SECTION 23 2113

HYDRONIC PIPING

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LANL MASTER SPECIFICATION SECTION

Word file at <http://engstandards.lanl.gov>

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| Rev. 6 Summary of ChangesInserted test pressures and duration for piping pressure tests. Updated Code references. Clarified use of unlisted components from the LANL Reputable Manufacturers’ List. |

**This section is for water from vacuum to 350 psig and temperature from 0–250 deg F (ASME B31.9-2020 scope).**

**This template must be edited for each project**. In doing so, Specifier must add job-specific requirements. Brackets are used in the text to indicate designer choices or locations where text must be supplied by the designer.  Once the choice is made or text supplied, remove the brackets.  The Section must also be edited to delete requirements for processes, items, or designs that are not included in the project -- and specifier’s notes such as these.

To seek a variance from requirements in the Section that are applicable, contact the Engineering Standards Manual Mechanical [POC](http://engstandards.lanl.gov/POCs.shtml#mech). Please contact POC with suggestions for improvement as well.

When assembling a specification package, include applicable Sections from all Divisions, especially Division 1, General requirements.

Section developed for ML-4 projects.  For ML-1, 2, and 3 applications, additional requirements might be necessary if increased confidence in procurement or execution is desired, and independent review is necessary. See ESM Chapter 1 Section Z10 Specifications and Quality sections.
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1. GENERAL
	1. SECTION INCLUDES
		1. Site and building pipe materials, fittings, valves, and accessories for process cooling water, chilled water, heating hot water, tower water, blow down piping, equipment drains, and overflow piping.
		2. [For water treatment piping, see Section 23 2500, *HVAC Water Treatment.]*
		3. [For potable water systems, see Section 22 1100, *Facility Water Distribution.]*
		4. [For make-up water systems for cooling towers and process water loop see Section 22 1100*, Facility Water Distribution*.]
	2. RELATED SECTIONS
		1. Section 01 4200, *References*.
		2. Section 01 2500, *Substitution Procedures.*
		3. Section 01 4000, *Quality Requirements.*
		4. Section 01 4115, *Pressure Safety Submittals*
		5. Section 01 4444, *Offsite Welding & Joining Requirements.*
		6. Section 01 4455, *Onsite Welding & Joining Requirements.*
		7. Section 01 4631, *Welding of ASME B31 Piping*
		8. Section 01 4731, *Flange Assembly for B31 Systems*
		9. [Section 01 8113, [LEED v4 and]Guiding Principles 2020: *Requirements for water efficiency, energy efficiency, material composition, and indoor air quality requirements*]
		10. Section 22 0529, *Hangers and Supports for Plumbing Piping and Equipment.*
		11. Section 22 0548.23, *Vibration and Seismic Controls for Mechanical Systems*
		12. Section 22 0554, *Identification for Plumbing, HVAC, and Fire Piping Equipment.*
		13. Section 22 0713, *Plumbing and HVAC Insulation.*
		14. Section 22 0813, *Testing Piping Systems.*
		15. Section 23 2500, *HVAC Water Treatment.*
		16. Section 25 5000, *Integrated Automated Facility Controls*
		17. Section 31 2000, *Earth Moving*
	3. REFERENCES

The following are the code of record that the design and fabrication must meet.

* + 1. ASME B31.9 – [2020]

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In the listing below, Designer must eliminate standards that are not applicable to the project. Then, designer must either (1) specify each B31.9-listed materials’ national standard edition for each remaining standard listed or (2) determine latest is equivalent. Then modify 1.3.B to either (1) keep the first option—and also list the edition year after each standard number (e.g., ASTM F493-04) or (2) keep the second option.

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* + 1. [All national standards invoked herein shall be taken to be the edition in effect for the code of record listed above in 1.3.A and shown below, unless noted otherwise] [All national standards invoked below and herein shall be taken to be the latest edition].

astm International

* + 1. ASTM A48, *Standard Specification for Gray Iron Castings*
		2. ASTM A53, *Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless*
		3. ASTM A105, *Standard Specification for Carbon Steel Forgings for Piping Applications*
		4. ASTM A108, *Standard Specification for Steel Bar, Carbon and Alloy, Cold-Finished*
		5. ASTM A126, *Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings*
		6. ASTM A197, *Standard Specification for Cupola Malleable Iron*
		7. ASTM A234, *Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service*
		8. ASTM A307, *Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60000 PSI Tensile Strength*
		9. ASTM A536, *Standard Specification for Ductile Iron Castings*
		10. ASTM A563, *Standard Specification for Carbon and Alloy Steel Nuts*
		11. ASTM A575, *Standard Specification for Steel Bars, Carbon, Merchant Quality, M-Grades*
		12. ASTM B16, *Standard Specification for Free-Cutting Brass Rod, Bar and Shapes for Use in Screw Machines*
		13. ASTM B32, *Standard Specification for Solder Metal*
		14. ASTM B68, *Standard Specification for Seamless Copper Tube, Bright Annealed*
		15. ASTM B75, *Standard Specification for Seamless Copper Tube*
		16. ASTM B88, *Standard Specification for Seamless Copper Water Tube*
		17. ASTM B280, *Standard Specification for Seamless Copper Tube for Air Conditioning and Refrigeration Field Service*
		18. ASTM B584, *Standard Specification for Copper Alloy Sand Castings for General Applications*
		19. ASTM D1785, *Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120*
		20. ASTM D2466, *Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40*
		21. ASTM D2467, *Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80*
		22. ASTM D2564, *Standard Specification for Solvent Cements for Poly(Vinyl Chloride) (PVC) Plastic Piping Systems*
		23. ASTM D2855, *Standard Practice for the Two-Step (Primer and Solvent Cement) Method of Joining Poly (Vinyl Chloride) (PVC) or Chlorinated Poly (Vinyl Chloride) (CPVC) Pipe and Piping Components with Tapered Sockets*
		24. ASTM F1545, *Standard Specification for Plastic-Lined Ferrous Metal Pipe, Fittings, and Flanges*
		25. ASTM G62, *Standard Test Methods for Holiday Detection in Pipeline Coatings*
		26. American Welding Society: AWS A 5.8, *Specification for Filler Metals for Brazing and Braze Welding*

American Water Works Association

* + 1. AWWA C110, *Ductile-Iron and Gray-Iron Fittings*
		2. AWWA C111, *Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings*
		3. AWWA C151, *Ductile-Iron Pipe, Centrifugally Cast*
		4. AWWA C153, *Ductile-Iron Compact Fittings*
		5. AWWA C606, *Grooved and Shouldered Joints*

Manufacturers Standardization Society of the Valve and Fittings Industry.

* + 1. MSS SP-25, *Standard Marking System for Valves, Fittings, Flanges, and Unions*
		2. MSS SP-67, *Butterfly Valves*
		3. MSS SP-70, *Gray Iron Gate Valves, Flanged and Threaded Ends*
		4. MSS SP-71, *Gray Iron Swing Check Valves, Flanged and Threaded Ends*
		5. MSS SP-72, *Ball Valves with Flanged or Butt-Welding Ends for General Service*
		6. MSS SP-80, *Bronze Gate, Globe, Angle, and Check Valves*
		7. MSS SP-85, *Gray Iron Globe & Angle Valves, Flanged and Threaded Ends*
		8. MSS SP-110, *Ball Valves Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends*
		9. MSS SP-125, *Gray Iron and Ductile Iron In-Line, Spring-Loaded, Center-Guided Check Valves*
		10. UL 207, Standard for Safety Refrigerant-Containing Components and Accessories, Nonelectrical
	1. SUBMITTALS
		1. ACTION submittals. Submit the following per submittal procedures prior to work:
			1. Catalog data on pipe materials, fittings, valves, and accessories.
			2. Spare Parts and Maintenance Materials list
			3. Installation, Operation, & Maintenance Manual
			4. Warranties
			5. Per the requirements of 01 4444, offsite welding and joining requirements and/or 01 4455, onsite welding and joining requirements, submit:

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When offsite only, delete submittals below regarding onsite welding. For high-risk applications such as FS1 or FS 2 or ML-1 or ML-2, add submittals for “weld filler material control procedures” and “filler material certified material test reports CMTRS)” when required. Add “post-weld heat treatment procedures” when required.

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* + - * 1. Welding procedure specification (WPS) and supporting procedure qualification record (PQR). [note: for onsite welding use of LANL WPS/PQR is the default; coordinate usage with the LANL CWI; no submittal required]
				2. Welder performance qualification records (WPQR) including continuity [NOTE: for onsite, welders are tested by LANL who will produce WPQR and track continuity; this includes brazing, bonding, and fusing; no submittal required]
				3. Inspector qualification records
				4. Inspection procedures
				5. Weld inspection report(s) and weld map(s)
			1. [Sustainable Design (LD) Submittals: Comply with requirements specified in [individual Specification Sections] Section 01 8113 - ***[LEED v4 and]*** *Guiding Principles 2020*: *Requirements for water efficiency, energy efficiency, material composition, and indoor air quality requirements]*
		1. CLOSEOUT Submittals.
			1. Submit under this Section the system and component documentation per Section 01 4115, Pressure Safety Submittals.
			2. Provide installation examination evidence documentation required by Article 3.1 of this Section.

1.5 QUALITY ASSURANCE

* + 1. Welders Certification and Qualified Procedure Standards shall be per Section IX of ASME Boiler and Pressure Vessel Code. Welding per Sections [01 4444, *Offsite Welding and Joining Requirements,* and/or 01 4455, *Onsite Welding and Joining Requirements*].
		2. Valve Identification: Each valve shall bear markings per MSS SP-25, including manufacturer’s name or trademark, the material of construction, and symbols to indicate the service conditions for which the manufacturer rates the valve.
		3. Component identification shall follow ESM Chapter 1, 200, Item Numbering & Labeling. At existing facilities, component labeling conventions are to be continued to be used to avoid confusion.
1. PRODUCTS
	1. PRODUCT OPTIONS AND SUBSTITUTIONS
		1. Alternate products may be accepted; follow Section 01 2500, *Substitution Procedures.*

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WARNING to DESIGNER on BRAZING: When specifying brazed joints, consider that brazing reduces the tube rating to the fully annealed condition.

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Direction to Designer on welding: Drawings shall include welding symbols complying with AWS A2.4 and showing weld size(s). Refer to Section 01 4631, Welding of ASME B31 Piping.

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Direction to Designer on flanges: Flange joint design must comply with ASME PCC-1.

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NOTE to designer: Copper tubing thickness callouts throughout are below based on LANL Alternate Method VAR- 2015-011

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* 1. HEATING WATER PIPING, BURIED OR ABOVE GROUND (SERVICE UP TO 250 DEG F)
		1. Copper Tubing: Alloy [102, 122], temper [drawn H and/or annealed O]. Thickness per UL 207, ASTM B88, B75, B68, or B280.
			1. Braze Joints
				1. Fittings: ASME B16.22, wrought copper and copper alloy, solder joint pressure fittings [and/or] ASME B16.18 cast copper alloy solder joint pressure fittings
				2. Use AWS A5.8 TB-BCuP-5 silver braze.
				3. Comply with Section 01 4444, *Offsite Welding and Joining Requirements*, and 01 4455, *Onsite Welding and Joining Requirements*].
			2. Solder joint
				1. application is restricted to [compressed air, non-flammable gas, non-toxic gas, non-toxic liquids] less than 4.125 inch OD.
				2. Fittings: ASME B16.22, wrought copper and copper alloy, solder joint pressure fittings [and/or] ASME B16.18 cast copper alloy solder joint pressure fittings
				3. Solder per ASTM B32, Alloy Grade [Sb5, Sn50, other] or UNS [L13950, L55031, other].
				4. Flux [manufacturer, material]
		2. Pipe up to 2”: black steel ASTM A53, type [E, F, S] grade [A or B], wall thickness [schedule 80]. Threaded joints per ASME B1.20.1 for pipe sizes 2 inches and under.
			1. Threaded Joints:
				1. Fittings: ASTM A197, ASME B16.3 malleable iron threaded type ASME B1.20.1.
		3. Greater than 2 inches black steel ASTM A53, type [E, F, S] grade [A or B], wall thickness [standard wall] [welded or bolted or mechanical joints]
			1. Bolted Joints:
				1. [Flanges and Flanged Fittings: Black steel, ASTM A105, ASME B16.5 class [150, 300, …2500].]
				2. Gaskets conforming to ASME B16.5 Nonmandatory Appendix B, Limiting Dimensions of Gaskets Other Than Ring Joint Gaskets, Group Ia. Gaskets used in ASME B16.5 flanges must satisfy the requirements of ASME B16.20a for metallic gaskets and ASME B16.21 for non-metallic flat gaskets.
				3. Bolts and Studs: ASTM A307, ASME [B18.2.1, …],[type of bolt], [nominal size], [thread class], [product length], [material], [finish (if required)]
				4. Nuts: ASTM A563, ASME B18.2.2, [type: heavy hex, heavy hex jam, hex thick slotted, etc…],[size], [thread class], [material], [finish (if required)]
				5. Washers: ASME B18.21.1 [type: plain, helical, tooth-lock], [material], [hardness], [nominal size], [finish (if required)]
			2. Welded Joints:
				1. Carbon steel, ASTM A234, Grade WPB, butt-welding type, ASME B16.9, Wrought Steel Butt-welding Fittings. Wall thickness same as pipe.
			3. Mechanical Joints:
				1. Pipe ends per AWWA-C606, Grooved and Shouldered Type Joints, (aka Victaulic 177N) with formed fittings and couplings (Warning: DO NOT use the reduced wall thickness fittings without express engineering direction).
				2. Fittings AWWA C606 (aka Victaulic 177N), ductile or malleable iron, service rating 86–250 deg F meeting ASTM A 536, grade [60-42-10, 70-50-05]. Grooved and Shouldered Type Joints, (aka Victaulic 177N) with formed fittings and couplings (Warning: DO NOT use the reduced wall thickness fittings without express engineering direction).
				3. [Manufacturer and model numbers]
				4. Factory reference: Installation Instructions I-177N QuickVic 7814 Rev B, Updated 01.2015 Z000177N00
			4. Outside Coating and/or Inside Lining: See Part 3, Corrosion Control
	2. PROCESS COOLING WATER, ABOVE GRADE
		1. Copper tubing alloy [102, 122] per ASME B31.9 Table I-1. Temper shall be [drawn H and/or annealed O].
			1. Braze Joints
				1. Fittings: ASME B16.22, wrought copper and copper alloy, solder joint pressure fittings [and/or] ASME B16.18 cast copper alloy solder joint pressure fittings
				2. Use AWS A5.8 TB-BCuP-5 silver braze. (Note: brazing reduces the tube rating to the fully annealed condition).
				3. Comply with Section 01 4444, *Offsite Welding and Joining Requirements,* and 01 4455, *Onsite Welding and Joining Requirements*.
			2. Solder joint
				1. Application is restricted to [compressed air, non-flammable gas, non-toxic gas, non-toxic liquids] less than 4.125 inch OD.
				2. Fittings: ASME B16.22, wrought copper and copper alloy, solder joint pressure fittings [and/or] ASME B16.18 cast copper alloy solder joint pressure fittings
				3. Solder per ASTM B32, Alloy Grade [Sb5, Sn50, other] or UNS [L13950, L55031, other].
				4. Flux [manufacturer, material]
		2. Pipe Up to 2”: black steel ASTM A53, type [E, F, S] grade [A or B], wall thickness [schedule 80]. Threaded joints per ASME B1.20.1 for pipe sizes 2 inches and under.
			1. Threaded Joints:
				1. Fittings: ASTM A197, ASME B16.3 malleable iron threaded type ASME B1.20.1.
		3. Greater than 2 inches black steel ASTM A53, type [E, F, S] grade [A or B], wall thickness [standard wall] [welded or bolted or mechanical joints]
			1. Bolted Joints:
				1. [Flanges and Flanged Fittings: Black steel, ASTM A105, ASME B16.5 class [150, 300, …2500].]
				2. Gaskets: ASME B16.5 Nonmandatory Appendix B, Limiting Dimensions of Gaskets Other Than Ring Joint Gaskets, Group Ia. Gaskets used in ASME B16.5 flanges must satisfy the requirements of ASME B16.20a for metallic gaskets and ASME B16.21 for non-metallic flat gaskets.
				3. Bolts and Studs shall be ASTM A307, ASME B18.2.1, …],[type of bolt], [nominal size], [thread class], [product length], [material], [finish (if required)]
				4. Nuts shall be ASTM A563. ASME B18.2.2, [type: heavy hex, heavy hex jam, hex thick slotted, etc…],[size], [thread class], [material], [finish (if required)]
				5. Washers shall be ASME B18.21.1 [type: plain, helical, tooth-lock], [material], [hardness], [nominal size], [finish (if required)]
			2. Mechanical Joints:
				1. Pipe ends per AWWA-C606, Grooved and Shouldered Type Joints, (aka Victaulic 177N) with formed fittings and couplings (Warning: DO NOT use the reduced wall thickness fittings without express engineering direction).
				2. Fittings AWWA C606, (aka Victaulic 177N), ductile or malleable iron, service rating 86–250 deg F meeting ASTM A 536, grade [60-42-10, 70-50-05]. Grooved and Shouldered Type Joints, (aka Victaulic 177N) with formed fittings and couplings (Warning: DO NOT use the reduced wall thickness fittings without express engineering direction).
				3. [Manufacturer and model numbers]
			3. Welded joints
				1. Carbon steel, ASTM A234, Grade WPB, ASME B16.9. Wall thickness same as pipe.
	3. CHILLED WATER PIPING, BURIED
		1. Copper Tubing: Alloy [102, 122], temper shall be [drawn H and/or annealed O]. Thickness per UL 207, ASTM B88, B75, B68, or B280.
			1. Braze Joints
				1. Fittings: ASME B16.22, wrought copper and copper alloy, solder joint pressure fittings [and/or] ASME B16.18 cast copper alloy solder joint pressure fittings
				2. AWS A5.8 TB-BCuP-5 silver braze.
				3. Comply with Section 01 4444, *Offsite Welding and Joining Requirements*, and 01 4455, *Onsite Welding and Joining Requirements].*
			2. Solder joint
				1. application is restricted to [compressed air, non-flammable gas, non-toxic gas, non-toxic liquids] less than 4.125 inch OD.
				2. Fittings: ASME B16.22, wrought copper and copper alloy, solder joint pressure fittings [and/or] ASME B16.18 cast copper alloy solder joint pressure fittings
				3. Solder per ASTM B32, Alloy Grade [Sb5, Sn50, other] or UNS [L13950, L55031, other].
				4. Flux [manufacturer, material]
		2. Ductile Iron Pipe:
			1. AWWA C151 for [3 inch, …48 inch] inch pipe size, Rated Water Working Pressure per Table 6 [150, 200, 250, 300, 350], suitable for trench Type [1, 2, 3, 4, 5].
				1. Outside Coating and/or Inside Lining See Part 3, Corrosion Control
			2. AWWA C110 Fittings:
				1. [350 psig pressure rating for [3 inch, … 24 inch], ductile-iron push-on-joint fittings or flange-joint fittings]
				2. [250 psig pressure rating for [24 inch, … 48 inch] [ductile-iron, grey-iron] ]
				3. [150 psig pressure rating for [24 inch, … 48 inch] grey-iron]
				4. AWWA C153 Ductile-Iron Compact Fittings, Class 350.
				5. Synthetic rubber gaskets meeting AWWA C111 [ring and/or full-face] conforming to AWWA C110 Table A.1.
				6. Outside Coating and/or Inside Lining: See part 3, Corrosion Control
			3. Bolted Joints:
				1. Fittings: ASME B16.42 Ductile Iron Pipe Flanges and Flanged Fittings, class [150, 300].
				2. Flange joint [bolts smaller than ¾ inch may have either standard square or heavy hex heads used with heavy hex nuts. Bolts ¾ in and larger have either square or hex heads and either hex or heavy hex nuts. Bolts and nuts threaded per ASME B1.1 Unified Inch Screw Threads (UN and UNR Thread Form) class 2A external and class 2B internal. Bolts and nuts low-carbon steel and conform to the chemical and mechanical requirements of ASTM A307, 60 ksi tensile strength, grade B. The carbon-steel bolts should be used where gray-iron flanges are installed with flat ring gaskets that extend only to the bolts. Higher-strength bolts may properly be used where gray-iron flanges are installed with full-face gaskets. Higher-strength bolts may be used where ductile flanges are installed with either ring or full-faced gaskets.]
				3. Bolts and Studs: ASTM A307, ASME B18.2.1 ,[type of bolt], [nominal size], [thread class], [product length], [material], [finish (if required)]
				4. Nuts: ASTM A563, ASME B18.2.2, [type: heavy hex, heavy hex jam, hex thick slotted, etc…],[size], [thread class], [material], [finish (if required)]
				5. Washers: ASME B18.21.1 [type: plain, helical, tooth-lock], [material], [hardness], [nominal size], [finish (if required)]
			4. Mechanical Joints:
				1. Mechanical joint bell, socket, plain ends, and accessories: AWWA C111 using [ductile-iron, grey-iron]
				2. [Manufacturers and model numbers]
		3. PVC Pipe: ASTM D1785, schedule [40][80].
			1. Fittings: PVC, schedule [40 ASTM D2466] [80 ASTM D2467].
			2. Joints: Assembly per ASTM D285 solvent weld with ASTM D2564 solvent cement for PVC D2564 or CPVC D2846.
			3. Solvent welding or thermal bonding shall comply with Section 01 4444, *Offsite Welding and Joining Requirements* and Section 01 4455, *Onsite Welding and Joining Requirements.*
				1. Pipe [Manufacturers and model numbers]
				2. Fittings [Manufacturers and model numbers]
				3. Primer [Manufacturers and model numbers]
				4. Solvent [Manufacturers and model numbers]
	4. CHILLED WATER PIPING, ABOVE GRADE
		1. Copper tubing alloy [102, 122] per ASME B31.9 Table I-1. Temper shall be [drawn H and/or annealed O].
			1. Braze Joints
				1. Fittings: ASME B16.22, wrought copper and copper alloy, solder joint pressure fittings [and/or] ASME B16.18 cast copper alloy solder joint pressure fittings
				2. Use AWS A5.8 TB-BCuP-5 silver braze.
				3. Comply with Section 01 4444, *Offsite Welding and Joining Requirements*, and 01 4455, *Onsite Welding and Joining Requirements].*
			2. Solder joint
				1. Application is restricted to [compressed air, non-flammable gas, non-toxic gas, non-toxic liquids] less than 4.125 inch OD.
				2. Fittings: ASME B16.22, wrought copper and copper alloy, solder joint pressure fittings [and/or] ASME B16.18 cast copper alloy solder joint pressure fittings
				3. Solder per ASTM B32 [year or state latest], Alloy Grade [Sb5, Sn50, other] or UNS [L13950, L55031, other].
				4. Flux [manufacturer, material]
		2. Pipe Up to 2”: black steel ASTM A53, type [E, F, S] grade [A or B], wall thickness [schedule 80]. Threaded joints per ASME B1.20.1 for pipe sizes 2 inches and under.
			1. Threaded Joints:
				1. Fittings: ASTM A197, ASME B16.3 malleable iron threaded type ASME B1.20.1.
		3. Greater than 2 inches black steel ASTM A53, type [E, F, S] grade [A or B], wall thickness [standard wall] [welded or bolted or mechanical joints].
			1. Bolted Joints:
				1. Flanges and Flanged Fittings: Black steel, ASTM A105, ASME B16.5 class [150, 300,…2500].
				2. Fittings: ASME B16.42 Ductile Iron Pipe Flanges and Flanged Fittings, class [150, 300].
				3. Gaskets: ASME B 16.5 Nonmandatory Appendix B, Limiting Dimensions of Gaskets Other Than Ring Joint Gaskets, Group Ia. Gaskets used in ASME B16.5 flanges must satisfy the requirements of ASME B16.20a for metallic gaskets and ASME B16.21 for non-metallic flat gaskets.
				4. Bolts and Studs: ASTM A307, ASME B18.2.1, …],[type of bolt], [nominal size], [thread class], [product length], [material], [finish (if required)]
				5. Nuts: ASTM A563, ASME B18.2.2, [type: heavy hex, heavy hex jam, hex thick slotted, etc…],[size], [thread class], [material], [finish (if required)]
				6. Washers: ASME B18.21.1 [type: plain, helical, tooth-lock], [material], [hardness], [nominal size], [finish (if required)]
			2. Mechanical Joints:
				1. Pipe ends per AWWA-C606, Grooved and Shouldered Type Joints, (aka Victaulic 177N) with formed fittings and couplings (Warning: DO NOT use the reduced wall thickness fittings without express engineering direction).
				2. Fittings AWWA C606, (aka Victaulic 177N), ductile or malleable iron, service rating 86– 250 deg F meeting ASTM A 536, grade [60-42-10, 70-50-05]. Grooved and Shouldered Type Joints, (aka Victaulic 177N) with formed fittings and couplings (Warning: DO NOT use the reduced wall thickness fittings without express engineering direction).
				3. [Manufacturers and model numbers]
				4. Factory reference: Installation Instructions I-177N QuickVic 7814 Rev B, Updated 01.2015 Z000177N00
			3. Welded Joints:
				1. Carbon steel, ASTM A234, Grade WPB, butt-welding type, ASME B16.9, Wrought Steel Butt-welding Short Radius Elbows and Returns. Wall thickness same as pipe.
	5. TOWER WATER PIPING BURIED
		1. Copper Tubing: Alloy [102, 122], temper [drawn H and/or annealed O]. Thickness per UL 207, ASTM B88, B75, B68, or B280.
			1. Braze Joints
				1. Fittings: ASME B16.22, wrought copper and copper alloy, solder joint pressure fittings [and/or] ASME B16.18 cast copper alloy solder joint pressure fittings
				2. AWS A5.8 TB-BCuP-5 silver braze.
				3. Comply with Section 01 4444, *Offsite Welding and Joining Requirements*, and 01 4455, *Onsite Welding and Joining Requirements*.
			2. Solder joint
				1. application is restricted to [compressed air, non-flammable gas, non-toxic gas, non-toxic liquids] less than 4.125-inch OD.
				2. Fittings: ASME B16.22, wrought copper and copper alloy, solder joint pressure fittings [and/or] ASME B16.18 cast copper alloy solder joint pressure fittings
				3. Solder per ASTM B32, Alloy Grade [Sb5, Sn50, other] or UNS [L13950, L55031, other].
				4. Flux [manufacturer, material]
		2. Ductile Iron Pipe:
			1. AWWA C151 for [3 inch, …48 inch] inch pipe size, Rated Water Working Pressure per Table 6 [150, 200, 250, 300, 350], suitable with trench type [1, 2, 3, 4, 5]
				1. Outside Coating and/or Inside Lining: See Part 3, Corrosion Control
			2. AWWA C110 Fittings:
				1. [350 psig pressure rating for [3 inch, … 24 inch], ductile-iron push-on-joint fittings or flange-joint fittings]
				2. [250 psig pressure rating for [24 inch, … 48 inch] [ductile-iron, grey-iron] ]
				3. [150 psig pressure rating for [24 inch, … 48 inch] grey-iron]
				4. AWWA C153, Ductile-Iron Compact Fittings, Class 350.
				5. Synthetic rubber gaskets meeting AWWA C111 [ring and/or full-face] conforming to AWWA C110 Table A.1.
				6. Outside Coating and/or Inside Lining: See Part 3, Corrosion Control
			3. Bolted Joints:
				1. Fittings: ASME B16.42 Ductile Iron Pipe Flanges and Flanged Fittings, class [150, 300].
				2. Flange joint [bolts smaller than ¾ inch may have either standard square or heavy hex heads used with heavy hex nuts. Bolts ¾ in and larger have either square or hex heads and either hex or heavy hex nuts. Bolts and nuts are threaded per ASME B1.1 Unified Inch Screw Threads (UN and UNR Thread Form) class 2A external and class 2B internal. Bolts and nuts are low-carbon steel and conform to the chemical and mechanical requirements of ASTM A307, 60 ksi tensile strength, grade B. The carbon-steel bolts should be used where gray-iron flanges are installed with flat ring gaskets that extend only to the bolts. Higher-strength bolts may properly be used where gray-iron flanges are installed with full-face gaskets. Higher-strength bolts may be used where ductile flanges are installed with either ring or full-faced gaskets.]
				3. Bolts and Studs: ASTM A307, ASME B18.2.1 ,[type of bolt], [nominal size], [thread class], [product length], [material], [finish (if required)]
				4. Nuts: ASTM A563, ASME B18.2.2, [type: heavy hex, heavy hex jam, hex thick slotted, etc…],[size], [thread class], [material], [finish (if required)]
				5. Washers: ASME B18.21.1 [type: plain, helical, tooth-lock], [material], [hardness], [nominal size], [finish (if required)]
			4. Mechanical Joints
				1. Mechanical joint bell, socket, plain ends, and accessories: AWWA C111 using [ductile-iron, grey-iron]
				2. [Manufacturers and model numbers]
		3. PVC Pipe: ASTM D1785, schedule [40][80].
			1. Fittings: PVC, schedule [40 ASTM D2466 or 80 ASTM D2467].
			2. Joints: Assembly per ASTM D285 solvent weld with ASTM D2564 solvent cement for PVC D2564 or CPVC D2846.
			3. Solvent welding or thermal bonding shall comply with Section 01 4444, *Offsite Welding and Joining Requirements* and Section 01 4455, *Onsite Welding and Joining Requirements.*
				1. Pipe [Manufacturers and model numbers]
				2. Fittings [Manufacturers and model numbers]
				3. Primer [Manufacturers and model numbers]
				4. Solvent [Manufacturers and model numbers]
		4. Pipe up to 18 in: Black steel, ASTM A53, type [e, f, s], grade [a, b], wall thickness [standard wall]. Bolted or mechanical joints for pipe sizes greater than 2 and up to 18 inches. Threaded joints per ASME B1.20.1 for pipe sizes 2 inches and under.
			1. Threaded Joints (up to 2 in.)
				1. Fittings: ASTM A197, ASME B16.3 malleable iron threaded type ASME B1.20.1.
			2. Bolted Joints
				1. Flanges and Flanged Fittings: Black steel, ASTM A105, ASME B16.5 class [150, 300, … 2500].
				2. Gaskets: ASME B16.5 Nonmandatory Appendix B, Limiting Dimensions of Gaskets Other Than Ring Joint Gaskets, Group Ia. Gaskets used in ASME B16.5 flanges must satisfy the requirements of ASME B16.20a for metallic gaskets and ASME B16.21 for non-metallic flat gaskets.
				3. Bolts and Studs: ASTM A307, ASME B18.2.1, …],[type of bolt], [nominal size], [thread class], [product length], [material], [finish (if required)]
				4. Nuts: ASTM A563, ASME B18.2.2, [type: heavy hex, heavy hex jam, hex thick slotted, etc…],[size], [thread class], [material], [finish (if required)]
				5. Washers: ASME B18.21.1 [type: plain, helical, tooth-lock], [material], [hardness], [nominal size], [finish (if required)]
			3. Mechanical Joints
				1. Pipe ends per AWWA-C606, Grooved and Shouldered Type Joints, (aka Victaulic 177N) with formed fittings and couplings (Warning: DO NOT use the reduced wall thickness fittings without express engineering direction).
				2. Fittings AWWA C606 (aka Victaulic 177N), ductile or malleable iron, service rating 86–250 deg F meeting ASTM A 536, grade [60-42-10, 70-50-05]. Grooved and Shouldered Type Joints, (aka Victaulic 177N) with formed fittings and couplings (Warning: DO NOT use the reduced wall thickness fittings without express engineering direction).
				3. [Manufacturers and model numbers]
			4. Welded Joints
				1. Carbon steel, ASTM A234, Grade WPB, ASME B16.9. Wall thickness same as pipe.
			5. Outside Coating: See Part 3, Corrosion Control
			6. Inside Lining: See Part 3, Corrosion Control
		5. Pipe 18” through 24”: Black steel, wall thickness [standard or schedule 40], API 5L-[year or state latest], Grade [A and/or B and/or X42], condition [as-rolled, normalizing rolled, normalized or normalizing formed].
			1. Bolted Joints:
				1. Flanges and Flanged Fittings: Black steel, ASTM A105, ASME B16.5 class [150, 300, …2500].
				2. Gaskets: ASME B16.5 Nonmandatory Appendix B, Limiting Dimensions of Gaskets Other Than Ring Joint Gaskets, Group Ia. Gaskets used in ASME B16.5 flanges must satisfy the requirements of ASME B16.20a for metallic gaskets and ASME B16.21 for non-metallic flat gaskets.
				3. Bolts and Studs: ASTM A307, ASME B18.2.1, …],[type of bolt], [nominal size], [thread class], [product length], [material], [finish (if required)]
				4. Nuts: ASTM A563, ASME B18.2.2, [type: heavy hex, heavy hex jam, hex thick slotted, etc…],[size], [thread class], [material], [finish (if required)]
				5. Washers: ASME B18.21.1 [type: plain, helical, tooth-lock], [material], [hardness], [nominal size], [finish (if required)]
			2. Welded Joints:
				1. Carbon steel, ASTM A234, Grade WPB, ASME B16.9. Pipe schedule same as pipe.
			3. Outside Coating and/or Inside Lining: See Part 3, Corrosion Control.
	6. TOWER WATER PIPING, ABOVE GRADE
		1. Copper Tubing: Alloy [102, 122], temper [drawn H and/or annealed O]. Thickness per UL 207, ASTM B88, B75, B68, or B280.
			1. Braze Joints
				1. Fittings: ASME B16.22, wrought copper and copper alloy, solder joint pressure fittings [and/or] ASME B16.18 cast copper alloy solder joint pressure fittings
				2. Use AWS A5.8 TB-BCuP-5 silver braze.
			2. Solder joint
				1. application is restricted to [compressed air, non-flammable gas, non-toxic gas, non-toxic liquids] less than 4.125 inch OD.
				2. Fittings: ASME B16.22, wrought copper and copper alloy, solder joint pressure fittings [and/or] ASME B16.18 cast copper alloy solder joint pressure fittings
				3. Solder per ASTM B32, Alloy Grade [Sb5, Sn50, other] or UNS [L13950, L55031, other].
1. [Manufacturer, model number]
	* + - 1. Flux [manufacturer, model number]
		1. Pipe up to 18”: Black steel, ASTM A53, type [E, F, S], grade [A, B], wall thickness [standard wall]. Bolted or mechanical joints for pipe sizes greater than 2 inches. Threaded joints per ASME B1.20.1 for pipe sizes 2 inches and under.
			1. Threaded Joints (up to 2 in.):
				1. Fittings: ASTM A197, ASME B16.3 malleable iron threaded type ASME B1.20.1.
			2. Bolted Joints:
				1. Flanges and Flanged Fittings: Black steel, ASTM A105, ASME B16.5 class [150, 300,…2500].
				2. Gaskets: ASME B 16.5 Nonmandatory Appendix B, Limiting Dimensions of Gaskets Other Than Ring Joint Gaskets, Group Ia. Gaskets used in ASME B16.5 flanges must satisfy the requirements of ASME B16.20a for metallic gaskets and ASME B16.21 for non-metallic flat gaskets.
				3. Bolts and Studs: ASTM A307, ASME B18.2.1, …],[type of bolt], [nominal size], [thread class], [product length], [material], [finish (if required)]
				4. Nuts: ASTM A563, ASME B18.2.2, [type: heavy hex, heavy hex jam, hex thick slotted, etc…],[size], [thread class], [material], [finish (if required)]
				5. Washers: ASME B18.21.1 [type: plain, helical, tooth-lock], [material], [hardness], [nominal size], [finish (if required)]
			3. Mechanical Joints:
				1. Pipe ends per AWWA-C606, Grooved and Shouldered Type Joints, (aka Victaulic 177N) with formed fittings and couplings (Warning: DO NOT use the reduced wall thickness fittings without express engineering direction).
				2. Fittings AWWA C606, (aka Victaulic 177N), ductile or malleable iron, service rating 86–250 deg F meeting ASTM A 536, grade [60-42-10, 70-50-05]. Grooved and Shouldered Type Joints, (aka Victaulic 177N) with formed fittings and couplings (Warning: DO NOT use the reduced wall thickness fittings without express engineering direction).
				3. [Manufacturers and model numbers]
			4. Welded Joints:
				1. Carbon steel, ASTM A234, Grade WPB, ASME B16.9. Wall thickness same as pipe.
		2. Pipe 18” through 24”: Black steel, wall thickness [standard or schedule 40], API 5L-[year or state latest], Grade [A and/or B and/or X42], condition [as-rolled, normalizing rolled, normalized or normalizing formed].
			1. Bolted Joints:
				1. Flanges and Flanged Fittings: Black steel, ASTM A105, ASME B16.5 class [150, 300,…2500].
				2. Gaskets: ASME B 16.5 Nonmandatory Appendix B, Limiting Dimensions of Gaskets Other Than Ring Joint Gaskets, Group Ia. Gaskets used in ASME B16.5 flanges must satisfy the requirements of ASME B16.20a for metallic gaskets and ASME B16.21 for non-metallic flat gaskets.
				3. Bolts and Studs: ASTM A307, ASME B18.2.1, …],[type of bolt], [nominal size], [thread class], [product length], [material], [finish (if required)]
				4. Nuts: ASTM A563, ASME B18.2.2, [type: heavy hex, heavy hex jam, hex thick slotted, etc…],[size], [thread class], [material], [finish (if required)]
				5. Washers: ASME B18.21.1 [type: plain, helical, tooth-lock], [material], [hardness], [nominal size], [finish (if required)]
			2. Welded Joints:
				1. Carbon steel, ASTM A234, Grade WPB, ASME B16.9. Wall thickness same as pipe.
	1. BLOW DOWN PIPING, ABOVE GRADE
		1. Copper tubing alloy [102, 122] per ASME B31.9 Table I-1. Temper shall be [drawn H and/or annealed O].
			1. Braze Joints
				1. Fittings: ASME B16.22, wrought copper and copper alloy, solder joint pressure fittings [and/or] ASME B16.18 cast copper alloy solder joint pressure fittings
				2. Use AWS A5.8 TB-BCuP-5 silver braze.
				3. Comply with Section 01 4444*, Offsite Welding and Joining Requirements*, and 01 4455, *Onsite Welding and Joining Requirements*.
			2. Solder joint
				1. Application is restricted to [compressed air, non-flammable gas, non-toxic gas, non-toxic liquids] less than 4.125-inch OD.
				2. Fittings: ASME B16.22, wrought copper and copper alloy, solder joint pressure fittings [and/or] ASME B16.18 cast copper alloy solder joint pressure fittings
				3. [Manufacturers and Model Numbers]
				4. Solder per ASTM B32 [year or state latest], Alloy Grade [Sb5, Sn50, other] or UNS [L13950, L55031, other].
				5. Flux [manufacturer, material]
		2. Pipe: Black steel, ASTM A53, type [E, F, S], grade [A, B], wall thickness [schedule 80]. Bolted or mechanical joints for pipe sizes greater than 2 and up to 18 inches. Threaded joints per ASME B1.20.1 for pipe sizes 2 inches and under.
			1. Threaded Joints:
				1. Fittings: Black steel, ASTM A234, butt welding type, ASME B16.9, [and/or], ASTM A197, ASME B16.3 malleable threaded type ASME B1.20.1.
				2. [Manufacturers and model numbers]
		3. Greater than 2 inches black steel ASTM A53 type [E, F, S] grade [A or B], wall thickness [standard wall] [welded or bolted or mechanical joints].
			1. Bolted Joints:
				1. Flanges and Flanged Fittings: Black steel, ASTM A105, ASME B16.5 class [150, 300,…2500].
				2. Fittings: ASME B16.42 Ductile Iron Pipe Flanges and Flanged Fittings, class [150, 300].
				3. Gaskets: ASME B 16.5 Nonmandatory Appendix B, Limiting Dimensions of Gaskets Other Than Ring Joint Gaskets, Group Ia. Gaskets used in ASME B16.5 flanges must satisfy the requirements of ASME B16.20a for metallic gaskets and ASME B16.21 for non-metallic flat gaskets.
				4. Bolts and Studs: ASTM A307, ASME B18.2.1, …],[type of bolt], [nominal size], [thread class], [product length], [material], [finish (if required)]
				5. Nuts: ASTM A563, ASME B18.2.2, [type: heavy hex, heavy hex jam, hex thick slotted, etc…],[size], [thread class], [material], [finish (if required)]
				6. Washers: ASME B18.21.1 [type: plain, helical, tooth-lock], [material], [hardness], [nominal size], [finish (if required)]
				7. [Manufacturers and model numbers]
				8. [Torque bolts for flanges of size 6 inch to 69 ft-lb; 4 inch to 49 ft-lb; and 3 inch to 73 ft-lb respectively – per Garlock requirements for full face homogenous rubber gaskets of B16.5 and 16.47 series A less than 70 durometer, #150 flat face flanges and ASTM A193 B7 and B7M bolts.]
			2. Mechanical Joints:
				1. Pipe ends per AWWA-C606, Grooved and Shouldered Type Joints, (aka Victaulic 177N) with formed fittings and couplings (Warning: DO NOT use the reduced wall thickness fittings without express engineering direction).
				2. Fittings AWWA C606, (aka Victaulic 177N), ductile or malleable iron, service rating 86–250 deg F meeting ASTM A 536, grade [60-42-10, 70-50-05]. Grooved and Shouldered Type Joints, (aka Victaulic 177N) with formed fittings and couplings (Warning: DO NOT use the reduced wall thickness fittings without express engineering direction).
				3. [Manufacturers and model numbers]
				4. Factory reference: Installation Instructions I-177N QuickVic 7814 Rev B, Updated 01.2015 Z000177N00
			3. Welded Joints:
				1. As shown in Drawings.
	2. BLOW DOWN PIPING BURIED
		1. Pipe: Black steel, ASTM A53, type [E, F, S], grade [A, B], wall thickness [schedule 80]. Bolted or mechanical joints for pipe sizes greater than 2 and up to 18 inches. Threaded joints per ASME B1.20.1 for pipe sizes 2 inches and under.
			1. Threaded Joints:
				1. Fittings: Black steel, ASTM A234, butt welding type, ASME B16.9, [and/or], ASTM A197, ASME B16.3 malleable threaded type ASME B1.20.1.
		2. Greater than 2 inches black steel ASTM A53 type [E, F, S] grade [A or B], wall thickness [standard wall] [welded or bolted or mechanical joints].
			1. Bolted Joints:
				1. Flanges and Flanged Fittings: Black steel, ASTM A105, ASME B16.5 class [150, 300, …2500].
				2. Fittings: ASME B16.42 Ductile Iron Pipe Flanges and Flanged Fittings, class [150, 300].
				3. Gaskets: ASME B 16.5 Nonmandatory Appendix B, Limiting Dimensions of Gaskets Other Than Ring Joint Gaskets, Group Ia. Gaskets used in ASME B16.5 flanges must satisfy the requirements of ASME B16.20a for metallic gaskets and ASME B16.21 for non-metallic flat gaskets.
				4. Bolts and Studs: ASTM A307, ASME B18.2.1, …],[type of bolt], [nominal size], [thread class], [product length], [material], [finish (if required)]
				5. Nuts: ASTM A563, ASME B18.2.2, [type: heavy hex, heavy hex jam, hex thick slotted, etc…],[size], [thread class], [material], [finish (if required)]
				6. Washers: ASME B18.21.1 [type: plain, helical, tooth-lock], [material], [hardness], [nominal size], [finish (if required)]
				7. [Manufacturers and model numbers]
				8. [Torque bolts for flanges of size 6 inch to 69 ft-lb; 4 inch to 49 ft-lb; and 3 inch to 73 ft-lb respectively – per Garlock requirements for full face homogenous rubber gaskets of B16.5 and 16.47 series A less than 70 durometer, #150 flat face flanges and ASTM A193 B7 and B7M bolts.]
			2. Welded Joints:
				1. As shown in Drawings.
			3. Coating: See Part 3, Corrosion Control.
	3. EQUIPMENT DRAINS AND OVERFLOWS (ALL EQUIPMENT)
		1. Pipe: Galvanized steel, ASTM A53, type [E, F, S], grade [A, B], wall thickness [schedule 80]. Bolted or mechanical joints for pipe sizes greater than 2 to 18 inches. Threaded joints per ASME B1.20.1 for pipe sizes 2 inches and under.
			1. Threaded joints
				1. Fittings: [Galvanized grey iron per ASME B16.12 and/or malleable iron ASTM A197, per ASME B16.3] Malleable iron threaded pipe unions per, B16.39].
				2. [Manufacturers and model numbers]
		2. Greater than 2 inches black steel ASTM A53, type [E, F, S] grade [A or B], wall thickness [standard wall] [welded or bolted or mechanical joints]
			1. Bolted Joints:
				1. Flanges and Flanged Fittings: Black steel, ASTM A105, ASME B16.5 class [150, 300, 2500].
				2. Gaskets: ASME B 16.5 Nonmandatory Appendix B, Limiting Dimensions of Gaskets Other Than Ring Joint Gaskets, Group Ia. Gaskets used in ASME B16.5 flanges must satisfy the requirements of ASME B16.20a for metallic gaskets and ASME B16.21 for non-metallic flat gaskets.
				3. Bolts and Studs: ASTM A307, ASME B18.2.1, [type of bolt], [nominal size], [thread class], [product length], [material], [finish (if required)]
				4. Nuts: ASTM A563, ASME B18.2.2, [type: heavy hex, heavy hex jam, hex thick slotted, etc.…],[size], [thread class], [material], [finish (if required)]
				5. Washers: ASME B18.21.1 [type: plain, helical, tooth-lock], [material], [hardness], [nominal size], [finish (if required)]
			2. Mechanical Joints:
				1. Pipe ends per AWWA-C606, Grooved and Shouldered Type Joints, (aka Victaulic 177N) with formed fittings and couplings (Warning: DO NOT use the reduced wall thickness fittings without express engineering direction).
				2. Fittings AWWA C606, (aka Victaulic 177N), ductile or malleable iron, service rating 86–250 deg F meeting ASTM A 536, grade [60-42-10, 70-50-05]. Grooved and Shouldered Type Joints, (aka Victaulic 177N) with formed fittings and couplings (Warning: DO NOT use the reduced wall thickness fittings without express engineering direction).
				3. [Manufacturers and model numbers]
				4. Factory reference: Installation Instructions I-177N QuickVic 7814 Rev B, Updated 01.2015 Z000177N00
			3. Welded Joints:
				1. Carbon steel, ASTM A234, Grade WPB, ASME B16.9. Wall thickness same as pipe.
	4. UNIONS, FLANGES, AND COUPLINGS (TOWER AND CHILLED WATER)
		1. Mechanical Couplings.
			1. Mechanical and Proprietary Joints, ductile or malleable, service rating 35–230 deg F at 300 psig, flexible type meeting AWWA-606.
			2. [Manufacturers and model numbers]
			3. Factory reference: Installation Instructions I-177N QuickVic 7814 Rev B, Updated 01.2015 Z000177N00

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Comply with ASME B31.9, *Building Services Piping*, for a maximum allowable working pressure (MAWP) of 250.

All the following components are either standard piping components (listed items) per ASME B31.9 para. 926 or have previously LANL approved unlisted component evaluations per ASME B31.9 para. 904.7.

The types of components shown may be a non-exhaustive list. Any substitutions or additions shall be ASME B31.9 compliant. All previously LANL approved B31.9 components are available in LANL ESM Ch. 17.

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* 1. VALVES
		1. Gates Valves up to 2 inches.
			1. Manufacturer: Nibco, Series 111.
			2. MSS SP-80 Class [125, 150 for threaded, or solder] ends, valve type [1A, 1B, 2, 3, or 4] bronze body, bronze trim.
		2. Gate Valves over 2 to 12 inches.
			1. Manufacturer: Nibco, Series F-617-0
			2. MSS SP-70, Class [125, 250], valve type [I, II, III, IV], construction [NF: non-rising stem, OF: outside screw and yolk], iron body, bronze trim flanged ends.
		3. Globe Valves up to 2 inches.
			1. Manufacturer: Nibco, Series 211.
			2. MSS SP-80, Class [125, 150 for threaded, or solder] ends, valve type [1, 2, or 3] bronze body, bronze trim, rising stem, hand wheel, inside screw.
		4. Globe Valves over 2 to 10 inches
			1. Manufacturer: Nibco F-718-B.
			2. MSS SP-85, Class 150 flanged ends, iron body, bronze trim, hand wheel, type [1, 2, or 3] removable bronze disc.
		5. Ball Valves up to 2 inches.
			1. Manufacturer: Nibco, Series 585-70.
			2. MSS SP 110, 150 psi non-shock cold working pressure (CWP) minimum pressure rating
			3. Bronze, two-piece body, chrome-plated brass ball, full port, Teflon seats and stuffing box ring, blowout proof stem, lever handle, solder or threaded ends.
		6. Ball Valves over 2 to 12 inches.
			1. Manufacturer: Nibco, Series F-510-CS-R-66-FS
			2. MSS SP-72, one piece body, full port ball, flange class 150, 150 psig non-shock cold working pressure (CWP) minimum,
		7. Butterfly Valves 2 inches to 12 inches
			1. Manufacturer: Nibco, Series GD-4775
			2. Standard: Design to comply with MSS SP-67, Type I (tight shut-off), AWWA C606 end connections, non-shock cold working pressure (CWP) minimum pressure rating
		8. Butterfly Flanged Valves 2 inches to 12 inches
			1. Manufacturer: Nibco, Series FD-57[6=EPDM, 7=BUNA]
			2. Standard: Design to comply with MSS SP-67, Type I (tight shut-off), flanged end connections class 150, minimum, non-shock cold working pressure (CWP) minimum pressure rating.
		9. Butterfly Wafer Valves over 2 inches to 12 inches
			1. Manufacturer: Nibco, Series WD 2000/ LD 2000
			2. Design to comply with MSS SP-67, Type I (tight shut-off). Bolting compatible with class 150 flange, 150 psig non-shock cold working pressure (CWP) minimum pressure rating.
		10. Lift Check Valves sizes up to 2 inches.
			1. Manufacturer: Nibco 473 Series.
			2. MSS SP-80, Type [1, 2] bronze, horizontal swing, Y-pattern, renewable seat and disc, non-shock cold working pressure (CWP) minimum pressure rating. Solder or threaded ends.
		11. Lift Check Valves sizes over 2 inches to 12 inches.
			1. Manufacturer: Nibco F-918-B.
			2. MSS SP-71, grey iron, type I [II, III, IV] class 125, flanged end connections, 150 psig minimum pressure rating.
		12. Spring Check Valves up to 2 inches.
			1. Manufacturer: Nibco 480 Series.
			2. MSS SP-80, Type [1, 2] bronze, horizontal swing, Y-pattern, renewable seat and disc, non-shock cold working pressure (CWP) minimum pressure rating. Solder or threaded ends.
		13. Spring Check Valves over 2 inches to 36 inches.
			1. Manufacturer: Nibco F-910-B.
			2. MSS-SP-125, Class 125, cast iron body, fluid to 200 degrees F, renewable seats and disc, spring actuated, flanged.
		14. Balancing Valves
			1. Size over 3 inches to 14 inches:
				1. Manufacturer. Griswold Controls class 150 wafer. ASTM A536 GR60-40-18, 16 inches to 24 inches Gray Iron ASTM A126-61T, Class 20, cartridge ANSI type 304 stainless steel, AISI Type 17-7 PH stainless steel spring. Compatible with ASME B16.5 class 150 steel flanges.
				2. Model Number: [specify model numbers]
			2. Size less than 3 inches:
				1. Manufacturer: Bell and Gossett
				2. Model Number: Circuit Setters cb [ ½, ¾, 1, 1 ½, 2, 2 ½][S]

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Pressure and Vacuum Gauges: Overpressure relief protection must be provided on Bourdon-tube, dial-indicating pressure gauges that operate at pressures greater than 15 psig by one of the following means:

Pressure gauges approved by Underwriters Laboratories (UL) per UL-404, “Standard for Gauges, Indicating Pressure, for Compressed Gas Service” Standard for Safety.

Tempered safety glass or plastic face or shield and a blowout back or plug for pressure relief.

Pressure gauges that serve primarily a pressure indication for overpressure protection (i.e., not used for process data collection) must have a range of at least 1.25 times, but no more than twice the set pressure of the relief device as recommended in ASME Section VIII, Div. 1, Appendix M, Para. M-14.

Refer to manufacturer’s recommendation for gauge pressure range. Generally, a pressure range of twice the expected normal pressure is recommended with maximum working pressure not exceeding 75 percent of the range. If pulsation occurs, working pressure should not exceed 65 percent of the pressure range. Pressure gauges in the suction side of the pump will be vacuum pressure gauges.
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* 1. PRESSURE GAUGES
		1. Manufacturer: Ashcroft, Type 1279 or 1009 (stainless steel)
		2. ASME B40.100, Accuracy Grade 1A, maximum plus or minus 1 percent full scale accuracy, minimum 4 1/2 inches dial, glycerin filled, phosphor bronze bourdon tube, 1/4-inch NPT brass bottom connection, phenolic case. Tempered safety glass or plastic face or shield meeting the requirements of ANSI Z97.1, and a blowout back or plug for pressure relief.
			1. [Range: [0-160] psi.]
			2. [Maximum temperature: [200 degrees F]]
			3. [Range and temperature are specified on Drawings]
			4. [Manufacturer and model numbers]
	2. THERMOMETER
		1. Manufacturer: Reotemp, Model MM
		2. ASME B40.200, Grade A, maximum plus or minus 1 percent full scale accuracy, bimetal thermometer, mercury free, minimum 4 inches dial, stainless steel case, all angle direct mount, with standard connection.
			1. Range: [ ] degrees F.
			2. Model: [ ]
	3. THERMOWELL
		1. Thermowell design meeting ASME PTC 19.3 TW
		2. Manufacturer: Daily Thermetrics, ½, ¾, or 1 inch NPT
		3. Materia: [316 stainless steel rated at 7000 psig at 70 F, brass rated at 5000 psig at 70 F]
	4. Dielectric Union
		1. Dielectric Connections.
			1. Union with galvanized or plated-steel threaded-end, copper solder-end, and water-impervious isolation barrier.
			2. Dielectric ASME B3.1 threaded fittings per ASME B16.9, 250 psi rating
			3. Dielectric flanged fittings, conforming to [ASME B16.42 (iron), ASME B16.24 (bronze)], with mandatory polysulfone bolt insulators.
			4. Materials of construction [grey iron ASTM A48, malleable iron ASTM A197, steel ASTM A108, brass ASTM B16, bronze ASTM B584]
			5. Gasket [Buna-N (180F at 250 psi), EPDM (300 F, 50psi)]
			6. Watts series 3000 dielectric
		2. Ferrous metal, plastic-lined: ASTM F1545, carbon steel ASTM A575.
			1. Manufacturer: Victaulic, Style 47
	5. Pressure Temperature Test Port
		1. Manufacturer: Pete’s Plug
			1. 316 stainless steel, ¼ inch, suitable for use in 150 psig systems. Provide extra-long (XL) plug when pipe insulation exceeds 1 in. thickness.
	6. AUTOMATIC AIR VENTS
		1. [Manufacturer: Spirax Sarco Automatic Air Vents, Model 13WS]
			1. [ASTM A126 Class B cast iron body, ASME B16.1 class 150 flanges]
		2. [Manufacturer: Bell & Gossett Automatic Air Vents, Model No. 87]
			1. [Brass body with non-ferrous internals]
			2. Rated for 150 psi and 250°F
	7. STRAINERS
		1. Basket strainer NPS size [2, … 36 inch]
			1. ASME B16.34, pressure [150…1500 psig], flange end ASME [B16.5 or B16.47].
			2. Materials [WCB, LCB, WC6, WC9, C12, C5, CF8, CF3, CF3M, CF8M].
			3. Manufacturer: Landee Valves M/N ASME B16.34 Basket Strainer, [WC6, WC9]
		2. Manufacturer: Eaton Model 510, 9 to 24 inches
			1. ASTM A126, class B compliant
			2. Bronze body, Y-type screwed end, 20 mesh stainless steel screen, for water service-WOG (non-shock) 400 psi at 210 degrees F.
		3. Eaton Model 72, 2 to 6 inches.
			1. Body: cast iron ASTM A126 Class B
			2. Screen: Stainless Steel, 1/8” perforations, ASME B16.1 class 150 flanges
	8. RELIEF VALVE
		1. Manufacturer/model number: [Kunkle Model 912.]
		2. Bronze body, brass trim, ASME Section VIII (UV) rated for liquid service, maximum pressure and temperature rating 300 psig and 406 deg F.
			1. Connection Sizes: [1/2 inch inlet, 3/4 inch outlet] [as shown on drawings].
			2. Set Pressure: [ ] psi.
			3. Orifice: [ ] dia.
			4. Capacity: [ ] gpm.
			5. Pressure source maximum flow rate: [ ] gpm.
	9. VIBRATION ELIMINATION
		1. Manufacturer: Anaconda, Universal Metal Hose
		2. Industrial Metal Hose, Refrigeration Products, Armored and Specialty Flexible Hose Components Anaconda Vibration Eliminators, bronze or stainless steel vibration eliminators, copper conforms to UL SA 2528, ends per ASME B16.18 and B16.22;
		3. Diameter [ ] inch
		4. Length [ ] inch
		5. Part Number [ ]
		6. Pressure rating [ ] psig
	10. EXPANSION TANK
		1. An air expansion tank is required on hot water heating and chilled water closed piping systems. An ASME coded tank is required on systems designed to operate at or above 15 psig.
		2. Size: [ ] gal
		3. Manufacture: [ ]
		4. Model Number: [ ]
		5. ASME code stamp for ASME Boiler and Pressure Vessel Code Section VIII, Division 1. Provide NBIC numbering and registration.
	11. CHEMICAL POT FEEDER WITH FILTER
		1. Manufacturer: [Griswold Water Systems]
		2. Series: [Professional DB-GE]
		3. Model: [DB-12-GE-CS-A.]
		4. ASME code stamp for ASME Boiler and Pressure Vessel Code Section VIII, Division 1. Provide NBIC numbering and registration.
		5. Accessories:
			1. Capacity [12] gallon
			2. Connections [3/4” FPT] inlet and outlet
			3. Full Bottom Drain
			4. Carbon steel construction
			5. Bolt on holes with anchor bolt holes.
			6. Stainless Steel basket
			7. [Filter bag kit with (4) 25 Micron Filter bags rated for 170°F]
			8. [Funnel kit]
			9. [Victaulic Cap Enclosure rated at 600 psi at 230°F]
	12. PUMP EXPANSION FITTING
		1. Manufacturer: Hyspan
		2. Model: 5501R
		3. Type: Laminated bellows with tie rods.
		4. Flange: ASME B16.5, Class 150
	13. CONTROL VALVES
		1. See Section 25 5000, *Integrated Automated Facility Controls*
	14. PRESSURE REDUCING VALVE
		1. [Manufacturer: Bell and Gossett, Model FB-38TU.]
		2. [Brass body, factory setting 12 psig, adjustable range 10-25 psig, removable strainer, low inlet pressure check valve, ½” NPT union and ½” sweat connections]
1. EXECUTION
	1. INSPECTION/EXAMINATION
		1. Inspection and Examination shall conform to Paragraph 936 of ASME B31.9.
		2. Examination activities to verify the quality of the work must be performed by persons other than those who performed the activity being examined. Such persons must not report directly to the immediate supervisors responsible for work being examined.
		3. The fabrication documentation must have evidence of the examination, the evidence must be maintained in the pressure system documentation package submitted to the pressure safety officer.
		4. Do not install underground piping when bedding is wet or frozen.
		5. Verify that excavations are to required grade.
	2. PREPARATION
		1. Ream pipe and tube ends. Remove burrs.
		2. Remove scale and dirt on inside and outside before assembly.
		3. Prepare piping connections to equipment with flanges or unions.
		4. [specify any special cleaning requirement]
	3. BURIED PIPING

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Tracer wire and test station(s): are required when specifying cast iron, ductile iron, and non-metallic piping.

Comply with Civil Standard Drawings ST-G30GEN-3 for tracer wire/test station details and Civil Standard Drawings ST-G30-GEN-4 for trenching detail.

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* + 1. Tracer wire and test station(s).
			1. Provide earth cover, bedding, warning tape, tracing wire and test stations. Refer to Section 31 2000, *Earth Moving*.
	1. INSTALLATION
		1. General
			1. Install process cooling water, chilled water, heating hot water, and condenser water (tower water), equipment drains, and overflow piping in conformance with ASME B31.9.
			2. Route piping in orderly manner and maintain gradient. Route parallel and perpendicular to walls.
			3. For multiple openings in piping mains, the distance between their centers shall be at least the sum of their inside diameters
			4. Branch connections shall utilize fittings (tee, lateral, or cross) per listed codes.
			5. Provide non-conducting dielectric connections wherever jointing dissimilar metals. Matching of bronze with steel or copper does not require dielectrics.
			6. Install piping to maintain headroom and neither interfere with use of space nor take more space than necessary.
			7. Group piping whenever practical at common elevations.
			8. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.
			9. Provide access where valves and other equipment are not exposed.
			10. All valves shall be installed per the manufacturer's instructions and with sufficient clearance and access for ease of operation and maintenance. Install valves with stems upright or horizontal, not inverted.
			11. Sleeve and caulk pipes penetrating exterior walls or interior bearing walls. Provide waterproof installation for exterior walls. Provide UL/FM approved through-penetration firestop system when penetrating fire rated barriers (e.g., walls, floors, etc.).
			12. Slope water piping and provide drain valves at low points
			13. Pipe relief devices to nearest floor drain. Install a union in the piping to allow the valve to be removed for service.
			14. Flush and chemically treat HVAC water piping systems per Section 23 2500, *HVAC Water Treatment*.
			15. Label piping system per Section 22 0554, *Identification for Plumbing, HVAC and Fire Piping and Equipment*.
			16. Insulate piping system per Section 22 0713, *Piping and HVAC Insulation*.
			17. Support piping system per Section 22 0529, *Hangers and Supports for Plumbing Piping and Equipment*. Do not anchor the pipe. Allow piping to slide and expand or contract with temperature.
			18. Provide automatic air vents in hydronic closed piping systems at high point. Provide isolation ball valve at inlet connection.
			19. Install chrome-plated steel escutcheons for insulated pipes at finished surfaces.
			20. Above grade piping: unless otherwise noted, provide ball valves in piping 2 inches and smaller, butterfly valves in piping 2 1/2 inches and larger, and gate valves with standard male capped hose connection, for equipment and drain valves. Provide globe valves for throttling applications. Provide strainers with full port drain ball valves. Valves are per Article 2.12.
			21. Instrument taps: isolated from the main process by a root valve. Instrumentation gauges and instruments that are calibrated provided with a calibration port, normally the same size as the instrument impulse line.
			22. Assemble bolts, nuts, and studs; torque using calibrated wrenches.
		2. Soldering
			1. Follow ASTM B828, Standard Practice for Making Capillary Joints by Soldering.
		3. Brazing
			1. Assemble brazed and soldered joints as follows:
				1. No visible unfilled joint space.
				2. Penetration of filler metal inside the pipe not to exceed 100% of the wall thickness.
				3. No visible evidence of overheating.
		4. Welding
			1. Welding (including solvent welding and thermal bonding) and brazing: per Section 01 4444, *Offsite Welding and Joining Requirements* and Section 01 4455, *Onsite Welding and Joining Requirements.*
			2. PVC Joints: Assembly per ASTM D2855 solvent weld with ASTM D2564 solvent cement for PVC D2564 or CPVC D2846.
		5. Threaded
			1. Assemble ASME B1.20.1 threaded pipe joints as follows
				1. No more than six and no less than two threads visible after makeup of the joint.
				2. No severe chipping or tearing of visible threads.
		6. Bolted
			1. [Torque bolts for flanges of size 6 inch to 69 ft-lb; 4 inch to 49 ft-lb; and 3 inch to 73 ft-lb respectively – per Garlock requirements for full face homogenous rubber gaskets of B16.5 and 16.47 series a less than 70 durometer, #150 flat face flanges and ASTM A193 B7 and B7M bolts.]
			2. [Flange torque process and values are shown in the Drawings.] [Example: Torque bolts for flanges of size 6 inch to 69 ft-lb; 4 inch to 49 ft-lb; and 3 inch to 73 ft-lb respectively – per Garlock requirements for full face homogenous rubber gaskets of B16.5 and 16.47 series a less than 70 durometer, #150 flat face flanges and ASTM A193 B7 and B7M bolts.]
				1. Before assembly, the flange faces shall be parallel within 1 deg, and the force required to align pipe axes not to exceed 10 ft-lb/in. (14 n·m/25 mm) of nominal pipe diameter.
				2. Assemble flanges per ASME PCC-1.
				3. Bolts and nuts fully engaged.
		7. Mechanical
			1. Mechanical joints per AWWA 606.
				1. Example Installation Instructions: [Factory reference: Installation Instructions I-177N QuickVic 7814 Rev B, Updated 01.2015 Z000177N00]
				2. [Tighten the nuts evenly by alternating sides until metal-to-metal contact occurs at the bolt pads. Make sure the housing keys engage the grooves completely during tightening.]
				3. [Visually inspect the bolt pads at each joint to ensure metal-to-metal contact is achieved across the entire bolt pad section.]
	2. Examination, Inspection, and Testing
		1. All soldering, brazing, and welding: Inspected, examined, and tested per ASME B31.9; ASME B&PV Code; and LANL ESM STD-342-100, Chapter 13, “Welding, Joining, and NDE.”
		2. Pressure test piping system per Section 22 0813, *Testing Piping Systems,* at the test pressures and durations indicated.
			1. Test with water per ASME B31.9 paragraph [937.3, 937.5] at [ ] psig for at least [10] minutes.

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For systems designed to operate above 100 psig, test hydronic piping to 1.5 times design pressure (para. 937.3). For systems designed to operate at or below 100 psig, test hydronic piping to either operating pressure (para. 937.5) or 1.5 times design pressure (para 937.3).

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* + - 1. For modifications to existing piping test the connection between new and existing at normal operating pressure. Bring system up to operating pressure gradually. Visually examine the piping for leaks at one-half the system operating pressure. Perform a final examination at the system operating pressure. No leaking from the piping indicates that the system meets the requirement of the project.
		1. Contact the Owners’ Inspector to determine the initial inspection points (minimum hold points).
		2. Holiday test buried piping with coating per ASTM G62.
	1. CORROSION CONTROL
		1. Contact LANL’s Utilities Engineering Corrosion Specialist for cathodic protection requirements when using black steel pipe below grade. NOTE: Factory pre-insulated piping systems (e.g., Perma Pipe, Multi Therm 500, (303) 751- 4100 or Rovanco Corp, (505) 344-7100, or solid pour-in-place insulation may be used as a replacement for corrosion control and/or field insulation.
			1. Pipe Coating (black steel pipe below grade). Field-wrap pipe coating such as Polyken or a factory coating suitable for the operating temperature of the piping system. Field-wrap joints and fittings.
				1. Piping Corrosion Tape for Joints and Fittings: Polyken #934-35 35-mil polyethylene tape or LANL-approved equal. Provide manufacturer-recommended primer (Polyken 1027). Maximum Operating Temperature [XXX]. Pre-clean pipe per tape manufacturer’s requirements. All joints and fittings field-wrapped with a minimum of two layers of 30-mil corrosion tape.
				2. Field-Applied Corrosion Coating: Polyken #1600-30HT or LANL-approved equal. Provide manufacturer-recommended primer (Polyken 955 or 954). Total thickness 30 mils. Maximum Operating Temperature 180°F. All joints and fittings field-wrapped with a minimum of two layers of 35-mil corrosion tape. Pre-clean pipe per tape manufacturer’s requirements. Field Applied Corrosion Coating System shall be a two layer system:

Layer One: A liquid adhesive (primer) layer consisting of thermally-activated material formulated for elevated temperature stability.

Layer Two: A coating layer consisting of a cross-linked polyethylene backing and a cross-linked elastomeric adhesive capable of maintaining long-term protection at the temperature up to 180°F.

* + - * 1. Factory Applied Corrosion Control Coating: Factory applied fused system consisting of: an adhesive primer layer, with minimum 10-mil thermoplastic elastomer layer and minimum 40-mil polyolefin top layer containing UV protection; or alternate of an epoxy primer layer with minimum 50-mil high-density polyethylene top layer or an approved equal. Product marking shall be transferred to and stenciled to the outside of the pipe coating. Minimum transferred information shall include: pipe specifications, grade, size, type, and heat number per the certified material test report and the product marking. All joints and fittings shall be field wrapped with a minimum of two layers of 35-mil corrosion tape.
				2. Factory Applied Corrosion Control manufacturers:

Tyco Adhesives, Synergy Plant Coating System.

Tyco Adhesives, VANGUARD Plant Coating System.

LANL-approved equal.

* + - * 1. Test coated underground steel piping for holidays per ASTM G62.
		1. [Specify a field wrap pipe coating such as Polyken or a factory coating suitable for the operating temperature of the piping system.] Field-wrap joints and fittings.
			1. Outside Coating: [cement mortar-lined with seal coated with asphaltic materials outside coating.] [asphaltic outside coating] [fusion bonded epoxy spray coating] [corrosion control thin-film coatings from 0.0254 to 0.254 mm (1 to 10 mils) per Article 3.6]
				1. [Manufacturer and model numbers]
			2. Inside Lining: [cement mortar-lined] [asphaltic lining] [corrosion control thin-film coatings from 0.0254 to 0.254 mm (1 to 10 mils) per Article 3.6]
				1. [Manufacturer and model numbers]
		2. Solid Pour-in-Place Insulation
			1. [Gilsulate, model number]
				1. [Manufacturer and model numbers]

END OF SECTION

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Do not delete the following reference information:

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THE FOLLOWING STATEMENT IS FOR LANL USE ONLY

This project specification section is based on LANL Master Specification Section 23 2113, Rev. 6, dated May 20, 2022.