 GENERAL PIPING REQUIREMENTS:

A. All piping materials shall be compatible for temperature, pressure and service.

B. All wetted seals shall be made from materials that are immune from chloramine degradation.

C. Provide long radius elbows and returns on welded steel pipe.

GROOVED JOINTS ARE ONLY PERMITTED IN ACCESSIBLE LOCATIONS. TYPICALLY, MECHANICAL ROOMS AND ABOVE LAY-IN ACOUSTIC CEILING ARE CONSIDERED ACCESSIBLE. SHAFTS AND AREAS ABOVE DRYWALL CEILINGS ARE EXAMPLES OF INACCESSIBLE LOCATIONS. REVISE THE PARAGRAPH BELOW TO INDICATE THE INACCESSIBLE LOCATIONS ON YOUR PROJECT.

D. Grooved Joints:

1. Where grooved joints are indicated as permitted, such joints are only permitted in accessible locations. The following locations are considered inaccessible: shafts, above dry wall ceilings.

E. Polypropylene – Niron

1. Pipe shall be manufactured from a βPP-RCT resin and solid grey in color having a cell classification of PP0220B56832 according to ASTM F4101. Pipe shall be coextruded with a POWERCORE middle layer containing added fiberglass, meeting the short-term properties and long-term strength requirements of ASTM F 2389. The pipe shall contain no rework or recycled materials except that generated in the manufacturer's own plant from resin of the same specification from the same raw material. All pipe shall be certified by NSF International as complying with NSF 14, NSF 61, ASTM F 2389 and CSA Bl 37.1 l. Pipe and fittings made from standard PPR materials, or those made from other alpha crystalline materials such as propylene-hexene copolymers are unacceptable. All pipe and fitting material shall be pigmented as solid steel grey in color, except for any outside UV protective layer, which will be white or gray (CoolPro) in color.
2. Fittings shall be manufactured from a βPP-RCT resin and solid grey in color having a cell classification of PP0220B56832 according to ASTM F4101, meeting the short-term properties and long-term strength requirements of ASTM F 2389. All fittings shall be certified by NSF International as complying with NSF 14, NSF 61, ASTM F 2389 and CSA Bl37.l l. Fittings shall be socket fusion through nominal 1-1/2 inch, butt fusion or socket fusion in nominal 2 inch through 4 inch sizes, and electrofusion from 4 inch through 10 inch. Electrofusion may also be performed in nominal sizes 10 inch through 24 inch by means of the use of electrofusion couplings as applied on butt fusion fittings and pipe.
3. Valves shall be Niron Clima βPP-RCT Lockout True Union Ball Valves through 4”, are manufactured in accordance with Nupi Americas’ specifications and shall comply with the performance requirements of ASTM F 2389 or CSA B137.11.
4. If installed in a return air plenum the pipe shall be wrapped and/or insulated with field installed standard pipe insulation. The pipe wrap or insulation shall meet the requirements of ASTM E8.

2.2 PLUMBING PIPING SYSTEMS:

PROJECTS CONSIDERING THE USE GROOVED JOINTS OR COPPER PRESS FITTINGS (E.G. "PROPRESS") SHALL OBTAIN APPROVAL FIRST FROM THE U-M DESIGN MANAGER AND THE PLUMBING/FIRE PROTECTION MECH TECH TEAM. IF GROOVED JOINTS OR COPPER PRESS FITTINGS ARE NOT BEING USED, REMOVE ALL ASSOCIATED REFERENCES TO THESE ITEMS, BELOW.

PVC PIPING MAY NOT BE USED IN RETURN PLENUMS OR SUPPLY DUCTS, OR IN BUILDING OVER 3 FLOORS HIGH.

A. Domestic Cold Water, Hot Water and Hot Water Return - Above Ground (including non-potable):

1. For piping through 6”:
   a. Pipe: Type L Copper, hard drawn, ASTM B88
   b. Fittings: Wrought Copper, ANSI B16.22
   c. Joints: Soldered through 2”; Brazed for 2-1/2” through 6”

ONLY USE THE CONTRACTORS OPTIONS BELOW WITH APPROVAL. SEE ARTICLE 2.2 SPEC EDITORS NOTE, ABOVE.

Contractor Options:

d. For piping 2-1/2" through 6", excluding inaccessible locations, Grooved Joints – may only be used on cold water systems and not on hot water or hot water return systems.

e. *For piping through 4", copper press to connect fittings – may only be used on cold water systems and not on hot water or hot water return systems.*

U-M'S EXPERIENCE WITH GALVANIZED PIPE HAS NOT BEEN GOOD, THEREFORE COPPER OR STAINLESS STEEL IS PREFERRED AND SPECIFIED FOR 8"-12" PIPE. IF LARGER DIAMETER IS REQUIRED, DESIGNER MUST REVISE SPECIFICATION (BELOW, AND THE FITTINGS SECTION, MUCH FARTHER BELOW.

2. For cold water piping 8" through 12":
   a. Pipe:
      1) Type L Copper, hard drawn, ASTM B88 or
      2) Sch. 10S Type 316L ASTM A312 seamless stainless steel.
   b. Fittings:
      1) For Copper Pipe: Wrought Copper, ANSI B16.22.
      2) For Stainless Steel Pipe:
         a) 316L ASTM A312 stainless steel.
         b) ASTM A403 Grade WP Class S or W, ANSI B16.9.
         c) Flanges: ASTM A182, weld neck, with ASTM A193/ASTM A194 bolts/nuts.
   c. Joints:
      1) Copper Pipe: Brazed. May be grooved where accessible, up to 8" maximum.
      2) Stainless Steel Pipe: Welded, or grooved where accessible. Weld per ASTM A312.

SPEC EDITOR NOTE: EDIT THE SPEC SECTION 012300 ACCORDINGLY TO INCLUDE A REQUIRED BID ALTERNATE FOR THE BIDDERS TO PROVIDE AN ALTERNATE PRICE TO INSTALL NIRON PIPE FOR THIS APPLICATION.

3. Required Bid Alternate for cold water piping (all sizes):
   Pipe: Niron (per 2.1E)

B. Domestic Cold Water - Under Ground (including non-potable):

1. For piping through 4"
   Pipe: Type K Copper, hard drawn, ASTM B88
   Fittings: Wrought Copper, ANSI B16.22
   Joints: Brazed.
2. For piping 5" and larger:
   Pipe: Ductile Iron, AWWA C115 or AWWA C151 with C104 cement mortar lining, polyethylene encased per ANSI/AWWA C105/A21.5.
   Fittings: AWWA C110 or AWWA C153, 150 psi rating with C104 cement mortar lining.
   Joints: AWWA C111 rubber gaskets.

FOR NEW INSTALLATIONS, SPECIFY THAT THE TERMINATION OF THE DUCTILE IRON PIPE (AND ANY DUCTILE IRON JOINT INSIDE THE BUILDING) BE FACTORY THREADED AND EQUIPPED WITH A SCREW-ON,

MACHINE TIGHTENED, DUCTILE IRON FLANGE THAT COMPLIES WITH ANSI/AWWA C110 AND C115, SIMILAR TO THAT AVAILABLE FROM AMERICAN DUCTILE IRON PIPE, US PIPE, AND OTHERS.

SPEC EDITOR: INVESTIGATE SPECIFIC R.O. AND DEIONIZED WATER REQUIREMENTS WITH CLIENT AND EDIT THE BELOW TWO PARAGRAPHS ACCORDINGLY. CONFIRM NEED FOR HEAT FUSION JOINTS, AND SUITABILITY FOR SCREWED JOINTS. FOR D.I. WATER AT U-M, RESEARCH LABS NORMALLY SHOULD USE POLYPROPYLENE PIPE WITH FUSION JOINTS. ULTRA PURE SYSTEMS SUCH AS FOR SEMI-CONDUCTOR FABRICATION ARE TYPICALLY RECOMMENDED TO BE PVDF PIPE WITH FUSION JOINTS.

C. Reverse Osmosis Water - Above Ground:

1. Pipe: CPVC, Schedule 80, ASTM F441
   Fittings: ASTM F439
   Joints: Screwed or Solvent Welded

D. Deionized Water - Above Ground:

1. Pipe: Polypropylene, Schedule 80 or SDR 11, ASTM D4101, PP Resin.
   Manufacturer: Georg Fischer Progef, IPEX Enfield, NIBCO, Orion.
   Fittings: ASTM D4101
   Joints: Heat Fusion Welded. "Riontite" mechanical Joints.

SPEC EDITOR NOTE: THE FOLLOWING PIPING SHOWN IN HIDDEN TEXT CAN BE USED AS AN ALTERANTIVE TO THE POLYPROPYLENE PIPE. USE ONLY WHERE APPROVED BY U-M PROJECT MANAGER.

2. Alternate Pipe: Low extractable, polyvinyl chloride (PVC) compound, Type II pressure rating, Schedule 80, ASTM D1784.
   Manufacturer: Spears LXT.
   Fittings: Schedule 80, ASTM 2467
   Joints: Specialty solvent cement, that meets or exceed the requirements of ASTM D2564 - Spears One-Step.

E. Lab Vacuum - Above Ground:

1. For piping through 4":
   Pipe: Type L Copper, hard drawn, ASTM B88
   Fittings: Wrought Copper, ANSI B16.22
   Joints: Soldered through 2"; Brazed for 2-1/2" through 4"

ONLY USE THE CONTRACTORS OPTIONS BELOW WITH APPROVAL. SEE ARTICLE 2.2 SPEC EDITORS NOTE, ABOVE.

Contractor Options:

a. For through 4", excluding inaccessible locations, Pro-press joints - may be used, per manufactures recommendations for pressure ratings.

FOR COMPRESSED AIR PIPING ABOVE 6", PRESENT MATERIAL ALTERNATIVES TO THE U-M DESIGN MANAGER FOR APPROVAL.

F. Compressed Air - Above Ground:

1. For piping through 6":
   Pipe: Type L Copper, hard drawn, ASTM B88
   Fittings: Wrought Copper, ANSI B16.22

Joints: Soldered through 2”; Brazed for 2-1/2” through 6”

ONLY USE THE CONTRACTORS OPTIONS BELOW WITH APPROVAL. SEE ARTICLE 2.2 SPEC EDITORS NOTE, ABOVE.

Contractor Options:

a. For piping through 2”, excluding inaccessible locations, Pro-press joints - may be used, per manufactures recommendations for pressure ratings.

THE FOLLOWING IS AN ACCEPTABLE ALTERNATE SPECIFICATION FOR COMPRESSED AIR IN HIGH HAZARD AREAS, WHERE PIPING MAY BE SUBJECTED TO PHYSICAL ABUSE. IF USED, UNHIDE TEXT AND INDICATE THE SPECIFIC LOCATION WHERE STEEL PIPE MAY BE USED.

2. For piping through 2” in areas subjected to physical abuse:
   Pipe: Black Steel, Schedule 40, ASTM A 53, ERW or seamless, grade B
   Fittings: Cast Iron, 125 lb. ASTM A 126 or malleable iron 150 lb. ASTM A 197; unions, 250 lb. ASTM A 197
   Joints: Screwed.

G. Natural Gas - Above Ground:

SPEC EDITOR: UNDERGROUND NATURAL GAS PIPING IS TYPICALLY PROVIDED ONLY BY THE GAS COMPANY AND IS THEREFORE NOT ADDRESSED HEREIN. IF REQUIRED, CONSULT CODES.

1. For piping through 2”:
   Pipe: Black Steel, Schedule 40, ASTM A 53, ERW or seamless, grade B
   Fittings: Malleable iron, 150 lb. ASTM A 197; unions, 250 lb. ASTM A 197
   Joints: Screwed Terminal connections 1/2” and less: Type L Copper, annealed, ASTM B 88, 24” maximum length, flared connections
2. For piping 2-1/2” and larger
   Pipe: Black Steel, Schedule 40, ASTM A 53, ERW or seamless, grade B, standard weight for 12” and above
   Fittings: Standard weight, butt welded, black steel, ASTM A 234
   Joints: Welded. Flanged ASTM A 181, 150#, forged steel at valves, and equipment.

H. Sanitary Waste and Vent - Above and Under Ground:

SPEC EDITOR: CHOOSE ONE OF THE FOLLOWING. CI IS STANDARD. PVC IS SHOWN IN HIDDEN TEXT BELOW. IT IS AN ECONOMICAL ALTERNATIVE ACCEPTABLE IN SOME BUILDINGS BUT CANNOT BE INSTALLED IN AIR PLENUMS (SUCH AS RETURN AIR) AND SHALL ONLY BE USED AFTER CONSULATION WITH THE U-M DESIGN MANAGER

1. Pipe: Cast Iron, Service Weight, CISPI Standard 301, ASTM A74, ASTM A888
   Fittings: Cast Iron, drainage pattern, ASTM A74, ASTM C564
   Joints: Hubless - Heavy duty, ASTM C1540 shielded couplings
2. Pipe: PVC Schedule 40, ASTM D 2665, NSF approved, type DWV
   Fittings: PVC, ASTM D 3311
   Joints: Screwed or solvent weld, ASTM D2564

LAB WASTE AND VENT: DEPENDING ON THE APPLICATION, A LOWER COST ALTERNATIVE TO CONSIDER VERSUS THE PP/FUSED JOINT PIPING LISTED

BELOW IS A SOLVENT JOINT SYSTEM MADE ESPECIALLY FOR LAB WASTE, SUCH AS SPEARS LABWASTE™ CPVC PIPING.

I. Laboratory Waste and Vent - Above Ground:

1. Pipe: Polypropylene, Schedule 40, ASTM- D 4101, Type 1
   Fittings: ASTM D-4101
   Joints: Mechanical joints with manufacturer's recommended seals by Orion, or fuse seal joints.
   Manufacturer: Orion/Watts, Enfield/Ipex, Georg Fischer Fuseal.

J. Laboratory Waste and Vent - Under Ground:

1. Pipe: Polypropylene, Schedule 80, ASTM- D 4101, Type 1
   Fittings: ASTM D-4101
   Joints: Mechanical joints with manufacturer's recommended seals by Orion, or fuse seal joints.
   Manufacturer: Orion/Watts, Enfield/Ipex, Georg Fischer Fuseal.

K. Cage Wash Waste:

1. Pipe: Polypropylene, Schedule 80, ASTM- D 4101, Type 1
   Fittings: ASTM D-4101
   Joints: Mechanical joints with manufacturer's recommended seals by Orion, or fuse seal joints.
   Manufacturer: Orion/Watts, Enfield/Ipex, Georg Fischer Fuseal.

L. Equipment Condensate Drains, including coils and energy recovery devices - Above Ground:

1. Pipe: Type DWV Copper, hard drawn, ASTM B306
   Fittings: Wrought Copper, ANSI B16.22
   Joints: Soldered.

SPEC EDITOR: CHOOSE ONE OF THE FOLLOWING. CI IS STANDARD. PVC IS SHOWN IN HIDDEN TEXT BELOW. IT IS AN ECONOMICAL ALTERNATIVE ACCEPTABLE IN SOME BUILDINGS BUT CANNOT BE INSTALLED IN AIR PLENUMS (SUCH AS RETURN AIR) AND SHALL ONLY BE USED AFTER CONSULATION WITH THE U-M DESIGN MANAGER

M. Storm - Above and Under Ground:

1. Pipe: Cast Iron, Service Weight, CISPI Standard 301, ASTM A74, ASTM A888
   Fittings: Cast Iron, drainage pattern, ASTM-A74, ASTM C564
   Joints: Hubless - Heavy duty, ASTM C1540 shielded couplings
2. Pipe: PVC Schedule 40, ASTM D-2665, NSF approved, type DWV
   Fittings: PVC, ASTM D-3311
   Joints: Solvent welded, ASTM D-2564

N. Sanitary and Storm Pump Pressure Piping- from pump discharge to connection to gravity main:

1. Pipe:
   a. Type L Copper, hard drawn, ASTM B88.
   b. Sch. 10S Type 304L ASTM A312 seamless stainless steel.
2. Fittings:
   a. For Copper Pipe: Wrought Copper, ANSI B16.22.
   b. For Stainless Steel Pipe:
      1) Type 304L or 316L ASTM A312 stainless steel.
      2) ASTM A403 Grade WP Class S or W, ANSI B16.9.
3. Joints:

a. Copper Pipe: Soldered. May be grooved where accessible, up to 8" maximum.
b. Stainless Steel Pipe: Welded, or grooved where accessible. Weld per ASTM A312.

4. Elevator sump pumps, in plenum return locations:
a. Type L Copper, hard drawn, ASTM B88.
b. Sch. 10S Type 304L ASTM A312 seamless stainless steel.
c. Fittings: For Copper Pipe: Wrought Copper, ANSI B16.22.

5. Excluding inaccessible locations, Grooved Joints - for Steel Piping may be used, with hot dip galvanized pipe and fittings (couplings may be un-galvanized).

6. Elevator sump pumps, in non-plenum return locations:
a. Schedule 40 PVC ASTM D 1785 pipe, ASTM D 2466 socket fittings, ASTM D 2464 Schedule 80 threaded fittings.

O. Animal Drinking Water system:

1. Pipe within the room:
a. 316L stainless steel tubing, electropolished, minimum 0.036" wall thickness, conforming to ANSI/ASTM A450.

2. Joints:
a. 316L stainless steel, compression/compression, or NPT/compression type fittings, or O-ring slip and ream connections, with FDA approved silicone o-ring.

3. Actuated Valves:
a. Body material: 316 stainless steel, electropolished
b. Ports: 3/8" FPT
c. Diaphragm: Teflon
d. Actuator: solenoid.

4. Downstream of PRV's throughout animal holding rooms and adjacent areas
a. Pipe: Stainless steel tubing, Type 316, ASTM A269, hardness not to exceed Rb80, fully annealed, seamless tubing, free of scratches, burrs and surface defects, suitable for bending and flaring for sizes 1/16" through 2", cleaned for oxygen service.
b. Fittings and Joints: Type 316 stainless steel, double ferrule, compression by male, or compression by female tubing fittings, cleaned and bagged for oxygen service.

5. Pipe outside of holding rooms:
a. Unpigmented natural polypropylene, conforming to ASTM D-4101.
b. Joints: Socket fusion.

P. Cage Rack Interconnect Station

1. Each cage rack interconnect station shall be provided with the following:
a. Interconnect (I/C) assembly on supply line:
1) Standard 1/4" universal style socket quick disconnect (QD)/half coupling fitting welded to clean fitting connection, 316 stainless steel, FDA Approved silicone seal.

2. Supply hose assembly for connecting supply header to cage rack manifold:
a. Tubing: Coiled black PVDF (Kynar), 3/8" OD x 1/4" ID, NSF standard 61, FDA grade.

b. Extended Reach: length of coiled drop to be determined on site (5' to 8' approx.).
c. Quick disconnect (QD) on each end:
1) Universal style QD couplings, push lock barb connection, 316 grade stainless steel, with high-grade FDA Approved silicone seal.
2) QD plug on upper end.
3) QD socket on lower end.
d. Stainless steel spring supports (3" long) both ends.

2.3 HYDRONIC, STEAM AND CONDENSATE PIPING SYSTEMS:

PROJECTS CONSIDERING THE USE OF GROOVED JOINTS, COPPER PRESS FITTINGS (E.G. "PROPRESS") OR POLYPROPYLENE PIPE SHALL FIRST OBTAIN APPROVAL FROM THE U-M DESIGN MANAGER AND THE PLUMBING/FIRE PROTECTION MECH TECH TEAM. IF GROOVED JOINTS OR COPPER PRESS FITTINGS ARE NOT BEING USED, REMOVE ALL ASSOCIATED REFERENCES TO THESE ITEMS, IN SECTION 2.5 BELOW.

A. Chilled Water - Above Ground:

1. For piping through 4":
Pipe: Type L Copper, hard drawn, ASTM B88
Fittings: Wrought Copper, ANSI B16.22
Joints: Soldered through 2"; Brazed for 2-1/2" through 4"

ONLY USE THE CONTRACTORS OPTIONS BELOW WITH APPROVAL AS DETAILED IN PARAGRAPH 2.3 EDITOR'S NOTE ABOVE.

Contractor Options:
a. For piping 2-1/2" through 4", excluding inaccessible locations, Grooved Joints - for Copper Piping may be used.
b. *For piping through 4"*, excluding inaccessible locations, Copper press to connect fittings may be used

2. For piping 5" and larger:
Pipe: Black Steel, Schedule 40, ASTM A53, ERW or seamless, grade B, standard weight for 12" and above
Fittings: Standard weight, butt welded, black steel, ASTM A234
Joints: Welded. Flanged ASTM A181, 150#, forged steel at valves, and equipment.

ONLY USE THE CONTRACTOR OPTION BELOW WITH APPROVAL AS DETAILED IN PARAGRAPH 2.3 EDITOR'S NOTE ABOVE.

Contractor Option: excluding inaccessible locations, Grooved Joints - for Steel Piping may be used for piping 5" through 12".

SPEC EDITOR NOTE: EDIT THE SPEC SECTION 012300 ACCORDINGLY TO INCLUDE A REQUIRED BID ALTERNATE FOR THE BIDDERS TO PROVIDE AN ALTERNATE PRICE TO INSTALL NIRON PIPE FOR THIS APPLICATION.

3. Required Bid Alternate for chilled water piping (all sizes):
Pipe: Niron (per 2.1E)
a. Niron piping and fittings.
If pipe will be exposed to direct UV light for more than 30 days, it shall be provided with a Factory applied, 30 year UV-resistant white coating and shall be Niron Clima CoolPro.

IF PROJECT HAS BELOW GROUND CHW PIPING BE SURE TO INCLUDE MS336100 IN THE SPECIFICATION

B. Chilled Water - Below Ground

1. Refer to Related Section 336100 Hydronic Utilities

C. Hot Water Heating - Above Ground:

1. For piping through 4”:
   Pipe: Type L Copper, hard drawn, ASTM B88
   Fittings: Wrought Copper, ANSI B16.22
   Joints: Soldered through 2”; Brazed for 2-1/2” through 4”

ONLY USE THE CONTRACTORS OPTIONS BELOW WITH APPROVAL AS DETAILED IN PARAGRAPH 2.3 EDITOR’S NOTE ABOVE.

   Contractor Options:
   a. For piping 2-1/2” through 4”, excluding inaccessible locations, Grooved Joints - for Copper Piping may be used.
   b. *For piping through 4", Copper press to connect fittings may be used.*

2. For piping 5” and larger:
   Pipe: Black Steel, Schedule 40, ASTM A53, ERW or seamless, grade B, standard weight for 12” and above
   Fittings: Standard weight, butt welded, black steel, ASTM A234
   Joints: Welded. Flanged ASTM A181, 150#, forged steel at valves, and equipment.

ONLY USE THE CONTRACTOR OPTION BELOW WITH APPROVAL AS DETAILED IN PARAGRAPH 2.3 EDITOR’S NOTE ABOVE.

   Contractor Option: excluding inaccessible locations, Grooved Joints - for Steel Piping may be used for piping 5” through 12”:

SPEC CHANGES HAVE BEEN MADE FOR LENGTHS OF CONDENSER WATER PIPING EXPOSED TO SEASONAL DRAIN DOWN OR WHERE EXTERIOR CORROSION OF UNINSULATED CONDENSER WATER PIPING COULD PRESENT PROBLEMS.

D. Condenser Water/ Cooling Tower Water - Above Ground:

1. For piping through 4”:
   Pipe: Type L Copper, hard drawn, ASTM B88
   Fittings: Wrought Copper, ANSI B16.22
   Joints: Soldered through 2”; Brazed for 2-1/2” through 4”

SPEC EDITOR: ONLY USE THE CONTRACTORS OPTIONS BELOW WITH APPROVAL AS DETAILED IN PARAGRAPH 2.3 EDITOR’S NOTE ABOVE.

   Contractor Options:
   a. For piping 2-1/2” through 4”, excluding inaccessible locations, Grooved Joints - for Copper Piping may be used.
   b. *For piping through 4", Copper press to connect fittings may be used.*

2. For piping 5” and larger(inside the building):
   Pipe: Black Steel, Schedule 40, ASTM A53, ERW or seamless, grade B, standard weight for 12” and above
   Fittings: Standard weight, butt welded, black steel, ASTM A234
   Joints: Welded. Flanged ASTM A181, 150#, forged steel at valves, and equipment.

3. For piping 5” and larger(outside the building and inside the building within 5' of the roof):
Pipe: Stainless Steel, Schedule 10, ASTM A312, ERW or seamless.
a. Fittings: Type 316L ASTM A312 stainless steel. ASTM A403 Grade WP Class S or W.
b. Flanges: ASTM A182, forged, weld neck. Bolts/nuts ASTM A193/ASTM A194.
c. Joints: welded per ASTM A312.

ONLY USE THE CONTRACTOR OPTION BELOW WITH APPROVAL AS DETAILED IN PARAGRAPH 2.3 EDITOR’S NOTE ABOVE.

Contractor Option: excluding inaccessible locations, Grooved Joints - for Steel Piping may be used for piping 5” through 12”.

SPEC EDITOR NOTE: EDIT THE SPEC SECTION 012300 ACCORDINGLY TO INCLUDE A REQUIRED BID ALTERNATE FOR THE BIDDERS TO PROVIDE AN ALTERNATE PRICE TO INSTALL NIRON PIPE FOR THIS APPLICATION.

4. Required Bid Alternate for condenser water / cooling tower water piping (all sizes):
Pipe: Niron (per 2.1E)
a. Niron piping and fittings.
If pipe will be exposed to direct UV light for more than 30 days, it shall be provided with a Factory applied, 30 year UV-resistant white coating and shall be Niron Clima CoolPro.

E. Steam - to 60 psig - Above Ground:

1. For piping through 2”:
Pipe: Black Steel, Schedule 40, ASTM A53, ERW or seamless, grade B.
Fittings: Forged steel, ASTM A181, ANSI B16.11.
Joints: Screwed.
2. For piping 2-1/2” and larger
Pipe: Black Steel, Schedule 40, ASTM A53, ERW or seamless, grade B, standard weight for 12” and above
Fittings: Standard weight, butt welded, black steel, ASTM A234
Joints: Welded. Flanged ASTM A181, 150#, forged steel at valves, and equipment.

F. Steam Condensate (gravity or pumped) - to 60 psig - Above Ground:

1. For piping through 2”:
Pipe: Black Steel, Schedule 80, ASTM A53, ERW or seamless, grade B.
Fittings: Forged steel, ASTM A181, ANSI B16.11.
Joints: Screwed.
2. For piping 2-1/2” and larger
Pipe: Black Steel, Schedule 80, ASTM A53, ERW or seamless, grade B.
Fittings: Standard weight, butt welded, black steel, ASTM A234.
For utility tunnels use only extra heavy weight, butt welded, black steel, ASTM A234
Joints: Welded. Flanged ASTM A181, 150#, forged steel at valves, and equipment.

G. Humidifier Piping (for steam humidifier using deionized or RO water):

1. Steam piping from steam generator to humidifier manifold:
   Pipe: Stainless steel for minimum 12" length at generator and at humidifier manifold.
   Hose: Supplied by humidifier manufacturer, continuously pitched back to humidifier and continuously supported.
   Fittings: Stainless steel.
   Joints: Screwed.
2. Condensate piping from manifold drip to generator or drain.
   Pipe: Stainless steel.
   Fittings: Stainless steel.
   Joints: Screwed.
3. Pipe and fittings: Sch. 40S Type 304L ASTM A312 seamless stainless steel pipe with ASTM A403 Grade WP Class S or W fittings.

2.4 SPECIAL PIPING SYSTEMS:

A. Refrigeration Piping - Above Ground and Under Ground:

1. Pipe: Type L or K Seamless Copper, Nitrogenized ACR, ASTM B 88 or ASTM B 280, annealed for 3/8" and smaller, hard drawn for ½" and larger. For underground piping 2" and smaller: Type K, annealed, with no fittings.
2. Fittings: ANSI B16.26 cast copper alloy refrigeration type with 45 degree flare or wrought copper ANSI B16.22 socket fittings
   Joints: brazed, flared (above ground only).
   Manufacturers: Vulcan Lokring

2.5 PIPE JOINTS:

A. Soldered Joints: ASTM B32; Alloy Sb5, (95% Tin, 5% Antimony, maximum 0.20% Lead). When recommended by the component manufacturer, use manufacturer's recommended flux. Unless noted otherwise, joints may be screwed or flanged to suit valves and equipment. Manufacturers: Engelehard "Silverbrite 100", Harris "Bridgit"

B. Brazed Joints: ASTM B32, silver brazed joints with 1000F minimum melting point, conforming to AWS - A5.8, "Specification for brazing filler metal". Classification BAg-1. For domestic potable water applications, maintain a nitrogen purge during brazing to prevent deposit formation inside the pipe. Unless noted otherwise, joints may be screwed or flanged to suit valves and equipment. Manufacturers: Lucas-Milhaupt Inc. "Sil-Fos", J.W. Harris "Stay-Silv 15" and "Safety Silv"

C. Screwed Joints: Tapered thread, ASME B1.20.1, joined with compatible compound or sealant tape applied to male thread only.

D. Welded Joints: Comply with Section II, Part C, ASME Boiler and Pressure Vessel Code for welding materials appropriate for the wall thickness and chemical analysis of the pipe being welded. Pipe and fittings shall be beveled and butt welded.

GROOVED PIPING JOINTS FOR COOPER PIPE ARE LIMITED TO 8", WHICH IS THE MAXIMUM SIZE THAT ALL THREE APPROVED MFRS HAVE AVAILABLE. PROJECTS CONSIDERING THE USE OF GROOVED JOINTS, OR COPPER PRESS

FITTINGS (E.G. "PROPRESS") SHALL FIRST OBTAIN APPROVAL FROM THE U-M DESIGN MANAGER AND THE PLUMBING/FIRE PROTECTION MECH TECH TEAM. IF GROOVED JOINTS OR COPPER PRESS FITTINGS ARE NOT BEING USED, REMOVE ALL ASSOCIATED REFERENCES TO THESE ITEMS, BELOW

E. Grooved Joints - for Copper Piping, maximum pipe size 8": Rolled grooves, peroxide cured EPDM gaskets, with pipe stop to ensure proper groove engagement, alignment, and pipe insertion depth, ductile iron housing (ASTM A 536) cast with offsetting angle-pattern bolt pads, wrought copper (ASTM B 75, ANSI B16.22) or cast bronze (ANSI B16.18) fittings, rated for minimum 300 psi working pressure at 250 215°F, when used with grooves that comply with AWWA C606. Grooved system/components shall provide rigid installation. UL and UPC approved. Utilize manufacturer's recommended gasket lubricant. Brazed Class 150 ANSI B16.24 cast bronze flanges (or copper companion flange by CTS Fabrication USA) must be used at any component requiring a flanged connection. Clamp-on branch outlets are prohibited. Exact gasket material and style shall be as recommended by the coupling manufacturer for the service, and NSF/ANSI-61 Annex G and NSF/ANSI-372 listed when used for potable water. On potable water service, provide non-standard gasket styles that close off and isolate gasket cavities from the water in the pipe. The manufacturer of the couplings, fittings and valves shall be the same. The same grooved component manufacturer shall be provided for the entire scope of the work, for each system. The grooving tools shall be of the same manufacturer as the grooved components. All castings used for couplings housings, fittings, or valve and specialty bodies shall be date stamped for quality assurance and traceability.

1. The following manufacturers and coupling model numbers are permitted, provided they comply with all the above: Victaulic Style 607; Grinnell/JCI 672 or 640; Anvil Gruvlok Couplings.
2. For copper piping in tunnels: Victaulic Style 607 only.

GROOVED JOINTS FOR STEEL PIPE ARE LIMITED TO 12". THE PRESSURE RATING OF GROOVED COUPLINGS DECREASE ABOVE 12" PIPE SIZE, AND VARIES BY COUPLING MFR. REVISE BELOW CAREFULLY IF USING GROOVED JOINTS ABOVE 12" PIPE SIZE.

F. Grooved Joints - for Steel Piping, for maximum pipe size of 12": Rolled or cut grooves, peroxide cured EPDM or EPDM-HP gaskets, ductile iron coupling and fittings (ASTM A536), rated for minimum 300 psi working pressure at 250°F, when used with grooves that comply with AWWA C606. Grooved system/components shall provide rigid installation. UL and FM approved. Utilize manufacturer's recommended gasket lubricant. Welded flanges must be used at any component requiring a flanged connection. Clamp-on branch outlets are prohibited. Exact gasket material and style shall be as recommended by the coupling manufacturer for the service. The manufacturer of the couplings and the fittings shall be the same. The same grooved component manufacturer shall be provided for the entire scope of the work, for each system. The grooving tools shall be of the same manufacturer as the grooved components. All castings used for couplings housings, fittings, or valve and specialty bodies shall be date stamped for quality assurance and traceability.

1. The following manufacturers and coupling model numbers are permitted, provided they comply with all the above: Victaulic Style 107N; Grinnell/JCI Fig. 740; or 772 Gruvlok Couplings.

ALTHOUGH THE BELOW ARTICLE CALLS FOR 300 PSI WORKING PRESSURE FOR STAINLESS STEEL FITTINGS UP TO 12", THE PRESSURE RATING OF GROOVED COUPLINGS IS OFTEN LESS ABOVE 8" PIPE SIZE, AND VARIES BY COUPLING MFR. REVISE BELOW CAREFULLY IF USING S.S. GROOVED JOINTS ABOVE 8" PIPE SIZE.

G. Grooved Joints - for Stainless Steel Piping, for maximum pipe size of 12": Rolled grooves, peroxide cured EPDM gaskets, galvanized ductile iron (indoor piping only) or stainless steel couplings, minimum sch. 10 stainless steel fittings. Provide stainless steel nuts and bolts when couplings are stainless steel. Couplings and fittings rated for a minimum 300 psi working pressure at 230°F. Grooved system/components shall provide rigid installation. NSF/ANSI-61 Annex G and NSF/ANSI-372 listed when used for potable water. On potable water service, provide non-standard gasket styles that close off and isolate gasket cavities from the water in the pipe. Welded flanges must be used at any component requiring a flanged connection. Clamp-on branch outlets are prohibited. Exact gasket material and style shall be as recommended by the coupling manufacturer for the service. Utilize manufacturer's recommended gasket lubricant. The manufacturer of the couplings and the fittings shall be the same. The same grooved component manufacturer shall be provided for the entire scope of the work, for each system. Use the manufacturer's required roll sets for stainless steel pipe. The grooving tools shall be of the same manufacturer as the grooved components. All castings used for couplings housings, fittings, or valve and specialty bodies shall be date stamped for quality assurance and traceability.

1. The following manufacturers and coupling model numbers are permitted, provided they comply with all the above: Victaulic Style 89 or W89 (indoor), Style 489 (outdoor); Victaulic Style 807N (for potable water service); Grinnell/JCI Fig. 770 (indoor), Fig. 772 (indoor), Fig. 472 (outdoor) Anvil Gruvlok Couplings).

USE PRESS JOINTS ONLY WHERE APPROVED BY U-M PROJECT MANAGER AND THE PLUMBING/FIRE PROTECTION MECH TECH TEAM.

H. Press Joints:

1. Limited to a maximum pipe size of 4".
2. Rated for a minimum 200 PSI working pressure from -4°F to 180°F.
3. Compatible with seamless type K, L, and M copper tube conforming to ASTM B88.
4. Fittings shall be a minimum 78% copper and a maximum of 15% zinc, alloyed to prevent dezincification.
5. Fittings shall conform to the material and sizing requirements of ASME B16.18 or ASME B16.12.
6. Seals/O-rings shall be peroxide cured EPDM.
7. Joints shall be pressed using the tool approved by the manufacturer.
8. Provide press fittings from the same manufacturer for the entire scope of the work, for each system.
9. For piping 2" and smaller, non-fitting components such as valves, strainers, check valves, etc. manufactured by the press fitting manufacturer may be used provided:
   a. The press fitting manufacturer is approved for those components elsewhere in the specifications

b. Such components fully comply with the requirements of the respective specification section for the component.

10. Approved fitting, tool, and process:
    a. Viega ProPress
    b. NIBCO Press System.
    c. Apollo Xpress
    d. Anvil
    e. Mueller Streamline

THE FOLLOWING JOINING METHOD IS UNDER CONSIDERATION: USE LOKRING ONLY WHERE APPROVED BY U-M PROJECT MANAGER AND THE PLUMBING/FIRE PROTECTION MECH TECH TEAM.

I. Lokring Joints

1. For use with uncoated Carbon Steel Pipe per ASTM A 106 Grade B or ASTM 53 Grade B. Maximum pipe size of 3". Shall only be used on ½" NPS thru 1" NPS pipe in schedule 40 thru 160, or on 1-1/2" NPS thru 3" NPS pipe in schedule 40 and 80. Design temperature shall be from -20F to 650F. Corrosion allowance is 0.063" or less. Shall not be used in systems where crevice corrosion is considered a problem, where there is a possibility of stress corrosion cracking, where post weld heat treatment is required, or where seal welding is required. Shall not be used as the first connection from an ASME stamped pressure vessel. Stress intensification factor shall be 1.35 or as determined by ASME B31. Flanges and fittings shall be manufactured by Lokring Corporation. Components shall be installed in accordance with the latest edition of the Lokring Fitting Application Guide and in accordance with Lokring Installation procedure LP-105. Components shall be installed by crews trained in the procedure and qualified or certified by Lokring. Design drawings, sketches, etc. shall have permanent drawing numbers. After installation and prior to operation, piping system shall be inspected and tested in accordance to the piping's original code of construction (ASME B31.1 or ASME B31.3) and site QA/QC procedures. Equipment integrity plans shall include a program to monitor the condition of Lokring components.
   a.

J. Flanged Joints:

1. Select flange and gasket materials to suit service of piping and to comply with the respective ASME B31.1 or B31.9 piping standard.
2. For steel pipe, provide raised face ANSI B16.5 compliant steel flanges.
3. For copper pipe, provide Class 150 flat face ANSI B16.24 cast bronze flanges, brazed to the copper tube.
   a. Alternative: Copper companion flange by CTS Fabrication USA rated 450 PSI minimum working pressure from -66°F to 272°F. ANSI B16.5 compliant, powder coated, with an EPDM insulator adhered to the plate steel flange protruding inside of the flange to prevent contact with the copper companion flange adapter. Flange adapter shall be manufactured to ASME B16.22, brazed to the copper tube.

4. Gaskets shall conform to respective ANSI Standards, A21.11, B16.20, B16.21. Gaskets in steam and condensate lines shall be "FLEXTALLIC", 316 L stainless steel with "FLEXICARB" filler. Flange gaskets for domestic hot water shall be 100% PTFE Garlock Blue-Gard Style 3000 ring type gaskets or comparable. Full face gaskets allowed only when BOTH flanges are full face. Butterfly valves with removable seat screw heads that would interfere with the metal strip winding shall be installed with Garlock Style 9800 gaskets on the seat screw head side.
5. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated. Central Power Plant and Tunnels: Provide ASTM A193 B7 bolts and studs with ASTM A194 grade 2H heavy hex nuts.

K. Hubless Joints for Cast Iron No-Hub Pipe: Heavy duty ASTM C1540 couplings with stainless steel shield with stainless steel bands and tightening devices, ASTM C564 rubber sleeve with integral center pipe stop.

1. When connecting cast iron no-hub pipe to dis-similar pipe: Provide ASTM C1460 couplings specifically designed for both pipe types, with stainless steel shield with stainless steel bands and tightening devices, with ASTM C564 rubber sleeve with integral center pipe stop. Unshielded couplings shall not be used. *Connections between dis-similar pipe materials shall be restrained.* Submit coupling and restraint methods for approval.
2. Approved Manufacturers:
   a. Anaco/Huskey
   b. Clamp-All Corp.
   c. Ideal Tridon
   d. Mission Rubber Company (MCP Industries Inc.)

L. Solvent Cement Joints: Select materials suitable for pipe materials joined and compatible with fluid served. Conform to respective ASTM Standards D-2235, D-2564, D-2855 and D-3138.

M. Gasket Joint Lubricant - for use with grooved and hubless joints: Provide manufacturer's recommended gasket lubricant.

2.6 MECHANICALLY FORMED TEE CONNECTIONS IN COPPER PIPING:

THE T-DRILL TOOL HAS BEEN DEMONSTRATED AT UM A&E, AND TO PLANT, AND SEEMS TO HAVE APPROPRIATE APPLICATIONS. THE SPEC BELOW LIMITS T-DRILL'S USE. FORWARD COMMENTS AND EXPERIENCES TO THE SPEC TEAM.

A. Contractor may use mechanically formed Tee connections in copper piping in lieu of tee fitting only where main piping is 2 1/2" or larger and where branch connection is 3/4" or smaller. Joint must be brazed. Tool manufacturer: T-Drill.

2.7 UNIONS:

A. Unions in steel piping systems shall be malleable iron with ground joints made between two bronze inserts.

B. Unions in copper piping systems shall be wrought copper or brass with sweat ends.

C. Unions or flanges for servicing and disconnect are not required in installations using grooved joint couplings.

2.8 PIPE HANGERS AND SUPPORTS:

PIPE HANGER MODEL NUMBERS, SPACING, AND APPLICATION OF HANGERS AND SUPPORTS MUST BE ADDRESSED IN DRAWINGS, IT IS NO LONGER INCLUDED HEREIN. SOME DETAILS MAY BE AVAILABLE ON THE U-M AEC WEBSITE.

A. Provide adjustable type pipe hangers, supports and accessories for the proper support of all piping. See details on drawings for requirements. Figure and model numbers specified on drawings are for Anvil International, and Pipe Shields Inc. Equivalent products by Carpenter & Paterson, Cooper B-line and PHD Manufacturing are also acceptable. Continuous threaded rod shall be used for intermediate attachments.

B. Dielectric protection for hangers and supports: Where copper piping is supported with steel hangers and supports, dielectric protection must be provided. Use one of the following means as applicable:

1. Coated hangers (copper or plastic coating)
2. Insulation inserts
3. Cushion clamps
4. Other as approved by Engineer.

C. Large piping and equipment shall be independently supported from building structure, not from roof decks, etc. All piping shall be directly supported from the building, not from other piping, ductwork or equipment.

D. Dissimilar metal-to-metal contact between pipe and hanger is prohibited. Specify isolators, such as plastic coated hangers for copper pipe, to avoid dissimilar metal-to-metal contact between pipe and hanger.

E. Hangers for piping that lacks rigidity, such as polypropylene pipe, shall be spaced, at a minimum, as recommended by the manufacturer or preferably, with a continuous support.

F. For cold piping systems, piping hangers to retain integrity of vapor barriers. Provide cal-sil or similar pre-formed inserts and insulation shields for all piping 4" to 12" requiring a vapor barrier (wood blocking is not acceptable). Insulation shields are acceptable for piping 3" and below.

G. "C" type clamp hangers are acceptable for fire protection piping and all piping 2" and smaller when retaining clips are used.

2.9 THERMAL-HANGER SHIELD INSERT ASSEMBLIES

A. Except as noted, thermal hanger shield "insert" assemblies shall be used on all insulated pipe systems at each horizontal support, and at each clamped or guided vertical support. Manufactured units shall comply with MSS SP-58 standards and be tested per MSS SP-89 guidelines. Each assembly shall closely fit the various pipe diameters and match the outside diameter of the adjoining pipe insulation. Provide pre-grooved inserts when piping is heat traced. Compressive strength shall be adequate to prevent deformation at the project's hanger spacing requirements, with a minimum 3:1 safety factor.

B. Thermal hanger shield insert assembly: Water-repellent treated, ASTM C 533, Type I calcium silicate, asbestos free insert. With G-90 galvanized sheet metal shield. With attached vapor barrier, where indicated. Each component shall have an ASTM E84 flame/smoke rating maximum of 25/50.

1. Inserts for Cold Piping (piping conveying materials less than or equal to 60F), including all chilled water and domestic cold water piping: Insert with an attached vapor barrier.
   a. Provide insert and sheet metal shield covering entire circumference of pipe.
2. Inserts for Hot Piping (piping conveying materials at more than 60F): Insert only.
   a. For clevis or band hangers that support pipe from bottom: Insert and sheet metal shield shall cover lower 180 degrees of pipe, or entire circumference of pipe.
   b. For trapeze hangers or clamped pipe: Insert and sheet metal shield shall cover entire circumference of pipe.
3. Inserts for piping less than 3/4-inch diameter: Not required except for piping conveying materials less than 45°F.

C. Minimum Compressive Strength of Insert Material:

1. 100 psig for sizes smaller than NPS 6.
2. 600 psig for sizes NPS 6 and larger.

D. Insert Length: Extend 2 inches beyond sheet metal shield.

E. Vapor barrier: meeting ASTM C1136, with 0.02 perms maximum water vapor permeance.

F. Adhesives shall comply with NFPA 90-A.

G. Sheet Metal Shield Dimensions for Pipe: Not less than the following:

1. NPS 1/4 to NPS 3-1/2: 12 inches long and 0.048 inch thick.
2. NPS 4: 12 inches long and 0.06 inch thick.
3. NPS 5 and NPS 6: 18 inches long and 0.06 inch thick
4. NPS 8 to NPS 14: 24 inches long and 0.075 inch thick
5. NPS 16 to NPS 24: 24 inches long and 0.105 inch thick

H. Manufacturers

1. Eaton
2. Rilco Manufacturing Company
3. Value Engineered Products.
4. Johns Manville

2.10 PIPE SLEEVES:

NOTE THAT SLEEVE DETAILS MUST APPEAR ON DRAWINGS, INCLUDING UNDERGROUND DETAILS IF APPLICABLE.

A. Furnish and set pipe sleeves per details on drawings.

2.11 DIELECTRIC FITTINGS:

A. For pipe 2 inch and less: Provide brass coupling. (Dielectric unions are not acceptable).

B. For pipe 2-1/2 inch and larger: Provide flange union with dielectric gasket and bolt sleeves. On copper pipe, copper companion flanges by CTS Fabrication USA may be used.

C. Dielectric waterways are prohibited for all joint systems.

2.12 STRAINERS:

A. Body shall be bronze for sizes 2" and less and bronze, cast steel, or cast iron for sizes over 2" unless otherwise indicated. Provide domestic water strainers with bronze, stainless steel, or epoxy lined cast iron bodies suitable for potable water.

1. Strainers shall be same size as piping.
2. Provide soldered or screwed connections on ¾" sizes or less, screwed connections on sizes between ¾" and 2-1/2" , and flanged connections on sizes 2-1/2" and larger. Where grooved piping is specified, grooved joint strainers may be used.
3. Pressure rating shall be that of piping system, minimum Class 125.
4. Provide with plugged blowdown port.
5. Provide screen free areas that are a minimum of twice the internal cross sectional area of the piping where installed.

B. For water service, screen material stainless steel, with openings of 1/16 (0.062) inches for pipes 2" and smaller and 1/8 (0.125) inches for pipe sizes 2-1/2" and larger.

C. For steam and condensate service, screen material stainless steel, with openings of 1/32 (0.031) inches for pipes 2" and smaller and 3/64 (0.047) inches for pipe sizes 2-1/2" and larger.

D. For air and gas service, screen material stainless steel, with openings of 0.006 inches for pipes 2" and smaller and 0.009 inch for pipe sizes 2-1/2" and larger.

E. Approved Manufacturers: Armstrong, Anvil International, Keckley, Metraflex, Mueller, Spirax-Sarco, Victaulic, Watts, Yarway, Titan.

2.13 FLEXIBLE PIPING CONNECTORS:

A. Refer to Related Section 220548 - Vibration Control.

2.14 PIPE ANCHORS:

A. Provide pipe anchors where shown and as detailed on drawings.

2.15 PIPING TRANSITIONS:

A. For transitions between ductile iron pipe and other pipe materials, refer to the requirements for hubless joints found elsewhere in this specification.

B. When two different pipe materials must be joined such as cast iron, clay, steel, copper or plastic, provide transition fittings specifically designed for that purpose and that are manufactured in compliance with the standards relevant for the pipes joined. Transitions shall have equal corrosion resistance to the pipes joined.

C. For dissimilar metal connections, see “Dielectric Fittings”.

2.16 SLEEVE-SEAL SYSTEMS

A. Approved Manufacturers:

1. EnPro Industries “Link Seal”
2. Advance Products & Systems, Inc.
3. Metraflex Company (The).
4. Proco Products, Inc.

B. Description: Modular sealing-element unit, designed for field assembly, for filling annular space between piping and sleeve. Shall provide a water-proof seal between the pipe and sleeve at up to 20 psig head pressure. Each link and pressure plate shall include permanent identification of size and manufacturer's name. Manufactured in an approved ISO-9001:2000 facility.

C. Sealing Elements: EPDM-rubber interlocking links shaped to fit surface of pipe.

D. Pressure Plates: Molded of glass reinforced nylon.

E. Connecting Bolts and Nuts: Mild steel with a 60,000 psi minimum tensile strength and 2-part Zinc Dichromate coating per ASTM B-633 and Organic Coating, tested in accordance with ASTM B-117 to pass a 1,500-hour salt spray test. Of length required to secure pressure plates to sealing elements.

F. Sleeves:

1. Galvanized steel, ASTM A53/A53M, Schedule 40, with plain ends and welded steel collar, zinc coated. Steel Sleeve sizes 12” and larger shall be 0.375” thick or standard pipe wall thickness. Sleeves through wall shall be cast in place and the pipe shall be installed centered in the sleeve. Provide 2” collar (water-stop) of steel to match sleeve, welded all around on both sides to the sleeve at the point on the sleeve that positions it at the mid-point of the structural wall when the sleeve is in place.
2. Molded non-metallic high density polyethylene sleeves (HDPE) with integral hollow, molded water-stop ring four inches larger than the outside diameter of the sleeve itself. End caps and reinforcing ribs, manufactured in an approved ISO-9001:2000 facility. With nailer flange.

PART 3 - EXECUTION

3.1 GENERAL PIPING INSTALLATION REQUIREMENTS:

A. Work shall be done in accordance with applicable ordinances and codes. Arrange for inspections.

B. For domestic potable water applications, maintain a nitrogen purge during brazing to prevent deposit formation inside the pipe, so that the inner pipe surface remains clean. Properly ventilate the area outside the pipe to avoid unsafe levels of nitrogen.

C. Install pipe components and joining systems in accordance with the manufacturer's installation instructions.

D. Install piping to permit complete draining. Provide capped hose end ball type drain valves at all low points.

EXPANSION OF PIPING MUST BE CONSIDERED IN DESIGN, AND ENGINEERED ON DRAWINGS, INCLUDING DIMENSIONED EXPANSION BENDS IF APPLICABLE.

E. If water (flushing water, closed loop system water, blow down, etc.) or hydronic system fluids have a pH between 5.0 and 10.0 and meets the requirements of City of Ann Arbor Sewer Use Ordinance, it may be discharged to the sanitary sewer. If the water does not meet the sewer discharge limits, contact U-M Environment, Health and Safety (EHS) Hazmat at 763-4568 for proper disposal. City of Ann Arbor Sewer Use Limitations (Chapter 28 Sewage and Sewage Disposal, subsection 2:43.1. Prohibited discharges.) can be found at:

1. http://www.municode.com/resources/gateway.asp?pid=11782&sid=22
2. or by contacting U-M EHS - Environmental Protection & Permitting Program at 936-1920.

F. Installed piping shall be free from sagging. Provide for expansion and contraction of piping in an approved and safe manner by means of loops or offsets, where mechanical expansion joints are not specifically called for.

G. Branch connections from horizontal steam, steam condensate, and gaseous system mains shall be taken off the top, up at a 45-degree angle, or off the side.

H. Branch connections from horizontal hydronic system mains shall not be taken off the main bottom, or at less than 45 degrees from horizontal.

I. Branch piping shall be valved at the branch connection points.

J. Provide fittings and specialties necessary to properly interconnect all items, whether or not shown in detail.

K. Piping shall remain protected and capped until just prior to connection. Immediately after assembly, restore all protection and cap unprotected ends to prevent odors, dust, moisture, and other debris from entering the piping system.

L. Clean and swab-out all piping before installation.

M. Lay out pipe lines straight, plumb and in true alignment. Offset as required to avoid interference with other work, to conceal piping, to allow maximum headroom and to avoid interference with windows and doors. Lay out all pipes and establish their levels from bench marks, existing floors or finished grades.

N. Piping shall be concealed unless indicated otherwise on drawings. Do not conceal piping until it has been inspected, tested, flushed and approved.

O. Use eccentric reducing fittings to increase or decrease pipe sizes. Bushings are not acceptable. Orient reducers to prevent trapping of water.

P. Lubricate flange bolts and install with hardened flat washers. Use a torque wrench to tighten flange bolts to the gasket manufacturer's recommended torque.

Q. Locate groups of pipe parallel to each other, spaced to permit applying insulation and servicing of valves. Install hot and cold water lines at least 6 inches apart.

R. Install piping at least 3 inches clear of electrical conduit. Do not install pipe within the National Electrical Code (NEC) working space zone of electrical equipment. Examples:

1. Above the footprint of electrical equipment in the zone extending 6' above the installed height of the equipment.
2. Within the NEC working space in front of the electrical equipment. NEC working space varies depending on voltage and other factors, typically for equipment 600 volts or less it extends from the floor to the height of the equipment or 6'-6", whichever greater, 3'-6" in front of the equipment, and for the width of the equipment or 30", whichever is greater.

Verify NEC clearance requirements prior to installing work. Note that variable frequency drives are considered electrical equipment.

S. Pipe extending into finished areas shall have chrome plated escutcheons large enough to cover pipe sleeves and shall fit snugly over pipe or insulation.

T. Pitch piping as follows, but not less than required by code:

1. Hydronic piping up in direction of flow at 1/16" per foot
2. Steam piping down in direction of flow at 1/16" per foot
3. Vent piping back toward waste at 1/16" per foot
4. Waste, condensate and compressed air piping down in direction of flow at 1/8" per foot.

U. Join hubless, cast-iron soil piping according to CISPI 310 and CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for hubless-piping coupling joints.

1. Support vertical pipe at no less than every floor level, at the base of each riser, and at every riser offset.
2. Support horizontal pipe 5" diameter and greater with a minimum of two pipe hangers between couplings, except sections of pipe less than 4 feet in developed length are permitted to be supported with no less than one hanger between couplings.
3. All horizontal piping 5" diameter and greater shall be restrained or braced to prevent movement at each joint at every direction change and at each branch connection.

4. Provide pipe hangers to support every horizontal branch connection; provide sway bracing when pipe is suspended in excess of 18" by non-rigid hangers, and comply with all other bracing, support, and installation recommendations and suggestions in the CISPI Handbook.
5. Provide hangers and supports to eliminate all misalignment at couplings.
6. Tighten all clamps to coupling manufacturer's recommended torque, using a torque wrench.
7. *Joints between dis-similar pipe materials shall be restrained.*

V. Sanitary and storm piping shall be anchored upstream of the first coupling at the point of building exit (interior side) to prevent movement due to back surges, by permanent blocks, bracing, threaded rodding anchored to the exterior wall, or other suitable means.

3.2 NATURAL GAS PIPING INSTALLATION REQUIREMENTS:

A. Install, inspect, test, and purge natural gas systems in accordance with NFPA 54, and local utility requirements.

SPEC EDITOR: INDICATE ON THE DRAWINGS, THE ROUTING AND TERMINATION LOCATION OF THE CONDUIT VENT PIPE.

B. Gas piping in air plenum ceilings shall be continuously welded or installed in air-tight conduit constructed of Schedule 40 seamless black steel pipe with welded joints. Vent conduit to the outside and terminate with a screened vent cap. Valves shall not be installed in plenums.

C. Drips and Sediment Traps: Install a drip leg at inlet to terminal equipment, points where condensate may collect, and at the outlet of the gas meter. Do not install drips where condensate is likely to freeze. Construct drips using a tee with plugged or capped bottom outlet. Drip shall be minimum of 3 pipe diameters long, same size as pipe. Locate drips to permit cleaning and emptying.

3.3 UNDERGROUND PIPING INSTALLATION REQUIREMENTS

A. Piping below grade intersecting tunnel walls, basement walls, or penetrating floors, shall be run through a sleeve seal system.

1. Size sleeves and select sleeve seal links per sleeve seal manufacturer’s recommendations.
2. Install sleeves and seals per manufacture’s recommendations. Center sleeve water stops at midpoint of wall/floor thickness. Provide temporary support to avoid sleeve collapse during pours.

B. Record as-built sketches and dimensions prior to backfilling.

3.4 GROOVED PIPING

A. Install couplings from the same manufacturer as the grooved fittings. The same grooved component manufacturer shall be installed for the entire scope of the work, for each system.

B. Groove pipe per manufacturer's requirements. Grooving tools shall be the same manufacturer as the couplings and fittings. Use special roll sets for copper and stainless steel pipe when required by the manufacturer.

C. Lubricate gaskets with manufacturer's recommended gasket lubricant. Use NSF-61 approved lubricant for domestic water piping. The gasket style and elastomeric material (grade) shall be verified as suitable for the intended service. Gaskets shall be molded and produced by the grooved coupling manufacturer.

D. Allow room for pipe expansion for couplings that allow pipe ends to separate before the joint acts in a fully restrained manner, for example, certain couplings used on stainless steel pipe.

E. Tighten coupling as recommended by the manufacturer. Use a torque wrench and tighten bolts to required torque level when required by the manufacturer.

3.5 WELDING:

A. All welding shall be performed by registered welders qualified to perform welding operations in accordance with the National Certified Pipe Welding Bureau's procedures and standards, ASME Code Standards and the HPACCNA Standard Manual of Welding.

B. Submit a certified copy of "Record of Pipefitter Welder Performance Qualification Test" of any employees who will be doing welding on this project.

C. No welding to building work shall be allowed without approval of Engineer.

D. Except where prohibited by the Reference Standards, code, or ordinance, Black steel piping larger than 6-inch diameter may be welded with chill rings.

SPEC EDITOR: DELETE THE FOLLOWING PARAGRAPH IF NO STEAM OR CONDENSATE OVER 15 PSIG

E. Mitered turns will not be allowed. Turns shall be made with factory-made ASME B16.9 long radius wrought steel buttwelding fittings.

F. Except where prohibited by the Reference Standards, code, or ordinance, branch take-offs with manufactured formed nipples will be permitted provided nipple size is at least two pipe sizes smaller than the main size. Formed nipples shall be Bonney Forge "Weldolets", "Threadolets", "Sockolets". In all other cases, use factory-made ASME B16.9 wrought steel buttwelding tee fittings.

G. Shop welded pipe assemblies shall have all welds plainly stamped by the welding operator for inspection by the Engineer before installation.

3.6 PROTECTION AGAINST FREEZING:

A. At any time that any of the piping is full of water for testing purposes or otherwise prior to actual heated operation, the system shall be protected against freezing by the introduction of pre-mixed propylene glycol type anti-freeze which will be flushed out before acceptance. Provision for introducing anti-freeze shall be made by means of valved connections to the system in an acceptable manner.

3.7 INSTALLATION OF PIPE HANGERS AND SUPPORTS:

A. Arrange pipe hangers and supports to permit proper pitch of piping, free to move with pipe expansion, installed at proper intervals to totally prevent sagging and attached to building construction through approved means. Hangers shall be located near or at changes in piping direction and concentrated loads. Valves, strainers, in line pumps and other heavy equipment shall be supported independent of the pipes. After systems have been installed and filled adjust hangers and supports to evenly distribute weight, and maintain proper pitch. Refer to drawings for pipe hanger and support details.

PARA. B MAY BE CONSERVATIVE, REVIEW AND EDIT, OR DETAIL ON DRAWINGS

B. Vertical Piping: When support locations are not indicated on the drawings, support piping at every floor level.

NOTE THAT HANGER SPACING IS TO APPEAR ON THE DRAWINGS - OR "APPLICABLE CODES" WILL DICTATE

C. Horizontal Piping Hanger Spacing: Space hangers in compliance with schedule on drawings and applicable codes, or per MSS SP-89, which ever results in shortest spacing.

D. For cold piping, install hangers and supports to maintain an effective continuous thermal and vapor barrier between cold piping and hangers and supports.

THE BELOW REQUIREMENTS FOR PLASTIC PIPE ARE GENERAL IN NATURE. THE DESIGNER SHOULD CAREFULLY SPECIFY HANGERS AND SUPPORTS AND PROVIDE DETAILS TO ASSURE PROPER SUPPORT AND TO ACCOMMODATE THE THERMAL EXPANSION OF PLASTIC PIPE.

E. Plastic Piping: Hang and support in compliance with manufacturer's recommendations. At hangers and supports, including "Unistrut®" style channel supports, install to prevent plastic pipe contact with metal (exception: angle iron may be used for continuous support, provided all sharp edges are removed). Anchor piping only where required for expansion loops or to protect against pressure surges, etc. Compression style clamps/supports shall not be used. Use plastic pipe sleeves or equivalent as guides at all other locations, to allow longitudinal thermal expansion and to prevent lateral pipe movement. Compression style riser clamps shall not be used, use other support methods such a supporting at fitting shoulders. Support valves and other significant weight components independent of pipe. Space hangers no farther than manufacturer's recommendations for the application temperature but in no case farther than recommended for 100 deg. F application temperature. Continuously support all piping 1.5-inch nominal diameter or less (exception: PVC pipe connected to sump pumps). Provide thrust restraints where piping is subject to cyclic pressure surges, e.g. on/off pump applications.

3.8 INSTALLATION OF PIPE SLEEVES:

A. Install pipe sleeves where piping passes through building construction including all walls, floors and ceilings.

B. For new wall construction, promptly and accurately locate and securely set sleeves in forms before concrete is poured. For masonry construction, set the sleeves over the piping for Masonry Contractor to build around.

3.9 INSTALLATION OF STRAINERS:

A. Provide Y-strainers in steam, condensate, or water piping preceding control valves, traps, pumps, pressure regulating valves and elsewhere as shown on drawings.

B. Install strainer elements prior to flushing piping. Remove, clean and reinstall during flushing.

C. On all strainers 2-1/2" or larger, provide a ball valve on the strainer blowdown port sized to match the blowdown port size on all strainers 1 1/2" and larger. Provide a 3/4" hose connection with cap on the ball valve.

D. Install Y-type strainers in horizontal steam lines so the screen pocket is in the horizontal plane.

E. Rotate screen removal flange so the blowdown port is at the lowest point.

F.

3.10 TRENCHING AND BACKFILLING:

USE THIS ARTICLE ONLY IF NOT COVERED IN ANOTHER DIVISION.

A. All trenching and backfilling required for the proper installation of the work shall be done as prescribed in other Divisions.

B. Excavate trenches so that pipe can be installed at proper depth. Lay pipe on a firm bed bearing its full length except at the bell. Where sewers are installed in backfilled areas, provide machine tamping and be responsible for any settling at, or rupture to the sewer work. Keep trenches water free and as dry as possible during bedding, laying and jointing. After the joints are made, place sufficient backfill along each side of pipe to offset conditions that might tend to move the pipe off line and grade.

C. Backfill only after pipes have been tested, inspected and approved.

D. Piping encountered in excavating, (if shown on the drawings or not), shall be supported, and protected from damage. If utility lines are encountered, notify the Owner's Representative and do not disturb the lines unless so directed. If existing utility lines are damaged during excavations, immediately repair the lines at no cost to the Owner.

E. Storm and sanitary piping may be installed side by side in same trench. Water piping may be installed in same trench with drainage piping, provided trench is benched so the water pipe may be laid on a shelf of firm earth not less than eighteen inches (18") above top of drain pipe.

F. No excavation for pipe shall be made in filled or disturbed earth until it has been compacted as directed.

G. Restore street pavements, curbs and sidewalks disturbed in the performance of this work. Restore in a manner prescribed by authorities having jurisdiction.

H. Where mains are to pass under roadways or in any locations where open ditches are dangerous or undesirable, the work is to be installed by tunneling. In all other locations, excavations shall be done by the open trench method and to the depths and widths as may be necessary. All material excavated shall be deposited on the sides of the trenches and beyond the reach of slides.

I. Supports:

1. Where lines pass under footings for walls or columns, or lower than adjacent footings, backfill trenches with concrete up to the level of the bottom of the footings.
2. Where pipes pass over column footings, or are laid in filled ground, or above the original natural grade, or in soil of insufficient bearing quality, or in other cases where necessary, they shall be supported by creosoted timbers carried by brick piers or piles or other approved supports carried down to firm bearing as approved.

J. Provide shoring, bracing or sheet piling necessary to maintain the banks of the excavations, or tunnels. Take same out as the work is backfilled. Shoring must prevent any movement of the trench banks and strains on the piping and utility lines.

3.11 FLUSHING AND CLEANING OF PIPING:

A. Flush and clean the following piping systems:

CUSTOMIZE FOR SPECIFIC PROJECT, IN CONJUNCTION WITH COMMISSIONER.

Domestic Cold Water (flush only)
Domestic Hot Water (flush only)
Steam and Condensate (flush only)
Chilled Water Supply and Return (flush and clean)
Heating Hot Water Supply and Return (flush and clean)
Cooling Tower Water Supply and Return (flush and clean)

B. Develop plan for flushing and cleaning piping. Submit plan for approval prior to completion of piping. Provide all temporary and permanent piping, equipment, materials necessary to complete flushing and cleaning.

C. Prior to flushing, swab out underground piping to remove all particulate.

D. Prior to flushing, temporarily remove, isolate or bypass dirt sensitive equipment and devices, including the following:

LIST BELOW TO SUIT PROJECT

1. Automatic flow control valves
2. Heating and cooling coils
3. Boilers
4. Chillers
5. Heat exchangers
6. Flow measuring devices

Reinstall after flushing is complete.

E. Prior to flushing, install fine mesh construction strainers at inlet to all equipment. Install fine mesh construction element in permanent strainers. During flushing and cleaning, remove and clean strainers periodically. At completion of final flush, clean permanent strainers, remove construction strainers.

CUSTOMIZE THE FOLLOWING PARAGRAPH IN CONJUNCTION WITH U-M PROJECT MANAGER AND COMMISSIONER. IDEALLY, PIPING SHOULD BE FLUSHED A MINIMUM OF ONE HOUR AT 6' PER SECOND. IN PROJECTS WHERE THIS IS SPECIFIED AND NO WATER SOURCE IS IMMEDIATELY AVAILABLE, HAVE CONTRACTOR PROVIDE SOURCE OF WATER, PIPING, HOSES AND PUMPS AS REQUIRED TO FLUSH PIPING.

F. Flushing for new piping: Flush all piping with cold water (or fire protection system where approved by owner) for a minimum of one hour, until water runs clear. Water supply shall be equivalent to piping to be flushed. Use (2) 2-1/2” fire hose connections for piping 3” and larger. Drain all low points.

THE FOLLOWING PARAGRAPH IS TYPICALLY USED FOR CLEANING A COMPLETE HYDRONIC SYSTEM USING SYSTEM PUMPS, CIRCULATING THROUGH THE ENTIRE SYSTEM. NOT APPLICABLE FOR MINOR PIPING MODIFICATIONS.

G. Chemical Cleaning for new and existing hydronic piping: Where flushing could not be completed at 6 feet per second, or where chemical cleaning is required for new and existing piping, circulate flush water and clean strainers prior to installing cleaning chemicals. Provide cleaning chemicals, under the direction of the owner's chemical supplier. Following flushing, install cleaning chemicals and circulate through the entire system for a minimum of one hour, or as directed by chemical supplier. Take water sample for owner's use. Drain system, including all low points. Flush, drain and fill system, circulate for one hour, sample for owner's use. Drain, flush, fill, circulate and sample until system is free of cleaning chemicals, as indicated by owner's analysis of samples.

EDIT BELOW, ADD ESTIMATED SYSTEM VOLUME.

1. Estimated system volume for Hot Water Heating System:
2. Estimated system volume for Chilled Water System:
3. Estimated system volume for Condenser Water System:

THE FOLLOWING PARAGRAPH IS NOT TYPICALLY USED. DELETE, OR EDIT CAREFULLY FOR SPECIFIC PROJECT

H. Special Provisions for Chemical Cleaning: Provide temporary pumps and piping to chemically clean piping at a minimum velocity of 6 fps without using the system pumps. Otherwise comply with chemical cleaning requirements stated above. These special provisions are required for the following piping systems:

1. _____
2. _____
3. _____

THE FOLLOWING PARAGRAPH IS NOT TYPICALLY USED. DELETE, OR EDIT CAREFULLY FOR SPECIFIC PROJECT

I. Provide temporary bypass piping around the following equipment:

1. _____
2. _____
3. _____

3.12 PIPING SYSTEMS PRESSURE TESTING

A. General

1. Test new systems only, from point of connection to the existing systems. Perform initial tests and correct deficiencies prior to requesting acceptance test.
2. Perform acceptance pressure tests in the presence of the authorities having jurisdiction. Acceptance tests must be satisfactorily completed before piping surfaces are concealed.

3. Pneumatic tests shall be conducted using dry, oil free compressed air, carbon dioxide or nitrogen. Evacuate personnel not directly involved in testing prior to performing pneumatic testing. Perform testing in two stages, initial and acceptance. Conduct initial testing at 5 PSI or less. Swab joints with a commercial leak detector. Repair deficiencies prior to testing at higher pressures. Under no circumstances shall plastic piping of any type be pneumatically tested, including pre-acceptance tests.
4. Components shall be removed or isolated during testing if damage may occur due to test pressure and/or test media.
5. Existing steam and hot water piping connected to piping to be tested shall be shutoff, drained and cooled before testing.

B. Acceptance Pressure Testing:

NOTE THAT THIS SPEC DOES NOT INDICATE ACTUAL PRESSURE TESTING VALUES. IT IS NECESSARY TO INCLUDE A PRESSURE TEST TABLE, SUCH AS THAT AVAILABLE FROM THE U-M AEC WEBSITE, ON THE PROJECT DOCUMENTS. EDIT THE TABLE TO MAKE IT PROJECT SPECIFIC. ALSO EDIT BELOW PARAGRAPH AS APPROPRIATE.

1. Perform acceptance pressure testing per table:

Piping System Pressure Test Table

System	Media	Pressure (*)	Permissible Press.Drop
Above Ground Water	Water	200 PSIG	1 PSIG in 2 Hrs
Steam and Condensate	Water	125 PSIG	1 PSIG in 2 Hrs
Lab Vacuum	Air	75 PSIG	2 PSIG in 2 Hrs
Compressed Air	Air	150 PSIG	2 PSIG in 2 Hrs
Natural Gas	Air	100 PSIG	0 PSIG in 2 Hrs
Waste and Vent	Water	10 Feet	Leakage in 10 Min

(*) Or 1½ times Operating Pressure, whichever is greater.

2. Remake leaking gasket joints with new flange bolting. Where welded joints fail, submit proposed method of repair for approval by the Owner's representative and authorities having jurisdiction.
3. For each system tested, provide a certificate testifying that the system was satisfactorily tested and passed, using owner furnished forms.

3.13 FLUSHING, DISINFECTING, AND TESTING DOMESTIC WATER

A. Flush, disinfect and test domestic water piping as follows:

1. Prior to disinfection, flush all domestic water piping as described under Flushing and Cleaning of Piping.
2. Purge and disinfect domestic water piping per plumbing code and City of Ann Arbor requirements. Do not use excessive amounts of disinfectant as it may damage piping seals.
3. Submit water samples in sterile bottles to the City of Ann Arbor. Repeat the procedure if the biological examination made by the City of Ann Arbor shows evidence of contamination.

B. Prepare reports for all purging and disinfecting activities. Furnish owner final copy of test results for acceptance.

3.14 DYE TESTING - STORM AND SANITARY WASTE

DYE TESTING IS TYPICALLY REQUIRED ON ALL UNDERGROUND STORM AND SANITARY CONNECTIONS, NEW CONNECTIONS TO CONCEALED STORM AND SANITARY PIPING, AND ON ALL PROJECTS CONTAINING MORE THAN 10 NEW PLUMBING FIXTURES. DYE TESTING LINK UPDATED IN 2 PLACES BELOW ON 10/1/13 PER REQUEST OF JODY SCHAUB OF U-M EHS ON SAME DATE.

A. Conduct Dye Testing on storm and sanitary piping connections as specified herein and in compliance with U-M EHS "Dye Testing Guidelines for Storm Water and Sanitary Systems" (Refer to http://www.ehs.umich.edu/environment/dye.shtml).

1. Dye testing is not required if all of the following apply:
   a. Minor renovation with fewer than 10 total fixtures.
   b. All piping can be clearly, visually traced back to clearly labeled existing piping.
   c. No new underground connections.

B. Preconstruction Phase: Prior to beginning demolition and construction activities:

1. Identify point of connection for all storm and sanitary connections. Provide pipe labels on existing piping if required for clear identification.
2. Identify dye test validation points in conjunction with U-M EHS (in general, first manhole outside the building).
3. Develop dye testing plan in conjunction with U-M EHS and U-M Project Manager or assignee.

C. Demolition and Construction Phase:

1. Furnish dye and conduct dye testing of all new connections to new and existing storm and sanitary piping prior to making connection. Coordinate testing with U-M Project Manager, U-M EHS and U-M Code Inspector. No dye testing shall be performed without explicit consent of code inspector. (Refer to http://www.ehs.umich.edu/environment/dye.shtml for dye requirements.)
2. Correct any cross-connect conditions revealed by the testing and retest to validate corrections.

D. Post-Construction:

1. Conduct additional dye testing at plumbing fixtures when instructed by U-M EHS (where new illicit connection is suspected).

3.15 MECHANICAL SYSTEM FLUID HANDLING

A. Glycol Handling:

1. Disposal of glycol (propylene or ethylene) into Sanitary Waste or Storm Water systems is strictly forbidden by City of Ann Arbor regulations, U-M EHS Department, and State of Michigan requirements.

2. Where indicated, remove and properly dispose of glycol mixture from hydronics systems. Drained mixture and associated flush water (flushing must be done until the water leaving the system has allowably low levels of glycol per U-M EHS - 4 system flushes minimum) is considered Liquid Industrial Waste unless otherwise notified by U-M EHS. Mixture shall be removed and disposed of by U-M EHS approved sub-contractors only. Contact U-M EHS HazMat at (734) 763-4568 for current approved sub-contractors

END OF SECTION 221113