SECTION 40 0504

Process piping

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LANL MASTER SPECIFICATION SECTION

Word file at <https://engstandards.lanl.gov/specs.shtml>

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| --- |
| Rev. 1 Summary of changesUpdated references, additional authors notes. |

This Section was developed to meet the requirements for ASME B31.3-2020, Fluid Service Category D and Normal except for oxygen and cryogenic service. Use of this section for a different fluid service or edition of the ASME code will require a detailed review versus the code and ESM Chapter 17. See ASME B31.3, Appendix M, Fig. M300 for classifying fluid services. This section must be augmented when ESM Chapters, like Chapter 10, *Hazardous Processes*, drive additional requirements (e.g., Category M).

This section is primary written for use inside a building. When used outside they should normally be covered in the site utilities series (Div 33). The utility sections may reference this section.

The designer is encouraged to review ASME B31.3; DOE Handbook 1132, Design Considerations; and LANL Engineering Standards Manual Chapters 13–*Welding, Joining, & NDE*, and 17–*Pressure Safety*.

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.  This 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.

Please contact the [pressure safety POC](https://engstandards.lanl.gov/POCs.shtml) on the ESM web page with suggestions for improvements.

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

This section was 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.

Seismic: In order to edit this section for job-specific seismic requirements, refer to author notes that begin with “Seismic.” Also, see the flowchart and Seismic Specification Guide for Mechanical (posted on LANL specs [webpage](http://engstandards.lanl.gov/specs.shtml#40)) for guidance on properly editing this section.

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Part 1 GENERAL

* 1. Section Includes

#### General requirements for tube, pipe, piping components, materials, fittings, valves, flanges, and installation of process piping systems applicable to ASME B31.3, Process Piping.

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#### See ASME B31.3, Appendix M, Fig. M300 for classifying fluid services for fluids not listed. Edit listings below to match Project.

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* + - 1. Normal Fluid Service:
				1. Process Vacuum (Dry and Wet Vacuum)
				2. Glovebox Atmosphere Purge/Dry
				3. Radioactive Liquid Waste (RLW)
				4. Flammable Liquid [specify liquid(s)]
				5. Flammable Gases [specify gas(es)] as defined by CGA P-23
				6. Membrane Filtration System above 150 psig, below -20°F, or above 366°F
				7. Compressed air systems above 150 psig, below -20°F, or above 366°F
				8. Specialty Gases (Argon, Nitrogen, Helium, P-10, Regen Gas) above 150 psig, below -20°F, or above 366°F
			2. Category D Fluid Service:
				1. Health Physics Vacuum
				2. Specialty Gas [specify for example Argon, Nitrogen, Helium, non-flammable gases) below 150 psig and between -20°F and 366°F].
				3. Deionizing water system below 150 psig and between -20°F and 366°F
	1. rELATED sECTIONS
		+ 1. Section 01 2500, *Substitution Procedures*
			2. Section 01 3300, *Submittal Procedures*
			3. Section 01 4000, *Quality Requirements*
			4. Section 01 4115, *Pressure Safety Submittals*
			5. Section 01 4444, *Offsite Welding and Joining Requirements*
			6. Section 01 4455, *Onsite Welding and Joining Requirements*
			7. Section 01 4631, *Welding of ASME B31 Piping*
			8. Section 01 4731, *Flange Assembly for B31 Systems*
			9. Section 01 8734, *Seismic Qualification of Nonstructural Components (IBC)*
			10. [Section 01 8113 [LEED v4 and]Guiding Principles 2020: Requirements for water efficiency, energy efficiency, material composition, and indoor air quality requirements]
			11. Section 22 0529, *Hangers and Supports for Plumbing Piping and Equipment*
			12. [Section 22 0548.23, *Vibration and Seismic Controls for Mechanical Systems]*
			13. Section 22 0713, *Plumbing and HVAC Insulation*
			14. Section 22 0813, *Testing Piping Systems*
			15. Section 31 2000, *Earth Moving*
	2. References
1. ASME B31.3 – [2020][YEAR], Process Piping

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In the listing below, designer shall eliminate standards that are not applicable to the project and add other standards that are. Then, designer must either (1) specify each B31.3-listed materials’ national standard edition for each remaining standard listed or (2) determine latest is equivalent. Then modify 1.3. to either (1) choose the first option—and also list the edition year after each standard number (e.g., ASTM F493-04) or (2) choose the second option (and remove the years listed for ASTMs, etc.).

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[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].

1. ASME (American Society of Mechanical Engineers)
2. ASME B1 Series
	1. ASME B1.1, Unified Inch Screw Threads (UN and UNR Thread Form)
	2. ASME B1.20.1, Pipe Threads, General Purpose (Inch)
3. ASME B16 Series

ASME B16.1, Cast Iron Pipe Flanges and Flanged Fittings

ASME B16.5, Pipe Flanges and Flanged Fittings.

ASME B16.9, Factory Made Wrought Steel Buttwelding Fittings

ASME B16.20, Metallic Gaskets for Pipe Flanges: Ring Joint Spiral Wound and Jacketed.

ASME B16.21, Nonmetallic Flat Gaskets for Pipe Flanges.

ASME B16.22, Wrought Copper and Copper Alloy Solder-Joint Pressure Fittings

ASME B16.24, Cast Copper Alloy Pipe Flanges and Flanged Fittings Classes 150, 300, 600, 900, 1500, and 2500

ASME B16.25, Buttwelding Ends

ASME B16.34, Valves-Flanged, Threaded, and Welding End

ASME B16.39, Malleable Iron Threaded Pipe Unions Classes 150, 250, and 300

ASME B16.42, Ductile Iron Pipe Flanges and Flanged Fittings Classes 150 and 300

1. ASME B18 Series
	1. ASME B18.2.1, Square, Hex, Heavy Hex, and Askew Head Bolts and Hex, Heavy Hex, Hex Flange, Lobed Head, and Lag Screws (Inch Series)
	2. ASME B18.2.2, Nuts for General Applications: Machine Screw Nuts, Hex, Square, Hex Flange, and Coupling Nuts (Inch Series)
	3. ASME B18.21.1, Washers: Helical Spring-Lock, Tooth Lock, and Plain Washers (Inch Series)
2. ASME B36 Series

ASME B36.19M, Stainless Steel Pipe

1. ASME Boiler and Pressure Vessel Code (ASME BPVC)

ASME BPVC Section V, Nondestructive Examination

ASME BPVC Section IX, Welding, Brazing, and Fusing Qualifications

1. API (American Petroleum Institute)
	* + 1. API 594-2010, Check Valves: Flanged, Lug, Wafer, and Butt-welding
2. ASTM (ASTM International)
	* + 1. ASTM A53/A53M-2007, Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
			2. ASTM A182/A182M-2009a, Standard Specification for Forged or Rolled Alloy and Stainless Steel Pipe Flanges, Forged Fittings, and Valves and Part for High-Temperature Service
			3. ASTM A193/A193M-2010a, Standard Specification for Alloy-Steel and Stainless Steel Bolting for High Temperature or High Pressure Service and Other Special Purpose Applications
			4. ASTM A194/A194M-2010, Standard Specification for Carbon and Alloy Steel Nuts for Bolts for High Pressure or High Temperature Service, or Both
			5. ASTM A269/A269M-2008, Standard Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Service.”
			6. ASTM A307-2007b, Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60,000 PSI Tensile Strength
			7. ASTM A312/A312M-2009, Standard Specification for Seamless, Welded, and Heavily Cold Worked Austenitic Stainless Steel Pipes
			8. ASTM A395/A395M-1999 (R2009), Standard Specification for Ferritic Ductile Iron Pressure-Retaining Castings for Use at Elevated Temperatures
			9. ASTM A403/A403M-2007a, Standard Specification for Wrought Austenitic Stainless Steel Piping Fittings
			10. ASTM A479/A479M-2011, Standard Specification for Stainless Steel Bars and Shapes for Use in Boilers and Other Pressure Vessels
			11. ASTM A563-2007a, Standard Specification for Carbon and Alloy Steel Nuts
			12. ASTM B32-2008, Standard Specification for Solder Metal
			13. ASTM B68-2002/B68M-1999 (R2005) Standard Specification for Seamless Copper Tube, Bright Annealed
			14. ASTM B75-2002/B75M-1999 (R2005) Standard Specification for Seamless Copper Tube
			15. ASTM B88-2003/B88M-2005, Standard Specification for Seamless Copper Water Tube
			16. ASTM B280-2008, Standard Specification for Seamless Copper Tube for Air Conditioning and Refrigeration Field Service
			17. ASTM B813-2010, Standard Specification for Liquid and Paste Fluxes for Soldering of Copper and Copper Alloy Tube
			18. ASTM B828-2002, Standard Practice for Making Capillary Joints by Soldering of Copper and Copper Alloy Tube and Fittings
			19. ASTM D1784-2011, Standard Specification for Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds (not listed)
			20. ASTM D1785-2006, Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic
			21. ASTM D2241-2005, Standard Specification for Poly(Vinyl Chloride) (PVC) Pressure-Rated Pipe (SDR Series)
			22. ASTM D2467-2006, Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80
			23. ASTM D2513-2009, Standard Specification for Polyethylene (PE) Gas Pressure Pipe, Tubing, and Fittings
			24. ASTM D2564-2004, Standard Specification for Solvent Cements for Poly(Vinyl Chloride) (PVC) Plastic Piping Systems
			25. ASTM D2672-1996a (R2003), Standard Specification for Joints for IPS PVC Pipe Using Solvent Cement
			26. ASTM D2846/D2846M-2009b, Standard Specification for Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Hot- and Cold-Water Distribution Systems
			27. ASTM D3261-03, Standard Specification for Butt Heat Fusion Polyethylene (PE) Plastic Fittings for Polyethylene (PE) Plastic Pipe and Tubing
			28. ASTM D3350-2014, Standard Specification for Polyethylene Plastics Pipe and Fittings Materials (not listed)
			29. ASTM F436/F436M-2011, Standard Specification for Hardened Steel Washers (referenced by ASME B18.21.1)
			30. ASTM F438-2009, Standard Specification for Socket-Type Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 401
			31. ASTM F439-2009, Standard Specification for Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 801
			32. ASTM F441/F441M-2009, Standard Specification for Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe, Schedules 40 and 80
			33. ASMT F442/F442M-2009, Standard Specification for Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe (SDR–PR)
			34. ASTM F714-2008, Standard Specification for Polyethylene (PE) Plastic Pipe (DRPR) Based on Outside Diameter
3. AWS (American Welding Society)
	* + 1. AWS A5.8M/A5.8:2004, Specification for Filler Metals for Brazing and Braze Welding
4. CGA (Compressed Gas Association)
5. CGA P-23, Standard for Categorizing Gas Mixtures Containing Flammable and Nonflammable Components (not listed)
6. SAE
	* + 1. SAE J461-1981 (2002), Wrought and Cast Copper Alloys
			2. SAE J513-1999, Refrigeration Tube Fittings General Specifications
			3. SAE J514-2004, Hydraulic Tube Fittings
7. MSS (Manufacturers Standardization Society)
	* + 1. MSS SP-25-2008, Standard Marking System for Valves, Fittings, Flanges, and Unions
			2. MSS SP-72-1999, Ball Valves with Flanged or Butt-Welding Ends for General Service.
	1. Submittals
		1. Submit per Section 01 3300, *Submittal Procedures*.
		2. Action Submittals - Materials
			1. Catalog Data: Include the Manufacturer’s name, model number, parts list, and brief description of equipment and its basic operational features.
			2. Design Data, Evaluations, and Calculations: An item may be considered unlisted due to its component type or its material of construction. Such items shall adhere to the items below, respectively.
				1. Items that are unlisted due to component type shall be in accordance with ASME B31.3 Paragraph 326.1.2 for metallic or A326.1 for non-metallic piping components.
				2. Items that are unlisted due to material of construction shall be in accordance with ASME B31.3 Paragraph 323.1.2 for metallic or A323.1 for non-metallic piping components.
		3. Action Submittals - Fabrication
			1. Qualifications
				1. Manufacturer Qualifications are required when specified items are not supplied; see 1.4 Submittals, B.2.
				2. Installer Qualifications
				3. Test, Nondestructive Examination (NDE), and Inspection Qualifications Records - Subcontractor and Supplier inspectors are required to have certifications and experience commensurate with the examinations or inspections
				4. Examiner Qualifications/Certifications
			2. Welder and Bonding Qualifications
				1. Welder and Bonding Qualification Records
				2. Welding and Bonding Procedure Specifications (WPS)
				3. Welding and Bonding Procedure Qualification Record (WPQR)
			3. Installation Instructions
			4. Procedures
				1. Prior to receiving materials submit the Material Control Procedure.
				2. Before fabrication, submit the following procedures:

NDE (non-destructive examination) procedures that will be used for examination of the piping,

Code leak testing

Cleaning procedures.

* + - 1. Test and Inspection Plan
				1. Provide TIP and Procedures for review and approval. All inspections and tests, including inspection and testing forms, logs shall be documented and submitted for review and approval.
				2. Provide a Field Test and Inspection Plan and Procedures for installed process plant piping and ancillary equipment.
			2. Test Reports
				1. Factory Acceptance Test Report
				2. NDE Test Reports
				3. Field Test and Inspection Report
			3. Certifications
				1. Instrument Calibration Certificates for equipment used during the Factory Acceptance Test
				2. Certified Material Test Reports (CMTR) for metallic piping and components required by the code of record specified below:

ASTM A269

* + - * 1. Certificate of Compliance (CoC) to show compliance to the applicable codes and standards as identified in this Section.

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In the listing below, the designer must (1) identify those piping components that are required to provide an Operation and Maintenance Manual and (2) edit Section 01 4115, *Pressure Safety Submittals,* to ensure that necessary information is collected.

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* + 1. Closeout Submittals
			- 1. Operation & Maintenance Manual
				2. Provide all submittals required by Section 01 4115, *Pressure Safety Submittals*, for the as-built configuration.
	1. Quality Assurance
1. Material Control Procedure
	* + 1. Work shall be performed in accordance with an approved Material Control Procedure. This procedure shall describe the control methods and documentation used to handle and monitor the use of controlled materials (piping component, fasteners, and welding filler rod and other components).
			2. The procedure shall follow manufacturer’s requirements for receiving, storage, handling, and preservation to minimize deterioration.
			3. Segregation of carbon steel and stainless-steel material and tools shall be maintained throughout fabrication.
			4. The procedure shall also address procurement through processing and final assembly.
			5. Subcontractor and Suppliers must provide protection against the weather, acceleration forces, airborne contamination, and physical damage for the equipment procured under this Section.
2. Inspection, Testing, and NDE
	* + 1. The Supplier shall perform inspection and testing to verify the conformance of the item to the specified requirements defined in Part 2 of this Section[, as well as any Supplier requirements as defined as part of the Suppliers QA/QC program].
			2. The Supplier shall provide an Inspection and Test Plan indicating all testing and inspection functions to be performed, including hold points during fabrication and assembly, as well as during the Factory Acceptance Testing (FAT).
			3. All inspection and testing functions shall be performed by qualified personnel using qualified procedures in accordance with specified requirements.
			4. Hold points are required during the fabrication process to allow inspection, verification, or approval by LANL before the Supplier does further work. Hold points shall be identified within the Inspection and Test Plan, with provisions for LANL review and acceptance. LANL has the right to waive Hold Points at their discretion.
			5. Inspection Records: The Supplier shall appropriately record, submit, and maintain records documenting the inspection and/or test then submit the completed Inspection Record as part of the QA Document Package. The status of all planned and executed inspection and testing activities shall be logged and traceable to ensure that the required inspection and testing have been performed, and any items that have failed inspection or testing are not inadvertently installed or implemented.
3. Qualifications
	* + 1. Welder Qualifications Subcontractor shall provide documentation that all personnel have passed relevant qualification tests per ASME B31.3 for joining processes involved and that certification is current.
				1. Metallic Pipe: Welders and brazers shall be qualified in accordance with ASME B31.3 Section 328.2.
				2. Bonding of plastics: Bonder and bonding operators shall be qualified per ASME B31.3, Section A328.2.
				3. Steel Support Welding (not touching the pressure boundary): Qualify processes and operators to AWS D1.1/D1.1M.
				4. Welder/welding operators are required to meet Sections 01 4444, *Offsite Welding and Joining Requirements,* and 01 4455, *Onsite Welding and Joining Requirements*.
			2. Welding Procedures
				1. Welding/Brazing procedures shall be qualified according to ASME BPVC Section IX.

Welding and joining requirements shall be in accordance with Sections 01 4444, *Offsite Welding and Joining Requirements* and 01 4455, *Onsite Welding and Joining Requirements*.

* + - * 1. Bonding procedures for plastic piping shall be in accordance with Sections 01 4444, *Offsite Welding and Joining Requirements* and 01 4455, *Onsite Welding and Joining Requirements* and qualified according to ASME B31.3 Section A328.

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The Designer is cautioned to include sufficient training and written procedures for proprietary or unlisted fitting and or joint assembly.

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* + - 1. Compression fitting assembler shall be qualified by UTrain Course 30831, *Compression Fittings Assembly,* or factory training within 30 days of start of assembly.
			2. Qualification of Examination Personnel:
1. Certified Welding Inspectors (CWI) shall be in accordance with Section 01 4444, *Offsite Welding and Joining Requirements* and/or 01 4455 *Onsite Welding and Joining Requirements*.
2. Personnel performing other examination shall be certified in accordance with contractor’s written practice. Personnel performing nondestructive examination to the requirements of B31.3 shall be qualified and certified for the method to be utilized following a procedure as described in BPV Code, Section V, Article 1, T-120 (e) or (f).
3. Certifications of examination personnel shall be maintained for the Owners Inspector’s review.
4. Examination records including examiner’s qualifications and procedures shall be retained for at least 5 years per ASME B31.3, Section 346.3.
	* + 1. Owner’s Inspector shall be qualified in accordance with ASME B31.3 Section 340 and LANL Engineering Services Inspection Team. LANL shall act for DOE to designate Owner’s Inspectors or Designee.
			2. Manufacturer Qualifications
				1. Must have a minimum of 5 years of experience
				2. Must have maintenance service based within 200 miles radius of installation.
	1. ENVIRONMENTAL REQUIREMENTS
5. All tubing and piping shall be designed to operate in the environmental conditions specified project requirements documents.

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Design notes

1. Threaded joints should be avoided in any service where crevice corrosion, severe erosion, or cyclic loading (pressure or thermal) may occur.
2. Gasket materials shall be compatible with the fluids and service conditions.

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Part 2 PRODUCTS

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Items that are approved for B31.3 applications that appear in the ESM Chapter 17 reference “Unlisted Components Approval Process and Forms” listing may be used within the ranges defined by the evaluation.

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Seismic: If Project specification includes 22 0548.23, ensure any/ all mounting and/or anchorage devices therein are de-conflicted from/consistent with those included herein.

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1. Threaded joints: Unless otherwise noted, all threaded joints shall be NPT (tapered threads) complying with ASME B1.20.1, Pipe Threads, General Purpose (Inch). The threaded joint assembly shall be in accordance with ASME B1.20.1 3.1.9 *Wrench-Tight Engagement between External and Internal Taper Threads*.
2. Fasteners are to be in accordance with ASME B1.1 UNS Classes 1A (external) and 1B (internal) uncoated unless otherwise specified.
3. product options and substitutions
4. Alternate products may be accepted per Section 01 2500, *Substitution Procedures*.
5. Proposal of unlisted components is strongly discouraged and will be evaluated in accordance with 01 2500, *Substitution Procedures*. Substitutions will be allowed only if the Subcontractor can demonstrate that the product can meet the same code requirements of the item specified in the design. Costs associated with evaluation of unlisted components shall be the responsibility of the Subcontractor.
6. If an unlisted component alternate is proposed, the manufacturer must submit Design Data in accordance with Article 1.4 (paragraph B.2) of this document.

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Seismic: For either para., if there are too many systems/components to list here, then list them in an appendix to this section, and then merely refer to that appendix in the para.

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1. [SEISMIC PERFORMANCE REQUIREMENTS]
	* 1. The [piping][, tanks][, pumps][, processing equipment][, and \_\_\_\_\_\_\_\_\_\_] shall remain in place without separation of any parts when subjected to the design basis earthquake [per Section 01 8734, *Seismic Qualification of Nonstructural Components (IBC)*] [as represented by the seismic forces derived from the criteria indicated [on the drawings] [in Section 22 0548.23, *Vibration and Seismic Controls for Mechanical Systems*].
		2. The [piping][, tanks][, pumps][, processing equipment][, and \_\_\_\_\_\_\_\_\_\_] [is][are] [a] Designated Seismic System[s] and, as such, [it] [they] shall remain in place and [be fully operational] [and] [maintain containment] following the design basis earthquake per Section 01 8734, Seismic Qualification of Nonstructural Components (IBC).

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It is unnecessary and can be confusing to have piping components defined in the body of the Section and in a referenced Attachment. An item must only be identified once, so edit section appropriately. However, all the information for the item including the fluid service, system application, location, and assembly method must also be identified for all piping components wherever they are in the section.

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1. PIPING/TUBING/FITTINGS
	* 1. Stainless Steel Pipe
			1. ASTM A312/A312M, Dual Grade TP316/316L, seamless, [Schedule per Appendix A]
			2. Fluid Service: [Category Normal, Category D, etc.]
			3. System Application(s): [Specialty Gases (Argon, Nitrogen, Helium, P-10, Regen Gas) above 150 psig or below -20°F or above 366°F, Radioactive Liquid Waste, etc.]
			4. Location: [Above grade, below grade; if below grade specify corrosion control in Part 3, Corrosion Control]
			5. Assembly Methods: [welded, brazed, solder, flanged, ASME B1.20.1 threads, Lok-Ring ®, etc,]
			6. Flanges: Raised Face, Weld neck, Slip-on, and Blind Flanges: ASME B16.5 Material Group 2.3 Forging, Class 150
			7. Fittings: Buttweld ASME B16.9 ASTM A403 WP316/315L, Class S
			8. Size: 4 inch
		2. Black Pipe
			1. Pipe steel, ASTM A53, Type F, grade A standard wall, schedule 40 [80].
			2. Fittings: Black steel, ASTM A234, WPB or WPC, butt-welded type, standard wall.
			3. Fluid Service: Category D
			4. System Application(s): [Deionized water system less than 150 psig]
			5. Location: [Above grade, below grade; if below grade specify corrosion control in Part 3, Corrosion Control]
			6. Assembly Methods: [welded, flanged, MNPT ASME B1.20, Lok-Ring ®, etc.]
			7. Size: 4 inch
		3. PVC Pipe
			1. ASTM D1785, PVC 1120, Type I, Gr. 1, Cell Classification 12454, Schedule 80 or ASTM D2241 PVC (SDR Series) Cell Classification 12454
			2. Fittings: ASTM D2467 PVC plastic pipe fittings Schedule 80
			3. Fittings: ASTM D2672, *Joints for IPS PVC Pipe Using Solvent Cement*
			4. Solvent ASTM D2564
			5. Fluid Service: Category D
			6. System Application(s): Deionizing water system less than 150 psig and between -20°F and 366°F
			7. Location: [Above grade below grade]
			8. Assembly Methods: [welded, MNPT ASME B1.20 (schedule 80 up only)]
			9. Size: 4 inch
		4. CPVC Pipe
			1. ASTM F441/F441M CPVC Plastic Pipe, Schedule 40 [ 80], cell class 23447, or ASTM F442/F442M CPVC Plastic Pipe (SDR PR) cell class 23447
			2. Fittings: ASTM D2846/D2846M, D3350 ASTM F438, ASTM F439
			3. Solvent ASTM F493
			4. Fluid Service: [Category Normal, Category D]
			5. System Application(s): [RLW, Deionizing water system less than 150 psig and between -20°F and 366°F]
			6. Location: [Above grade below grade]
			7. Assembly Methods: [welded, MNPT ASME B1.20 (schedule 80 up only)]
			8. Size: 4 inch
		5. Double Wall Hi-Density Polyethylene (HDPE)
			1. ASTM F714 with Cell Classification PE445574C per ASTM D3350, HDPE PE4710
			2. Internal wall thickness shall conform to dimension ration DR 11. Exterior or containment pipe wall shall alternatively conform to DR 17.
			3. Manufacturer: ASAHI (Poly-Flo or Fluid-Lok), Performance Pipe or LANL-approved equal
			4. Fittings: Factory Molded Fittings
			5. Fluid Service: Category Normal
			6. System Application(s): RLW Carrier and Containment Pipe
			7. Location: [Above grade, below grade]
			8. Assembly Methods: welded, ASME B1.20.1 threads
			9. Size: 4 inch
		6. Stainless Steel Tubing
			1. ASTM A269, Dual Grade 316/316L, Seamless, Schedule per Appendix A
			2. Fluid Service: [Category Normal. Category D]
			3. System Application(s): [Specialty Gases (Argon, Nitrogen, Helium, P-10, Regen Gas) above 150 psig or below -20°F or above 366°F, Radioactive Liquid Waste, etc.…]
			4. Location: [Above grade, below grade]
			5. Assembly Methods: [welded, flanged, CF flanges (Conflat), Lok-Ring ®, compression fittings, flare fittings etc.…]
			6. Size: 1 inch
		7. Copper Tubing (B88) to be Soldered
			1. ASTM B 88, Type L, [hard drawn (requires CMTR)] annealed UNS C12200 for pipe sizes 2 in. and smaller.
			2. Fittings: ASME B16.22, UNS C12200 wrought copper and copper alloy, solder joint.
			3. Joints: Solder, ASTM B 32, Alloy Sb5.
			4. Flux per ASTM B813 *Standard Specification for Liquid and Paste Fluxes for Soldering of Copper and Copper Alloy Tube*
			5. Dielectric Connections Union with galvanized or plated steel threaded end, copper solder end, and water impervious isolation barrier, minimum rating 250 psig at 250 °F. Watts Series 3000.
			6. Fluid Service: Category D
			7. System Application(s): Deionizing water system less than 150 psig and between -20°F and 366°F
			8. Location: Above grade
			9. Assembly Methods: [solder, flare, MNPT ASME B1.20, flanged, Lok-Ring ®, etc.]
			10. Size: 3/4 inch
		8. Copper Tubing (B280) to be Brazed
			1. Copper Tubing: ASTM B280, UNS C12200, Type ACR annealed temper, seamless tube, 2 inches and smaller (Note: B280 lists only a single wall thickness based on standard size, diameter) ).
			2. Fittings: ASME B16.50, wrought copper, brazed joints.
			3. Copper Unions and Couplings: Bronze, brazed joints, ASME B16.22-2013.
			4. Joints: Braze, AWS A5.8-2011 BCuP-5 silver/phosphorus/copper alloy with melting range 1190 to 1480°F.
			5. Fluid Service: Normal
			6. System Application(s): [Flammable Liquids, Membrane Filtration System above 150 psig or below -20°F or above 366°F]
			7. Location: [Above grade/Below grade]
			8. Assembly Methods: [braze, flare, MNPT ASME B1.20, Lok-Ring ®, etc...]
			9. Size: 1 inch
		9. Copper Tubing, 45-degree Flare Fittings
			1. Flare Joint Fittings: SAE J513, Refrigeration Tube Fittings General Specifications. Description: A 45-degree flare flared body and nut for use with annealed copper tubing. Materials are SAE J461 CA 360 (half-hard), CA 345 or CA 377 (forged) brass with CA377 nuts. Fittings may have a combination of ASME B1.1 UNF (5/16 to 7/8 inch) or UNS 1 1/16 inch and ASME B1.20.1 NPT tapered threads (1/8 through ¾ inch). Fittings are available based on outside diameter tube.
			2. Location: [Above grade/Below grade]
			3. Fluid Service: Category D [Normal]
			4. System Application(s): Deionizing water system less than 150 psig and between -20°F and 366°F
			5. Size: 1/4-inch annealed tube outside diameter [3/16, ¼, 5/16, 3/8, ½, 5/8, ¾ tube outside diameter inch]
			6. Temperature range: -65 to +250oF
			7. Pressure: 200 psig
			8. Manufacturer: Parker
		10. Copper Tubing, 37-degree Flare Fittings
			1. Flare Joint Fittings: SAE J514, Hydraulic Tube Fittings: Description: A 37-degree flare flared body, nut, and sleeve for use only with tube that is fully annealed for flaring and bending. Materials brass, Fittings may have a combination of ASME B1.1 UNF (5/16 to 7/8 inch) or UNS 1 1/16 inch and ASME B1.20.1 NPT tapered threads (1/8 through 2 1/2 inch). Fittings are available based on outside diameter tube.
			2. Location: [Above grade/Below grade]
			3. Fluid Service: Normal
			4. System Application(s): [Flammable Liquids, Membrane Filtration System above 150 psig or below -20°F or above 366°F]
			5. Size: 1/4 inch annealed tube outside diameter [1/8, 3/16, ¼, 5/16, 3/8, ½, 5/8, ¾, 7/8, 1, 1 ¼, 1 ½, 2, 2 1/2 tube outside diameter inch]
			6. Temperature range: -40 to +400oF
			7. Pressure: 3,300 psig ¼ inch tube to tube (1/4 inch, 4:1 safety factor)
			8. Manufacturer: Parker [SSP Corporation]
			9. Model Number: Triple Lok® [SAE 37 Degree Flare]
		11. Stainless Steel Tubing, 37-degree Flare Fittings
			1. Flare Joint Fittings: SAE J514, Hydraulic Tube Fittings. Description: A 37-degree flare flared body, nut, and sleeve for only with seamless or welded and drawn tube that is fully annealed for flaring and bending. Materials 316 stainless steel. Fittings may have a combination of ASME B1.1 UNF (5/16 to 7/8 inch) or UNS 1 1/16 inch and ASME B1.20.1 NPT tapered threads (1/8 through 2 1/2 inch). Fittings are available based on outside diameter tube.
			2. Location: [Above grade/Below grade]
			3. Fluid Service: Normal
			4. System Application(s): [Flammable Liquids, Membrane Filtration System above 150 psig or below -20°F or above 366°F]
			5. Size: 1/4 inch annealed tube outside diameter [1/8, 3/16, ¼, 5/16, 3/8, ½, 5/8, ¾, 7/8, 1, 1 ¼, 1 ½, 2, 2 1/2 tube outside diameter inch]
			6. Temperature range: -425 to +400 oF
			7. Pressure: 7,500 psig ¼ inch tube to tube (1/4 inch, 4:1 safety factor)
			8. Manufacturer: Parker [Pressure Connections Corp]
			9. Model Number: Triple Lok® [37 Degree JIC Flare]

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Design note on minimum wall thickness. Determine min wall per table below from Swagelok Publication MS-01-107, Rev. N.

Swagelok Copper Tube Wall Thickness Requirements

|  |  |  |
| --- | --- | --- |
| **Tube OD in.** | **Tube Wall Thickness in.** | **Swagelok Fitting Series** |
| **0.028** | **0.030** | **0.035** | **0.049** | **0.065** | **0.083** | **0.095** | **0.109** | **0.120** | **0.134** |
| **Working Pressure**, psig**Note:** For gas service, select a tube wall thickness outside of the shaded area; see Gas Service below. |
| 1/8 | 2700 | 3000 | 3600 |  |  |  |  |  |  |  | 200 |
| 3/16 | 1800 | 1900 | 2300 | 3400 |  |  |  |  |  |  | 300 |
| 1/4 | 1300 | 1400 | 1600 | 2500 | 3500 |  |  |  |  |  | 400 |
| 5/16 |  |  | 1300 | 1900 | 2700 |  |  |  |  |  | 500 |
| 3/8 |  |  | 1000 | 1600 | 2200 |  |  |  |  |  | 600 |
| 1/2 |  |  | 800 | 1100 | 1600 | 2100 |  |  |  |  | 810 |
| 5/8 |  |  |  | 900 | 1200 | 1600 | 1900 |  |  |  | 1010 |
| 3/4 |  |  |  | 700 | 1000 | 1300 | 1500 | 1800 |  |  | 1210 |
| 7/8 |  |  |  | 600 | 800 | 1100 | 1300 | 1500 |  |  | 1410 |
| 1 |  |  |  | 500 | 700 | 900 | 1100 | 1300 | 1500 |  | 1610 |
| 1 1/8 |  |  |  |  | 600 | 800 | 1000 | 1100 | 1300 | 1400 | 1810 |

# Gas Service

Gases (air, hydrogen, helium, nitrogen, etc.) have very small molecules that can escape through even the most minute leak path. Some surface defects on the tubing can provide such a leak path. As tube outside diameter (OD) increases, so does the likelihood of a scratch or other surface defect interfering with proper sealing.

The most successful connection for gas service will occur if all installation instructions are carefully followed and the heavier wall thicknesses of tubing on the accompanying tables are selected.

A heavy-wall tube resists ferrule action more than a thin-wall tube, allowing the ferrules to coin out minor surface imperfections. A thin-wall tube offers less resistance to ferrule action during installation, reducing the chance of coining out surface defects, such as scratches. Within the applicable suggested allowable working pressure table, select a tube wall thickness whose working pressure is *outside* of the shaded areas.

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* + 1. Copper Tubing (Gas, B75 or B68)
			1. Copper Tubing: 3/8 inch outside diameter, UNS C12200: Either B75 temper 060 [0.015 – 0.035 inch wall], B88 Type K (0.035 inch wall) temper 060, or B68 temper 060, 0.035 inch wall.
			2. Fluid Service: [Category Normal. Category D]
			3. System Application(s): [Flammable gases, and specialty gases above 150 psig or outside the range of -20 to 366°F, Health Physics Vacuum, Specialty Gases (Argon, Nitrogen, Helium, P-10, Regen Gas) below 150 psig between -20°F and 366°F]
			4. Location: [Above grade/Below grade]
			5. Assembly Methods: compression (Swagelok)
			6. Fittings: Swagelok compression brass fittings
		2. Copper Tubing (Liquid, B75 or B68)
			1. Copper Tubing: 1/2 inch outside diameter, UNS C12200: Either B75 temper 060 [0.035-inch wall], B88 [Type K (0.049 inch wall) or Type L (0.035 inch)] temper 060, or B68 temper 060, 0.035 inch wall.
			2. System Application(s): [Flammable liquids, Membrane Filtration System above 150 psig or below -20°F or above 366°F]
			3. Fluid Service: [Category Normal. Category D]
			4. System Application(s): [Flammable gases, and specialty gases above 150 psig or outside the range of -20 to 366°F, Deionizing water system less than 150 psig and between -20°F and 366°F],
			5. Location: [Above grade/Below grade]
			6. Assembly Methods: compression (Swagelok)
			7. Fittings: Swagelok compression brass fittings

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Seismic: As necessary/applicable, edit what follows, to include PART 3, to ensure compliance with the seismic requirements for flexible connectors.

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1. FLEXIBLE CONNECTORS
	* 1. Manufacturer: Swagelok.
			1. Type: [FM, FJ, FL, T, X, S, C, N, W, F, U]
			2. Material: 316L SS braid with 316L SS core
			3. Working-Pressure Rating: 150 psig minimum
			4. End Connections: [MNPT ASME B1.20, Compression]
			5. Fluid Service: [Category Normal. Category D]
			6. System Application(s): [Flammable gases, and specialty gases above 150 psig or outside the range of -20 to 366°F, Deionizing water system less than 150 psig and between -20°F and 366°F],
			7. Location: Above grade
			8. Assembly Methods:
			9. Size: ¾ inch [See Swagelok Catalog for sizes]
			10. Length: 35 inches [state required length]
		2. Manufacturer: Spear
			1. Type: True Union 2000
			2. Material: 316L SS braid with 316L SS core
			3. Working-Pressure Rating: 150 psig minimum
			4. End Connections: [MNPT ASME B1.20, Compression]
			5. Fluid Service: [Category Normal. Category D]
			6. System Application(s): [Flammable gases, and specialty gases above 150 psig or outside the range of -20 to 366°F, Deionizing water system less than 150 psig and between -20°F and 366°F],
			7. Location: Above grade
			8. Assembly Methods:
			9. Size: [1/2 to 8 inch]
			10. Length: [state required length]
2. FLEXIBLE HOSE RESTRAINTS
	* 1. Manufacturer: Hubbell
			1. Model: Kellems ® Universal Eye
			2. Material: stainless steel 302-304T
			3. Size 0.5 to 3.99 inches
			4. Types: Universal Eye, closed mesh; split mesh, lace closing, universal eye, split mesh, rod closing (to suit location)
			5. Example Part number: 02401050 (1 to 1.25 inches stainless steel, universal eye, closed mesh)
		2. Manufacturer: Parker Hannifin
			1. Model: [Transportation 201, Constant Working Pressure P35 or 797TC, Hydraulic JK or 302]
			2. Size: [¼ inch to 4 inch]
			3. Type: [Port or flange]
			4. Example Part Number: WRC1313-3 (0.51 to 0.531 inch, for Hydraulic 302)
3. FLEXIBLE HOSE RESTRAINT SYSTEMS
	* 1. Restraint
			1. Manufacture: Adel
			2. Example Part Number: MS21919-DG16 (1 inch)
			3. Material: Aluminum band, Chloroprene Cushion (212F)
			4. Type: MS21919 DG
			5. Size: 1/8 inch to 3 1/8 inch
		2. Chain
			1. Trade size 4
			2. Low Carbon Steel
			3. Brass Glo or Zinc Plated
			4. 0.12-inch diameter material
			5. 205 lbf working load limit
4. BALL VALVES (PLASTIC)
	* 1. Manufacturer: Spears True Union 2000
			1. Example Part Number: 1829-005 (1/2-inch Socket/ ASME B1.20.1 threads; EPDM)
			2. Description: Thermoplastic ball valves: True Union 2000 Industrial type manufactured to ASTM F1970 and constructed from PVC Type I, ASTM D1784 Cell Classification 12454 or CPVC Type IV, ASTM D1784 Cell Classification 23447. O-rings: EPDM or Viton®. Safe-T-Shear® stem with double O-ring stem seals. Polypropylene valve handles with built-in lockout mechanism. Valve union nuts with Buttress threads. Safe-T-Blocked® seal carriers. All valve components shall be replaceable.
			3. Rating: All 1/2" through 2" valves shall be pressure rated to 235 psi, all 2-1/2" through 8” venturied, and all flanged valves shall be pressure rated to 150 psi for water at 73°F.
			4. Fluid Service: Normal
			5. System Application(s): RLW
			6. Location: Above grade
			7. Assembly Methods: [welded, ASME B1.20.1 threads]
5. PNEUMATIC-ACTUATED BALL VALVES (PLASTIC)
	* 1. Manufacturer/Model: Spears True Union 2000 Pneumatic Actuated Ball Valves

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Pneumatic-actuated valves are equivalent to the standard True Union 2000 Ball Valves for the purposes of B31.3 (the standards of manufacture and construction are equivalent).

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* + 1. Description
			1. [designer, refer to manual valve description above (2.6), or transfer description here if no manual valve article is needed in section as is deleted]
			2. Fluid Service: Normal
			3. System Application(s): RLW
			4. Location: Above grade
			5. Assembly Methods: [welded, ASME B1.20.1 threads]

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Designer Note: The relief valve is required to have a calculation meeting the rigor of AP-341-605 to show that it can accommodate the fail-open regulator fault condition and meet the design parameters of ASME B31.3 paragraph 322.6 Pressure-Relieving Systems. This requirement is for any liquid or gas. The regulator and relief device shown below are examples only and the section must be tailored to the design requirements. The designer is cautioned that the design must accommodate flow demand requirements of the system as well as relief valve sizing.

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1. GAS REGULATORS
	* 1. Manufacturer/Model: Swagelok K Series, Part Number: KPR-AGJA415C2000
			1. Design Description: Maximum 500 psig inlet, 0- maximum 45 psig outlet
			2. Fluid Service: Normal,
			3. System Application(s): Compressed Air
			4. Inlet Size: ¼ in
			5. Outlet Size: ¼ in
			6. Cv: 0.20
			7. Inlet Pressure: 500 psig
			8. Outlet Control Range: 0 to 250 psig
			9. Location: Above grade
			10. Assembly Methods: ASME B1.20.1 threads
			11. Failure flow in application: 61.61 SCFM as air with 500 psig maximum inlet pressure
2. GAS RELIEF VALVES
	* 1. Manufacturer/Model: Kingston Valves, M/N 118, Part Number: 118CSS-2-045
			1. Description: stainless steel ASME stamped relief device, set pressure 45 psig
			2. Fluid Service: Category D
			3. System Application(s): Compressed Air
			4. Inlet Size: ¼ inch
			5. Set Pressure: 45 psig (+/- 2 psig)
			6. Location: Above grade
			7. Assembly Methods: ASME B1.20.1 threads
			8. Manufacturers rating: 69 SCFM air
3. DIAPHRAGM VALVES (THERMOPLASTIC)
	* 1. Manufacturer: Spears
			1. Example Part Number: 2729-005 (1/2-inch, EPDM, Socket/ ASME B1.20.1 threads)
			2. Description: Weir-type manufactured to ASTM F1970 and constructed from PVC Type I, ASTM D 1784 Cell Classification 12454 or CPVC Type IV, ASTM D1784 Cell Classification 23447. Diaphragms shall be EPDM, genuine Viton® or PTFE with [EPDM or Viton®] bonded backing. Valves shall have built-in position indicator with polypropylene handwheel. True Union style valve union nuts shall have Buttress threads.
			3. Rating: PVC and CPVC 1/2” through 2” valves shall be pressure rated to 235 psi, all 2-1/2” through 4” and all flanged valves shall be pressure rated to 150 psi, all 6” valves shall be pressure rated to 100 psi, and all 8” valves shall be pressure rated to 75 psi for water at 73°F.
			4. Fluid Service: Normal
			5. System Application(s): RLW
			6. Location: Above grade
			7. Assembly Methods: [welded, ASME B1.20.1 threads]
4. STRAINERS
	* 1. Manufacturer: Spears
			1. Example Part Number: YS22P12-005 (1/2-inch EPDM), 12 mesh (0.062 inch); Socket)
			2. Description: Sediment strainers: Y-type constructed from PVC Type I, ASTM D1784 Cell Classification 12454 or CPVC Type IV, ASTM D1784 Cell Classification 23447. O-rings shall be EPDM or Viton®. Y-strainers shall have replaceable PVC, CPVC or Type 316 stainless steel screens and O-ring-sealed drain plugs with magnetic drain plug option. Threaded Y-strainers shall have Special Reinforced (SR) threads.
			3. Rating: Y-Strainers sizes 1/2"- 2" pressure-rated to 150 psi, sizes 3"- 4" to 90 psi for water at 73°F
			4. Fluid Service: Normal
			5. System Application(s): RLW
			6. Location: Above grade
			7. Assembly Methods: [welded, ASME B1.20.1 threads]
		2. Manufacturer: Pelmar Engineering Ltd.
			1. Example Part Number: IFC Series Y150SST (threaded)
			2. Description: One piece cast A351-CF8M Stainless Steel Body, 304SS screen, A182-316 plug, Teflon gasket, ½ inch size, 0.032-inch screen opening
			3. Rating: 275 psig non shock, 200 psig at 400 °F, sizes [1/2"- 3"]
			4. Fluid Service: Normal
			5. System Application(s): RLW
			6. Location: Above grade
			7. Assembly Methods: [socket welded, ASME B1.20.1 threads]
5. INDUSTRIAL BALL CHECK VALVES
	* 1. Manufacturer/Model: Spears True Union 2000
			1. Example Part Number: 4529-005 (1/2-inch EPDM, Socket/ ASME B1.20.1 threads)
			2. Description: True Union 2000 Industrial Ball Check type manufactured to ASTM F1970 and constructed from PVC Type I, ASTM D1784, Cell Classification 12454 or CPVC Type IV, ASTM D1784 Cell Classification 23447. O-rings shall be EPDM or Viton®. Valve union nuts shall have Buttress threads. Valve seats shall be a standard O-ring type. Seal carriers shall be Safe-T-Blocked®. All valve components shall be replaceable.
			3. Rating: PVC and CPVC 1/2" through 2" valves shall be pressure rated to 235 psi, 2-1/2" through 8" venturied, and flanged valves pressure rated to 150 psi for water at 73°F.
			4. Fluid Service: Normal
			5. System Application(s): RLW
			6. Location: Above grade
			7. Assembly Methods: [welded, ASME B1.20.1 threads]
6. DIELECTRICS
	* 1. Threaded/Soldered
			1. Manufacturer: Watts
			2. Example Model Number: 3001A
			3. ASME B16.39 union female iron pipe thread per ASME B1.20.1 to copper solder joint
			4. Rating 250 psig @ 180 F
			5. Size: ½ inch [ to 2 inch]
			6. Fluid Service: [Normal. Category D]
			7. System Application(s):
			8. Location: Above grade
			9. Assembly Methods: [ASME B1.20.1 threads, braze, solder]
		2. Flanged
			1. Manufacturer: Watts
			2. Example Model Number: 3100
			3. Description: Dielectric Connections Union with galvanized or plated steel threaded end, copper braze (solder) end, and water impervious isolation barrier, minimum rating 250 psig at 250°F. Watts Series 3000. Flange bolts to be used with bolt insulators.
			4. ASME B16.42 (iron), ASME B16.24 (bronze) class 125 flange, female iron pipe thread per ASME B2.1, or copper braze joint
			5. Rating 175 psig at 180°F
			6. Size: 2 inch [to 4 inch]
			7. Fluid Service: Normal
			8. System Application(s): Membrane Filtration System above 150 psig, below ‑20°F, or above 366°F
			9. Location: Above grade
			10. Assembly Methods: [ASME B16.42 (iron) , ASME B16.24 (bronze) class 125 flange, ASME B1.20.1 threads, braze]

PART 3 EXECUTION

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Seismic: If Project Spec includes 22 0548.23, and if requirements herein associated with installation, testing, and inspection of mounting and/or anchorage devices differ from those requirements in 22 0548.23, they must be described herein. Also, if this is applicable, identify special types of seismic-control devices required for each application using the same terminology used for those devices in PART 2 herein.

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1. GENERAL
	* 1. Piping (and tubing) Systems: Fabricate, inspect, examine, and test in accordance with ASME B31.3.
		2. Piping systems include all piping components (including pressure retaining portions of instruments), pipe fixtures, clamps, and supports, instrument mounting plates and their attachment to structural framework.

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Note:

ASME B31.3 places restrictions on the application of solder and plastics.

Soldered joints shall be used only in Category D fluid service.

Plastics shall not be used in flammable fluid service above ground unless they are approved by the owner in accordance with A323.4.2.a.1.

PVC and CPVC shall not be used in compressed air or other compressed gas service.

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1. TAGGING & MARKING
	* 1. To facilitate identification and assembly in the field, each pipe spool shall be conspicuously marked on the outside surface of each end with a spool piece identification number as identified in the [isometric drawing, drawing, or line list].
		2. The identification numbers shall permanently attached barcode stickers are an acceptable alternative.
		3. For austenitic stainless steel and nonferrous alloys, the marking paint required for piece numbers or color coding shall contain no harmful metal or metal salts such as zinc, lead, or copper which cause corrosive attack upon heating. Marking materials shall contain no halides. Markings shall not be water soluble.
		4. Nameplates shall be attached by seal welding, permanent adhesive or stainless-steel wire. Nameplates shall include:
			1. Purchase order number
			2. Manufacturer’s name and address
			3. Identification number
			4. Size
			5. Pressure class (if applicable)
			6. Fluid Service
			7. System Application(s)
2. PREPARATION

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

Review ESM Chapter 17 ADMIN-2 Design, Documentation, and Records, for information on cleaning

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

* + 1. Pre-Assembly
			1. Verify materials are correct before assembly in accordance with the accepted Material Control Procedure.
			2. Fastener materials shall be free of nicks, burrs, chips, dirt, and damage (inspect threads, shank, and nuts). All damaged fasteners must be replaced.
1. FABRICATION
	* 1. Piping shall be fabricated in accordance with the provided [Construction] Drawings.

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

Designer may allow tube bends and edit B below but must then provide thickness calculations and supporting documentation showing the bending results in acceptable thicknesses before section will be acceptable.

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

* + 1. No pipe or tube bends are allowed. Fittings are to be used instead of bends.
		2. Solder per ASTM B828, *Standard Practice for Making Capillary Joints by Soldering of Copper and Copper Alloy Tube and Fittings*.

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

Designer Note

Master specification sections 01 4631, *Welding of ASME B31 Piping*, and 01 4731 *Flange Assembly for B31 Systems* were created to provide the engineering specifications necessary for flange assembly of B31 piping systems. These new Sections were created to ensure the designer adequately addressed the flange assembly requirements required by ASME. As normal these sections must be edited to meet the requirements of the project — or their material incorporated into this Section. It is very likely that information will need to be added to this Section so that welding assembly is adequately defined for the specific project.

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

* + 1. Welded Joints
			1. Welding [Brazing] procedures, pre-weld cleaning, and weld dimensions, shall be per Section 01 4631, *Welding of B31 Piping*.
			2. Unless noted otherwise on the isometric drawing, field fit-up welds shall include 6 inches of pipe beyond the length required.
			3. Weld joints shall meet the approved WPS joint requirements.
1. ERECTION

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

Designer Note

Sections 01 4631 *Welding of B31 Piping* and 01 4731 *Flange Assembly for B31 Systems* provide the requirements for those topics (they are not addressed in this section).

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

* + 1. Flange assembly shall be per Section 01 4731, *Flange Assembly* *for B31 Systems.*
		2. Compression joints shall be per manufacturer’s recommendations.
		3. Install all piping shown on the construction drawings per manufacturer’s recommended procedures and this section.
		4. Deviations from locations identified on the drawings must be approved by LANL and documented for incorporation into as-built drawings.
		5. Route piping in an orderly manner and maintain gradient. Route parallel and perpendicular to walls and equipment to allow service and maintenance.
		6. Install piping to maintain headroom and ensure that it does not interfere with use of space or take more space than is necessary. Piping shall not block access to manholes, access covers, etc.
		7. Group piping whenever practical at common elevations.
		8. Wedges shall not be used to laterally contain or position pipe for closure fit-ups.
		9. Valves shall be placed to permit easy operation and access and be installed upright where possible. Valve stems shall be upright or horizontal, not inverted.
		10. Flanged dielectric connections shall be installed with dielectric bolt insulators.
		11. Provide drain valves at low points and vents at high points. The use of vertical installation tolerance shall not increase unvented high points unless these are explicitly approved by LANL.
		12. Drain piping shall slope downward in the direction of flow. The minimum slope or grade indicated on design documents shall be maintained regardless of other installation tolerance. If low points cannot be avoided on pressurized lines, a ball valve the same size as the line with a threaded plug in the outlet shall be provided at the low point.
		13. Sleeve and caulk pipes penetrating exterior and interior bearing walls [in accordance with Section 22 0548.23]. Provide waterproof installation for exterior walls. Provide UL/FM approved through-penetration firestop system when penetrating fire-rated barriers (e.g., walls, floors, etc.) per Section 07 8400 *Firestopping*. Install chrome-plated steel escutcheons where pipes are not insulated in finished areas.
		14. Identification and/or traceability marks of piping components shall not be removed or hidden by surface treatment, coating, or subdividing during installation unless other identification methods are implemented to ensure that all markings are properly transferred, and traceability documentation is maintained for the components. Installer must verify that items are correct for the installation and have legible identification markings.
		15. Threaded Joints
			1. Compound or lubricant used on bolt threads shall be suitable for the service conditions and shall not react unfavorably with either the service fluid or the piping material. Reference manufacturer’s recommendations for suitable compounds and lubricants. Lubricant for stainless steel shall contain no chloride.
			2. Provide non-conducting dielectric connections whenever joining dissimilar metals in liquid systems with corrosion potential.
			3. The threaded joint assembly shall be in accordance with ASME B1.20.1 3.1.9 *Wrench-Tight Engagement between External and Internal Taper Threads*.
		16. Flare Joint 45-Degree (SAE J513)
			1. Cut tubing squarely and clean tube end thoroughly to remove burrs.
			2. Place nut onto tube. Place threaded end of nut toward end of tube.
			3. Flare tube end with flaring tool to provide 45° flare.
			4. No scratches, breaks, or other mars at sealing surface of flare shall be permitted.
			5. Clamp tube flare between nut and nose of fitting body by screwing nut on finger-tight. Tighten with a wrench an additional 1/4 turn for a metal-to-metal seal.
		17. Flare Joint, 37-Degree (SAE J514)
			1. Flaring of the tubing will meet the manufactures requirements.
			2. Power flaring is quicker and produces more accurate and consistent flares compared to hand flaring. Therefore, it is a preferred method of flaring. Hand flaring should be limited to places where power flaring tools are not readily available.
			3. Cut tubing squarely and clean tube end thoroughly to remove burrs.
			4. Place nut and sleeve if used onto tube in the proper sequence. Place threaded end of nut toward end of tube.
			5. Flare tube end with flaring tool to flare tubing. Flares will be within the minimum and maximum flare outside diameters. Inspect flare for surface quality.
			6. No scratches, breaks, or other mars at sealing surface of flare shall be permitted.
			7. Align the component and hand tighten fitting. With proper tube flare alignment with the nose of the fitting, tighten the nut to appropriate torque value shown in the manufacturer’s literature.
			8. Torque tolerances:
				1. 2 ft-lbs if torque value is 50 ft-lbs or less
				2. 4 ft-lbs if torque value is greater than 50 but less than 100 ft-lbs
				3. 4% of torque value if greater than 100 ft-lbs.
		18. Underground Piping
			1. Do not install underground piping when the bedding is wet or frozen.
			2. Verify that excavations are to the required grade and depth.
			3. Trenching, backfill, compaction, and testing for underground pipe shall be in accordance with Section 31 2000, *Earth Moving*.
			4. Provide cover, bedding, warning tape, and tracer wire per trench details and below-grade piping details shall be in accordance with Section 31 2000, *Earth Moving*.
		19. Double-Wall Piping
			1. Installation of the double-wall piping shall be planned and executed to ensure that all piping joints (except connections to existing piping), terminations, and transition flanges are leak tested as new construction.
		20. Final Assembly Cleaning
			1. Subcontractor shall be responsible for the cleanliness and integrity of the system. Internal and external of pipe, tube, and components shall be free of loose scale, sand, dirt, paint, metal chips, filings, flux, slag, weld spatter, mill scale, rust, grease, oil, waxes, or other contaminants that are easily seen with the unaided eye.
			2. Consult manufacturer’s recommendation for the use of acids and cleaning agents to prevent damage. Cleaning agents used with stainless steel systems shall contain no more than 50 ppm halide content.
			3. Ensure safeguards are taken to protect personnel from hazards of cleaning, which may include but not be limited to flying particulates, corrosive chemicals, and harmful vapors.
			4. A suitable chemical and/or mechanical cleaning method shall be used, if necessary, to clean all surfaces.
1. HANGER AND SUPPORT INSTALLATION
	* 1. Follow Section 22 0529, *Hangers and Supports for Plumbing Piping and Equipment*, as applicable.
2. INSULATION INSTALLATION
	* 1. Follow Section 22 0713, *Plumbing and HVAC Insulation*, as applicable.
3. EXAMINATION, TESTING, AND INSPECTION

NOTE: All piping joints connecting to existing piping are to be leak tested in accordance with the Engineering Standards Manual STD-342-100 Chapter 17 – Pressure Safety, Section EXIST – Legacy System Requirements, 3.0 Modification or Maintenance of an Existing System*.*

* + 1. For the purposes of this section, the Subcontractor (constructor) is responsible for all tasks identified as examination and testing. CWI activities are considered examination. Owner’s Inspector activities are considered inspection.
		2. Examination
			1. Pipe examinations shall be performed after fabrication, after required heat treatment, and before leak testing.
			2. Both the extent of examination and acceptance criteria shall be in accordance with ASME B31.3 paragraph 341 Examination and Section A341 Examination for non-metallic systems, as applicable.
			3. When pneumatic testing is planned 100% of all threaded, bolted, and other mechanical joints shall be examined.
			4. Any items rejected because of defects shall be repaired, replaced, and examined per this section and ASME B31.3.
			5. Methods of examination shall be per ASME B31.3 Section 344.
			6. In-process examination of welds [may, may not] replace radiographic [or, and] ultrasonic volumetric analysis for [all, specify welds] welding per 344.7 In-Process Examination.
		3. Testing
			1. Pressure test piping system per Section 22 0813, *Testing Piping Systems*.
		4. Inspection
			1. Owner’s Inspector shall have access to any and all design, fabrication, manufacture, fabrication, heat treatment, assembly, erection, examination, testing , records, documentation or other project information or activities to verify that all required examinations and testing have been completed and to inspect the piping to the extent necessary to be satisfied that it conforms to all applicable examination requirements of the Code and of the engineering design and to perform the role defined in ASME B31.3.
			2. Owner’s Inspector is the final authority on acceptance of the project examination, or test.

END OF MAIN SECTION

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

Do not delete the following reference information:

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

THE FOLLOWING STATEMENT IS FOR LANL USE ONLY

This project specification is based on LANL Master Specification Section 40 0504, Rev. 1, dated January 10, 2023.

**\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\***

Designer Notes

The following appendices include a collection of typical piping specifications used at LANL. These specifications are not designed for specific projects, and only applicable specification(s) should be selected and modified as necessary to meet the specific project requirements. Components in this appendix are either listed components in ASME B31.3 or unlisted components with justification per ASME B31.3, Section 326.1.2.

The designer must specify all required components. Items that are to be included must be added. Items that are not required are to be removed.

It is unnecessary and can be confusing to have piping components defined in the body of the Section and in a referenced Attachment. An item must only be identified once and duplicative requirements deleted. However, all the information for the item including the Fluid Service, System Application, Location, and Assembly Method must also be identified for each piping component.

**\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\***

**APPENDIX A**[Specialty gases (argon, nitrogen, helium, p-10, regen gas) above 150 psig or below -20°F or above 366°F, radioactive liquid waste, etc.…]

|  |  |
| --- | --- |
| Code of Record:  | ASME B31.3-2020 |
| Fluid service:  | Category Normal [Category D, etc.…] |
| System application(s):  | [Specialty gases (argon, nitrogen, helium, p-10, regen gas) above 150 psig or below -20°F or above 366°F, radioactive liquid waste, etc.…] |
| Location:  | Above Grade [above grade, below grade] |
| Assembly method:  | Welded and threaded [welded, brazed, solder, flanged, ASME B1.20.1 threads, Lok-Ring ®, etc.…] |

DESIGN PARAMETERS

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Design Pressure (psig) | 275 | 235 | 215 | 195 | 182.5 |
| Design Temperature (°F) | 100 | 200 | 300 | 400 | 450 |
| Minimum Temperature (°F) | -20 | -20 | -20 | -20 | -20 |

|  |  |
| --- | --- |
| Material | Dual Grade Stainless Steel (TP316/316L) |
| Pressure Rating: | Class 150 |

ALLOWABLE PIPE MATERIALS

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Component | Size (NPS) | Rating | Standard | Material | Material Grade | Additional Requirements |
| Piping | **½** - 12 | Schedule Tables | ASME B36.19 | ASTM A312 | TP316/316L dual certified | Seamless |
| Nipples | ½ - 1 ½” | Schedule Tables | ASME B36.19 | ASTM A312 | TP316/316Ldual certified | Seamless, (Threaded or Plain end) |

REQUIRED PIPE SCHEDULES

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Corrosion Allowance (in.) | Application | Size (NPS)Schedule | ½ | ¾ | 1 | 1 ½ | 2 | 3 | 4 | 6 | 8 | 10 | 12 |
| 0.063 | Welded | Schedule | 40S | 40S | 40S | 40S | 40S | 40S | 40S | 40S | 40S | 40S | 40S |

FITTINGS

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Component | Size (NPS) | Rating | Standard | Material | Material Grade | Additional Requirements |
| Butt-weld Fittings | ½ - 12 | Schedule Tables | ASME B16.9 | ASTM A403 | WP316/316L dual certified | Class S |

FLANGES

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Component | Size (NPS) | Rating | Standard | Material | Material Grade | Additional Requirements |
| Weld neck Flange | ½ - 12 | Class 150 | ASME B16.5 | ASTM A182 | F316/316L dual certified | Raised Face |
| Slip-on Flange | ½ - 12 | Class 150 | ASME B16.5 | ASTM A182 | F316/316L dual certified | Raised Face |
| Blind Flange | ½ - 12 | Class 150 | ASME B16.5 | ASTM A182 | F316/316L dual certified | Raised Face |

MECHANICAL FASTENERS

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Component | Size | Rating | Standard | Material | Material Grade | Additional Requirements |
| Fasteners | ½ - 12 | Class 150 | ASME B18.2.1ASME B1.1 | ASTM A193 | B7 | None |
| Nuts | ½ - 12 | Class 150 | ASME B18.2.2ASME B1.1 | ASTM A194 | 2H | None |

BALL VALVES

Size: NPS 2 (DN 50) and Smaller

Description: ASME class 150 Butt-Weld, 3- Piece, Full Port Ball with Stainless Steel Lever

Standards: ASME B16.34, MSS SP-25, MSS SP-72

Ends: Butt-Weld [welded, brazed, solder, flanged, ASME B1.20.1 threads, Lok-Ring ®, etc.…]

Body: ASTM A182 F316

Seal: UHMWPE

Shaft: Stainless Steel

Ball: 316 Stainless Steel, ASTM A479

Packing: Graphite

P-T rating: ASME class 150 Full Flange Rating from -20°F to 200°F

Manufacturer:

Model Number:

Size: NPS 3 (DN 80) and Larger

Description: ASME 150 Butt-Weld or Flanged Ends, 3- Piece, Stainless Steel Lever\* Standards: ASME B16.5, ASME B16.34, MSS SP-25, MSS SP-72

Ends: Butt-Weld or Flanged

Body: ASTM A182 F316

Seal: UHMWPE

Shaft: Stainless Steel

Ball: 316 Stainless Steel, ASTM A479

Packing: Graphite

P-T rating: ASME class150 Full Flange Rating from -20°F to 200°F

\*Gear operator required for NPS 8” and Larger

Manufacturer:

Model Number:

CHECK VALVES

Size: NPS 2 (DN 50) and Smaller

Description: ASME class 150, Standard Valve Butt-weld or Flanged Ends, Swing

Check Standards: ASME B16.34, B16.5,

Ends: Butt-weld or Flanged

Body: ASTM A182 F316

O-Ring: Fluorocarbon FKM

Shaft: Stainless Steel

P-T rating: 195 psig from -10°F to 400°F

Manufacturer:

Model Number:

GLOBE VALVES

Size: NPS 2 (DN 50)

Type: ASME 150 Butt-weld or Flanged Ends, Regular Port Standards: ASME B16.5 (flange), ASME B16.25, (butt weld ends) ASME B16.34 (flanged, welded, threaded valves)

Ends: Butt-weld or Flanged

Body: ASTM A182 F316

Seat: UHMWPE

Shaft: Stainless Steel

Packing: Graphite

P-T rating: ASME 150 Full Flange Rating from -20°F to 200°F

GASKETS:

Size: ½ to 12

Type: ASME 150, 1/8” Thick SS wound, Graphite Filler, ASME B16.20, Garlock FLEXSEAL RWI

90° BRANCH CHART:

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **½** | **¾** | **1** | **1-½** | **2** | **3** | **4** | **6** | **8** | **10** | **12** |  |
| ST | WRT | WLP | WLP | WLP | WLP | WLP | WLP | WLP | WLP | WLP | **½** |
|  | ST | WRT | WLP | WLP | WLP | WLP | WLP | WLP | WLP | WLP | **¾** |
|  | ST | WRT | WLP | WLP | WLP | WLP | WLP | WLP | WLP | 1 |
|  | ST | WRT | WLP | WLP | WLP | WLP | WLP | WLP | 1-½ |
|  | ST | WRT | WLP | WLP | WLP | WLP | WLP | 2 |
|  | ST | WRT | WLP | WLP | WLP | WLP | 3 |
|  | ST | WRT | WLP | WLP | WLP | 4 |
| SYMBOLS: | ST | WRT | WRT | WLP | 6 |
| ST=STRAIGHT TEE | ST | WRT | WRT | 8 |
| WLP=BUTT WELD LIGHTWEIGHT PIPET | ST | WRT | 10 |
| WRT = BUTT WELD REDUCING TEE | ST | 12 |

**APPENDIX B**

Liquid DI Water above 150 psig [radioactive liquid waste, etc.…]

\*MANUFACTURER SHALL BE SWAGELOK OR APPROVED EQUAL

|  |  |
| --- | --- |
| Code of Record:  | ASME B31.3-2020 |
| Fluid service:  | Category Normal [Category D, etc.…] |
| System application(s):  | Liquid DI Water above 150 psig [radioactive liquid waste, etc.…] |
| Location:  | Above Grade [above grade, below grade] |
| Assembly method:  | Compression [welded, brazed, solder, flanged, threaded, etc.…] |

DESIGN PARAMETERS

|  |  |  |
| --- | --- | --- |
| Design Pressure (psig) | 150 | 150 |
| Maximum Design Temperature (°F) | 100 | 150 |
| Minimum Design Temperature (°F) | -20 | -20 |

|  |  |
| --- | --- |
| Material: | Dual Grade Stainless Steel (TP316/316L) |
| Pressure Rating: | 150 psig |

ALLOWABLE TUBE MATERIALS

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Component | Size (NPS) | Rating | Material | Material Grade | Additional Requirements |
| Tubing | 1/8 – 2 ½ | Thickness Table | ASTM A269 | TP316/316L | CMTR must specify tensile and yield properties, Seamless |

REQUIRED THICKNESS**\*** FOR TUBE:

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| CorrosionAllowance (in.) | Size (NPS) | 1/8 | ¼ | 5/16 | 3/8 | ½ | 5/8 | ¾ | 7/8 | 1 | 1 ¼ | 1 ½ | 2 | 2 ½ |
| 0.010 | Thickness (in.) | 0.028 | 0.028 | 0.035 | 0.035 | 0.035 | 0.049 | 0.049 | 0.049 | 0.065 | 0.083 | 0.095 | 0.109 | 0.120 |

**\***Thickness is for liquid service see Swagelok literature for gas service

FITTINGS

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Component | Size (NPS) | Rating | Standard | Material | Material Grade | Additional Requirements |
| Tube Fittings | 1/8 – 2 ½ | Manufacturer’s | Manufacturer’s | ASTM A182/A479 | 316/316L | Compression Ferrule Tube Fitting / THRD |
| Brazed Fittings | 1/8 – 2 ½ | Manufacturer’s | Manufacturer’s | ASTM A182/A479 | 316/316L | - |

CHECK VALVES

Size: NPS 1 (DN 25) and Smaller

Type: Spring Check with poppet and backup ring, Fixed Cracking Pressure Standards: ASME B1.20.1

Ends: Straight Female Threaded

Body: 316 Stainless Steel, ASTM A479

Seal: Fluorocarbon FKM

P-T rating: 2000 psig from -10°F to 100°F, 1715 psig up to 200°F

Manufacturer: Swagelok,

Model Number: CH Series

BALL VALVES

Size: NPS 1 (DN 25) and Smaller

Type: Compression Ferrule Tube Fitting, One- Piece, Regular Port Ball with Stainless Steel Lever

Standards: Manufacturer’s Standard

Ends: Compression Ferrule Tube Fitting

Body: 316

Seal: Reinforced PTFE

Shaft: Stainless Steel

Ball: 316 Stainless Steel, ASTM A479

Packing: Reinforced PTFE

P-T rating: 2200 from -20°F to 100°F and 1850 up to 150°F

Manufacturer: Swagelok,

Model Number: 60 Series

Size: NPS 1 ½ (DN 40) and NPS 2 (DN 50)

Type: Compression Ferrule Tube Fitting, One- Piece, Regular Port Ball with Stainless Steel Lever

Standards: Manufacturer’s Standard

Ends: Compression Ferrule Tube Fitting

Body: 316

Seal: Reinforced PTFE

Shaft: Stainless Steel

Ball: 316 Stainless Steel, ASTM A479

Packing: Reinforced PTFE

P-T rating: 1500 from -20°F to 100°F and 1210 up to 150°F

Manufacturer: Swagelok,

Model Number: 60 Series

90° BRANCH CHART:
HEADER SIZE

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 1/8 | ¼ | 5/16 | 3/8 | ½ | 5/8 | ¾ | 7/8 | 1 | 1 ¼ | 1 ½ | 2 | 2 ½ |  |
| ST | RT | RT | RT | RT | RT | RT | RT | RT | RT | RT | RT | RT | 1/8 |
|  | ST | RT | RT | RT | RT | RT | RT | RT | RT | RT | RT | RT | ¼ |
|  | ST | RT | RT | RT | RT | RT | RT | RT | RT | RT | RT | 5/16 |
|  | ST | RT | RT | RT | RT | RT | RT | RT | RT | RT | 3/8 |
|  | ST | RT | RT | RT | RT | RT | RT | RT | RT | ½ |
|  | ST | RT | RT | RT | RT | RT | RT | RT | 5/8 |
|  | ST | RT | RT | RT | RT | RT | RT | ¾ |
|  | ST | RT | RT | RT | RT | RT | 7/8 |
|  | ST | RT | RT | RT | RT | 1 |
| SYMBOLS: | ST | RT | RT | RT | 1 ¼ |
| ST= STRAIGHT TEE (TCE x MNPT / TCE x FNPT)  | ST | RT | RT | 1 ½ |
| RT=REDUCING TEE (TCE x MNPT / TCE x FNPT) | ST | RT | 2 |
|  | ST | 2 ½ |

**APPENDIX C**

[Deionized Water System less than 150 psig and between -20°F and 366°F]

|  |  |
| --- | --- |
| Code of Record:  | ASME B31.3-2020 |
| Fluid service:  | Category D[other] |
| System application(s):  | [Deionized Water System less than 150 psig and between -20°F and 366°F] |
| Location:  | Above Grade [above grade, below grade] |
| Assembly method:  | Welded and threaded [welded, brazed, solder, flanged, threaded, etc.…] |

DESIGN PARAMETERS

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Design Pressure (psig) | 150 | 118 | 95 | 70 | 50 |
| Design Temperature (°F) | 73 | 100 | 120 | 130 | 140 |
| Minimum Temperature (°F) | 73 | 73 | 73 | 73 | 73 |

|  |  |
| --- | --- |
| Material | PVC 1120; Type I, Gr. 1 Cell Classification 12454 |
| Pressure Rating: | 150 psig |

ALLOWABLE PVC MATERIALS

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Component | Size | Rating | Standard | Material | Material Grade | Additional Requirements |
| Piping | ½ - 8 | Schedule Tables | ASTM D1785 | ASTM D1784 PVC 1120, Type I, Gr. 1 | Cell Classification 12454 | None |

REQUIRED SCHEDULES

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Corrosion Allowance | Size | ½ | ¾ | 1 | 1 ½ | 2 | 3 | 4 | 6 | 8 |
| 0.010 in | Schedule | 80 | 80 | 80 | 80 | 80 | 80 | 80 | 80 | 80 |

FITTINGS

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Component | Size | Rating | Standard | Material | Cell Classification | Additional Requirements |
| Piping | ½ - 8 | Schedule Tables | ASTM D2467 | ASTM D1784 PVC 1120,Type I, Gr. 1 | 12454 | SW |

FLANGES

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Component | Size | Rating | Standard | Material | Cell Classification | Additional Requirements |
| Socketweld Flange | ½ - 8 | Schedule Tables | ASTM D24671 | ASTM D1784 PVC 1120,Type I, Gr. 1 | 12454 | Flat Faced |
| Socketweld Van Stone Flange | ½ - 8 | Schedule Tables | ASTM D24671 | ASTM D1784 PVC 1120,Type I, Gr. 1 | 12454 | Flat Faced |
| Blind Flange | ½ - 8 | Schedule Tables | ASTM D24671 | ASTM D1784 PVC 1120,Type I, Gr. 1 | 12454 | Flat Faced |

1Socket fitting dimensions shall be in accordance with ASTM D2467 and bolt hole pattern dimensions shall be in accordance with ASME B16.5 Class 150 flanges.

MECHANICAL FASTENERS

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Component | Size | Rating | Standard | Material | Material Grade | Additional Requirements |
| Fasteners | ½ - 8 | Class 150 | ASME B18.2.1ASME B1.1 | ASTM A307 | B | - |
| Nuts | ½ - 8 | Class 150 | ASME B18.2.2 ASME B1.1 | ASTM A563 | A | ASME B18.21.1 Hardened Plain Washer (ASTM F436 Washers) |

GASKETS:

Size: ½ to 8

Type: ASME 150, 1/8” Thick, full-face neoprene, 50 durometer nominal hardness, ASME B16.21

90° BRANCH CHART

HEADER SIZE

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| ½ | ¾ | 1 | 1-½ | 2 | 3 | 4 | 6 | 8 |  |
| ST | RT | BRT | BRT | BRT | BRT | BRT | BRT | BRT | **½** |
|  | ST | RT | BRT | BRT | BRT | BRT | BRT | BRT | **¾** |
|  | ST | RT | BRT | BRT | BRT | BRT | BRT | 1 |
|  | ST | RT | BRT | BRT | BRT | BRT | 1-½ |
| Symbols | ST | RT | BRT | BRT | BRT | 2 |
| ST=STRAIGHT TEE | ST | RT | BRT | BRT | 3 |
| RT=REDUCING TEE | ST | RT | BRT | 4 |
| BRT=REDUCING TEE W/ BUSHINGS | ST | RT | 6 |
|  | ST | 8 |

**APPENDIX D**

[radioactive liquid waste]

|  |  |
| --- | --- |
| Code of Record:  | ASME B31.3-2020 |
| Fluid service:  | Category Normal [Category D, etc…] |
| System application(s):  | [radioactive liquid waste] |
| Location:  | Above Grade [above grade, below grade] |
| Assembly method:  | Welded and threaded [welded, brazed, solder, flanged, threaded, etc…] |

DESIGN PARAMETERS

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Design Temperature (oF) | 73 | 100 | 120 | 140 |
| Minimum Temperature (oF) | 32 | 32 | 32 | 32 |
| Design Pressure (psig) (Carrier / Inside Pipe) | 160 | 124 | 100 | 80 |
| Design Pressure (psig) (Containment / Outer Pipe) | 100 | 78 | 63 | 50 |

|  |  |
| --- | --- |
| Material | HDPE PE4710 |
| Pressure Rating: | 160 psig (Carrier)100 psig (Containment) |
| Corrosion Allowance | 0.00 |

ALLOWABLE HDPE MATERIALS

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Component | Size (IPS) | Rating | Standard | Cell Classification | Material Grade | Additional Requirements |
| Carrier Piping | 2-12 | DR 11 | ASTM F714 | ASTM D3350 PE445574C | PE4710 | - |
| Containment Piping | 4-16 | DR 17 | ASTM F714 | ASTM D3350 PE445574C | PE4710 | - |

FITTING1

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Component | Size (IPS) | Rating | Standard | Cell Classification | Material Grade | Additional Requirements |
| Carrier Piping | 2-12 | DR 11 | ASTM D3261 | ASTM D3350 PE445574C | PE4710 | - |
| Containment Piping | 4-16 | DR 17 | ASTM D3261 | ASTM D3350 PE445574C | PE4710 | - |

1 Fabricated fittings are only allowed when molded fittings are not available. Fabricated fittings shall be provided with documentation showing compliance with the Code of Record. Fabricated tees shall be provided with reinforced branch connections. All molded and fabricated fittings shall meet the design operating pressure requirements of the system as specified.

FLANGES

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Component | Size (IPS) | Rating | Standard | Cell Classification | Material Grade | Additional Requirements |
| Flange Adaptor | 2-12 | DR 11 | ASTM D3261/ D2513 | ASTM D3350 PE445574C | PE4710 | ASTM A395,Dimensions per ASME B16.1 Class125 flanges, Epoxy- Coated Metal Ductile Iron Backing Ring |
| Blind Flange | 2-12 | DR 11 | ASTM D3261/D2513 | ASTM D3350 PE445574C | PE4710 | none |
| Flange Adaptor | 4-16 | DR 17 | ASTM D3261/D2513 | ASTM D3350 PE445574C | PE4710 | ASTM A395,Dimensions per ASME B16.1 Class125 flanges, Epoxy- Coated Metal Ductile Iron Backing Ring |
| Blind Flange | 4-16 | DR 17 | ASTM D3261/D2513 | ASTM D3350 PE445574C | PE4710 | none |

MECHANICAL FASTENERS

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Component | Size | Rating | Standard | Material | Material Grade | Additional Requirements |
| Fasteners | 2-12 | Class 150 | ASME B18.2.1ASME B1.1 | ASTM A193 | B8 Cl. 2 | - |
| Nuts | 2-12 | Class 150 | ASME B18.2.2ASME B1.1 | ASTM A194 | 8 | - |

90° BRANCH CHART:

HEADER SIZE

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 2 | 3 | 4 | 6 | 8 | 10 | 12 | 14 | 16 |  |
| ST | SRT | RT | RT | RT | RT | RT | RT | RT | 2 |
|  | ST | SRT | RT | RT | RT | RT | RT | RT | 3 |
|  | ST | SRT | RT | RT | RT | RT | RT | 4 |
|  | ST | SRT | RT | RT | RT | RT | 6 |
|  | ST | SRT | RT | RT | RT | 8 |
| SYMBOLS:  | ST | SRT | RT | RT | 10 |
| ST=STRAIGHT TEE | ST | RT | RT | 12 |
| SRT=STRAIGHT TEE W/ BUTTWELD REDUCER OR BRANCH SADDLE REDUCING TEE | ST | RT | 14 |
| RT=REDUCING TEE/ BRANCH SADDLE OR TEE W/ BUTTWELD REDUCER Normal Fluid Service | ST | 16 |

END OF SECTION