SECTION 40 0504

Process piping

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LANL MASTER SPECIFICATION SECTION

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| Rev. 2 Summary of Changes  Added references to 01 4525 NDE specification throughout Section. Removed content related to welding, brazing and soldering and added reference to 01 4631 throughout Section. Revamped Article *Submittals* in Part 1 and Article *Seismic Performance Requirements* in Part 2 to standardize across piping specifications. Clarified when unlisted component evaluations are required in submittal space. Updated designer notes to provide additional useful information to designers. Relocated pressure/leak testing details from Section 22 0813 to this Section. Various updates to Part 3 for clarification and accuracy and other minor editorial changes. |

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

This Section was developed to meet the requirements for ASME B31.3-2022, Category D, and Normal Fluid Services. The Designer is expected to select those items for the appropriate Fluid Service, for example, solder is only permitted for Category D Fluid Service. Use of this section for a different fluid category including oxidizers will require a detailed review of ASME B31.3 and ESM Chapter 17 specifically [PS-REQUIREMENTS](https://engstandards.lanl.gov/ESM_Chapters.shtml#esm17), and its attachments. See ASME B31.3, Appendix M, Fig. M300 and ESM Chapter 17 [Attachment REQ-1](https://engstandards.lanl.gov/ESM_Chapters.shtml#esm17), *Category M Fluid Service and Lethal Service*, for classifying fluid services.

The designer is encouraged to review ASME B31.3; [DOE Handbook DOE-HDBK-1132, *Design Considerations*](https://www.standards.doe.gov/standards-browse?b_size=175&facets=TSPType&facets=opi&facets=slmOrg&facets=SeriesLines&facets=subjectareas&facets=ApprovedDate&facets=dnfsb&facets=invokedstandard&query=%5B%7B%22i%22%3A%22portal_type%22%2C%22o%22%3A%22paqo.selection.any%22%2C%22v%22%3A%5B%22TSP.Type.standard%22%5D%7D%2C%7B%22i%22%3A%22TSPStatus%22%2C%22o%22%3A%22paqo.selection.is%22%2C%22v%22%3A%5B%22Current%22%5D%7D%2C%7B%22i%22%3A%22subpart%22%2C%22o%22%3A%22paqo.selection.is%22%2C%22v%22%3A%5B%22No%22%5D%7D%2C%7B%22i%22%3A%22TSPType%22%2C%22o%22%3A%22paqo.list.contains%22%2C%22v%22%3A%5B%22Approval%20Memo%22%2C%22Change%20Notice%20Memo%22%2C%22Handbook%22%2C%22Project%20Justification%20Statement%22%5D%7D%5D&sort_on=getId&sort_order=ascending); and LANL Engineering Standards Manual [Chapters 13, *Welding, Joining, & NDE*](https://engstandards.lanl.gov/ESM_Chapters.shtml#esm13), and [Chapter 17, *Pressure Safety*](https://engstandards.lanl.gov/ESM_Chapters.shtml#esm17).

The appendices included in this Section is a collection of typical piping specifications used at LANL for process piping. It is unnecessary and can be confusing to have piping materials and components defined in the body of the Section above and in a referenced Appendix. 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.

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. This template is tailored to meet requirements contained in the LANL Engineering Standards Manual (ESM). To seek a variance from or alternate method to requirements in this section that are applicable, contact the ESM Pressure Safety[POC](https://engstandards.lanl.gov/POCs.shtml#pressure) and/or Mechanical [POC](https://engstandards.lanl.gov/POCs.shtml#mech). Please contact POCs with suggestions for improvement as well.

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.

This specification does not address buried piping. It is the responsibility of the Designer to include provisions for corrosion control of buried piping if necessary. Consult other Sections such as 23 2113 *Hydronic Piping* for template information on buried piping.

All tubing and piping shall be designed to operate in the environmental conditions specified in the project requirements documents for the life of the system.

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PART 1 GENERAL

* 1. SECTION INCLUDES

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

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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. Category 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. Reverse Osmosis (RO) Water Piping (Membrane Filtration) System above 150 psig, below -20 degreesF, or above 366 degrees F
         7. Compressed air systems above 150 psig, below -20 degreesF, or above 366 degrees F
         8. Specialty Gas [Argon, Nitrogen, Helium, non-flammable gases, \_\_\_\_\_\_\_] above 150 psig, below -20 degrees F, or above 366 degrees 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 degrees F and 366 degrees F
         3. Deionized water system below 150 psig and between -20 degreesF and 366 degrees F
  1. RELATED SECTIONS
     + 1. Section 01 2500, *Substitution Procedures*
       2. Section 01 3300, *Submittal Procedures*
       3. Section 01 4000, *Quality Requirements – Non-nuclear*
       4. Section 01 4115, *Pressure Safety Submittals*
       5. Section 01 4444, *Offsite Welding, Brazing and Joining Requirements*
       6. Section 01 4455, *Onsite Welding, Brazing and Joining Requirements*
       7. Section 01 4525, *Nondestructive Examination (NDE) Requirements*
       8. Section 01 4631, *Welding, Brazing and Soldering of ASME B31 Piping*
       9. Section 01 4731, *Flange Assembly for ASME B31 Systems*
       10. Section 01 8734, *Seismic Qualification of Nonstructural Components (IBC)*
       11. [Section 01 8113.13 [LEED v4 and]Guiding Principles 2020: Requirements for water efficiency, energy efficiency, material composition, and indoor air quality requirements]
       12. Section 07 8400, *Firestopping*
       13. Section 22 0529, *Hangers and Supports for Plumbing Piping and Equipment*
       14. [Section 22 0548.23, *Vibration and Seismic Controls for Mechanical Systems]*
       15. Section 22 0554, *Identification for Plumbing, HVAC, and Fire Piping and Equipment*
       16. Section 22 0713, *Plumbing and HVAC Insulation*
       17. Section 22 0813, *Testing Piping Systems*
       18. Section 23 2500, *HVAC Water Treatment*
       19. Section 31 2000, *Earth Moving*
  2. REFERENCES

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In the listing below, designer shall eliminate code and standards that are not applicable to the project and add other code and standards that are. The referenced standards editions are based on the code of record ASME B31.3-2022 and ASME BPVC-2023. If the Code of Record for the project refers to a different version of ASME B31.3 & ASME BPVC, the designer is responsible to update the years/editions for the invoked standards. If the invoked standards editions do not comply with those referenced by the Code of Record, EOR needs to evaluate and verify those for equal or better. For the standards without an edition/year, the latest edition is to be used. In addition, the designer must ensure the code and standards editions align between sections in the project specification package and the project design drawings.

Note: ASCE 7 edition is based on Code of Record IBC 2021.

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1. ASCE 7-[16], Minimum Design Loads and Associated Criteria for Buildings and Other Structures
2. ASME B1.1-[2024], Unified Inch Screw Threads (UN, UNR and UNJ Thread Forms)
3. ASME B1.20.1-[2013(R2018)], Pipe Threads, General Purpose (Inch)
4. ASME B16.1-[2020], Gray Iron Pipe Flanges and Flanged Fittings
5. ASME B16.5-[2020], Pipe Flanges and Flanged Fittings NPS ½ Through NPS 24 Metric/Inch Standard
6. ASME B16.9-[2018], Factory-Made Wrought Buttwelding Fittings
7. ASME B16.18-[2021], Cast Copper Alloy Solder Joint Pressure Fittings
8. ASME B16.20-[2023], Metallic Gaskets for Pipe Flanges
9. ASME B16.21-[2021], Nonmetallic Flat Gaskets for Pipe Flanges
10. ASME B16.22-[2021], Wrought Copper and Copper Alloy Solder-Joint Pressure Fittings
11. ASME B16.24-[2021], Cast Copper Alloy Pipe Flanges, Flanged Fittings, and Valves Classes 150, 300, 600, 900, 1500, and 2500
12. ASME B16.25-[2022], Buttwelding Ends
13. ASME B16.34-[2020], Valves-Flanged, Threaded, and Welding End
14. ASME B16.39-[2020], Malleable Iron Threaded Pipe Unions Classes 150, 250, and 300
15. ASME B16.42-[2021], Ductile Iron Pipe Flanges and Flanged Fittings Classes 150 and 300
16. ASME B18.2.1-[2012 (R2021)], Square, Hex, Heavy Hex, and Askew Head Bolts and Hex, Heavy Hex, Hex Flange, Lobed Head, and Lag Screws (Inch Series)
17. ASME B18.2.2-[2022], Nuts for General Applications: Machine Screw Nuts; and Hex, Square, Hex Flange, and Coupling Nuts (Inch Series)
18. ASME B18.21.1-[2009(R2016)], Washers: Helical Spring-Lock, Tooth Lock, and Plain Washers (Inch Series)
19. ASME B31.3-[2022], Process Piping
20. ASME B36.19-[2022], Welded and Seamless Wrought Stainless Steel Pipe
21. ASME BPVC Section V-[2023], Nondestructive Examination
22. ASME BPVC Section IX-[2023], Qualification standard for Welding, Brazing, and Fusing Procedures; Welders; Brazers; and Welding, Brazing and Fusing Operators
23. ASTM A53/A53M-[2016], Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
24. ASTM A182/A182M-[2017], Standard Specification for Forged or Rolled Alloy and Stainless Steel Pipe Flanges, Forged Fittings, and Valves and Part for High-Temperature Service
25. 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
26. ASTM A194/A194M-[2017a], Standard Specification for Carbon Steel, Alloy Steel, and Stainless Steel Nuts for Bolts for High Pressure or High Temperature Service, or Both
27. ASTM A234/A234M-[2007], Standard Specification for Piping Fittings of Wrought Carbon Steel an Alloy Steel for Moderate and High Temperature Service
28. ASTM A269-[2008], Standard Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Service
29. ASTM A307-[2007b], Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60,000 PSI Tensile Strength
30. ASTM A312/A312M-[2017], Standard Specification for Seamless, Welded, and Heavily Cold Worked Austenitic Stainless Steel Pipes
31. ASTM A395/A395M-[1999 (R2018)], Standard Specification for Ferritic Ductile Iron Pressure-Retaining Castings for Use at Elevated Temperatures
32. ASTM A403/A403M-[2016], Standard Specification for Wrought Austenitic Stainless Steel Piping Fittings
33. ASTM A479/A479M-[2017], Standard Specification for Stainless Steel Bars and Shapes for Use in Boilers and Other Pressure Vessels
34. ASTM A563/A563M-[2007a], Standard Specification for Carbon and Alloy Steel Nuts (Inch and Metric)
35. ASTM B68-[2002]/B68M-[1999 (R2005)] Standard Specification for Seamless Copper Tube, Bright Annealed
36. ASTM B75-[2002]/B75M-[1999 (R2005)] Standard Specification for Seamless Copper Tube
37. ASTM B88-[2003]/B88M-[2005], Standard Specification for Seamless Copper Water Tube
38. ASTM B280-[2008], Standard Specification for Seamless Copper Tube for Air Conditioning and Refrigeration Field Service
39. ASTM D1784, Standard Classification system and Basis for Specification for Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds (not listed)
40. ASTM D1785-[2015], Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120
41. ASTM D2241-[2015], Standard Specification for Poly(Vinyl Chloride) (PVC) Pressure-Rated Pipe (SDR Series)
42. ASTM D2467-[2006], Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80
43. ASTM D2513-[2009], Standard Specification for Polyethylene (PE) Gas Pressure Pipe, Tubing, and Fittings
44. ASTM D2672-[1996a(R2003)], Standard Specification for Joints for IPS PVC Pipe Using Solvent Cement
45. ASTM D2846/D2846M-[2019], Standard Specification for Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Hot- and Cold-Water Distribution Systems
46. ASTM D3261-[2003], Standard Specification for Butt Heat Fusion Polyethylene (PE) Plastic Fittings for Polyethylene (PE) Plastic Pipe and Tubing
47. ASTM D3350, Standard Specification for Polyethylene Plastics Pipe and Fittings Materials (not listed)
48. ASTM F436/F436M-[2002(R2009)], Standard Specification for Hardened Steel Washers
49. ASTM F438-[2009], Standard Specification for Socket-Type Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 40
50. ASTM F439-[2009], Standard Specification for Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 80
51. ASTM F441/F441M-[2015], Standard Specification for Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe, Schedules 40 and 80
52. ASTM F442/F442M-[2013], Standard Specification for Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe (SDR–PR)
53. ASTM F714-[2013], Standard Specification for Polyethylene (PE) Plastic Pipe (DR-PR) Based on Outside Diameter
54. ASTM F1970-[2019], Standard Specification for Special Engineered Fittings, Appurtenances or Valves for use in Poly (Vinyl Chloride) (PVC) or Chlorinated Poly (Vinyl Chloride) (CPVC) Systems
55. B31.3 Code Cases [2014]
56. CGA P-23, Standard for Categorizing Gas Mixtures Containing Flammable and Nonflammable Components (not listed)
57. MSS SP-25-[2018], Standard Marking System for Valves, Fittings, Flanges, and Unions
58. MSS SP-72-[2010a], Ball Valves with Flanged or Butt-Welding Ends for General Service
59. NMAC, New Mexico Administrative Code
60. SAE J513-[1999(R2019)], Refrigeration Tube Fittings - General Specifications
61. SAE J514-[2012], Hydraulic Tube Fittings
    1. SUBMITTALS
       1. Submit the following in accordance with Section 01 3300, *Submittal Procedures*.
       2. Action Submittals
          1. Catalog data on pipe materials, fittings, valves, and accessories. Include the Manufacturer’s name, model number, parts list, and brief description of equipment and its basic operational features.

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When offsite only, delete submittals below regarding onsite welding. When onsite only, delete submittals below for offsite welding. For high-risk applications such as 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. Per the requirements of Section 01 4444, offsite welding, brazing and joining requirements and/or Section 01 4455, onsite welding, brazing and joining requirements, submit:

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]

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].

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Examination requirements vary based on the ASME Fluid Service Category. See ASME B31.3, 341 Examination to determine the necessary NDE submittal requirements.

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* + - 1. [Per the requirements of Section 01 4525, *Nondestructive Examination* (*NDE) Requirements*, submit:

1. Written Practice or Procedure for Qualification and Certification of NDE personnel.
2. NDE Personnel Qualification Records
3. NDE Procedures
4. NDE Procedure Qualification Records
5. NDE Report(s)
6. NTIP submitted under Section 01 4525.]
   * + 1. Before fabrication, submit:
7. Proof of journeyman certificate of competence in accordance with NMAC 14.6.6.11
8. Leak test plan submitted under Section 22 0813
9. Cleaning procedures for joint assembly preparation
10. Certified Material Test Reports (CMTR) for metallic piping and components required by the code of record specified below:
11. ASTM A269
    * + 1. After fabrication, submit:
12. [Factory Acceptance Test Report]
13. Examination records per ASME B31.3 para. 346.3
    * 1. Informational Submittals at Closeout
         + 1. Spare Parts and Maintenance Materials list
           2. Installation, Operation, & Maintenance Manual
           3. Warranties
           4. Manufacturer’s data report form for ASME pressure vessels (e.g., ASME Form U-1) showing National Board registration
    1. QUALITY ASSURANCE
14. Material and Installation: Conform to ASME B31.3 for Category D, and Normal Fluid Services.
15. Welders Certification and Qualified Procedure Standards shall be in accordance with Section IX of ASME Boiler and Pressure Vessel Code. Welding per Sections [01 4444, *Offsite Welding, Brazing and Joining Requirements,* and/or 01 4455, *Onsite Welding, Brazing and Joining Requirements*].
16. [NDE Personnel Certification and NDE Procedures shall be per Section 01 4525, *Nondestructive Examination (NDE) Requirements.*]
17. Valve Identification: Each valve shall bear markings in accordance with 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.
18. Component identification shall follow [ESM Chapter 1, Section 200, Item Numbering and Labelling](https://engstandards.lanl.gov/ESM_Chapters.shtml#esm1)*.* At existing facilities, component labeling conventions are to be continued to be used to avoid confusion.
19. Design pressure and temperature of piping systems within this Section is provided in the Pressure Safety Implementation Plan, contained in [drawing or document number].

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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. LANL 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.

PART 2 PRODUCTS

* 1. PRODUCT OPTIONS AND SUBSTITUTIONS

1. Alternate products may be accepted per Section 01 2500, *Substitution Procedures* and 01 4115, *Pressure Safety Submittals*.
2. Proposal of unlisted components as substituted components is strongly discouraged and shall be evaluated per Section 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 substituted unlisted components shall be the responsibility of the Subcontractor.
   1. SEISMIC PERFORMANCE REQUIREMENTS

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The seismic exemptions noted below are based on ASCE 7-16. If the Code of Record for the project refers to a different version of ASCE 7, the Designer is responsible to check the seismic design requirements per that applicable edition.

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* + 1. Piping systems with trapeze assemblies/rod hangers that meet the requirements per ASCE 7, Section 13.6.7.3 are seismically exempt.
    2. For piping systems not meeting the above exemption, Structural EOR shall design seismic supports per [ESM Chapter 5, Structural, Section II](https://engstandards.lanl.gov/ESM_Chapters.shtml#esm5); ASCE 7, Chapter 13; and ASME B31.3.

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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.

Threaded joints should be avoided in any service where crevice corrosion, severe erosion, or cyclic loading (pressure or thermal) may occur.

Buried RLW shall be double-wall piping.

Piping containing radiological fluid shall not be erected with a liquid hold-up (e.g., a P-trap). Piping shall be installed such that it drains continuously to its final location.

Gasket materials shall be compatible with the fluids and service conditions.

Provide safe access or remote operators where valves and fittings are not exposed or installed over 7 feet in height above finished floor.

If using tubing with Swagelok compression fittings in gas service, refer to Swagelok Publication MS-01-107 for minimum required wall thickness.

Thermoplastics shall not be used in flammable fluid service above ground unless they are approved by LANL in accordance with ASME B31.3, A323.4.2(a)(1).

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

All the following components (disregarding ASME BPVC items) are either standard piping components (listed items) per ASME B31.3 para. 326 or have previously LANL approved unlisted component evaluations in accordance with ASME B31.3 para. 304.7.2.

The types of components shown may be a non-exhaustive list. Any substitutions or additions shall be ASME B31.3 compliant. All previously LANL approved ASME B31.3 components are available in the [LANL ESM Ch. 17](https://engstandards.lanl.gov/ESM_Chapters.shtml#esm17) Approved ASME Unlisted Material/Component List and Approval Process under Chapter References and Resources.

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* 1. PIPING/TUBING/FITTINGS
     1. Stainless Steel Pipe
        1. Pipe: ASTM A312/A312M, Dual Grade TP316/316L, seamless, Schedule [10] [40] [80] [160]
        2. Fittings: Buttweld ASME B16.9, ASTM A403 WP316/316L, Class S
        3. Fluid Service: Category [Normal, D, \_\_\_\_\_\_]
        4. System Application(s): [Specialty Gases (Argon, Nitrogen, Helium, P-10, Regen Gas) above 150 psig or below -20 degrees F or above 366 degrees F, Radioactive Liquid Waste, \_\_\_\_\_\_\_\_\_]

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If below grade option is selected, specify Corrosion Control by adding an article in Part 3, Corrosion Control

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* + - 1. Location: [Above grade, Below grade]
      2. Assembly Methods: [welded, brazed, solder, flanged, ASME B1.20.1 NPT, Lok-Ring ®, \_\_\_\_\_\_\_\_]
      3. Flanges: Raised Face, Weld neck, Slip-on, and Blind Flanges: ASME B16.5 Material Group 2.3 Forging, Class 150
      4. Fittings: Buttweld ASME B16.9 ASTM A403 WP316/316L, Class S
      5. Size: [4 inch]
    1. Steel Pipe
       1. Pipe: Black steel, ASTM A53, Type F, Grade A standard wall, schedule [40] [80].
       2. Fittings: Steel, ASTM A234, WPB or WPC, butt-welded type, standard wall.
       3. Fluid Service: Category Normal
       4. System Application(s): [Compressed air systems greater than 150 psig]

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If below grade option is selected, specify Corrosion Control by adding an article in Part 3, Corrosion Control

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* + - 1. Location: [Above grade, Below grade]
      2. Assembly Methods: [welded, flanged, MNPT ASME B1.20.1, Lok-Ring ®, \_\_\_\_\_\_\_]
      3. Size: [4 inch]
    1. PVC Pipe
       1. Pipe: [ASTM D1785, PVC 1120, Type I, Gr. 1, Cell Classification 12454, Schedule 80, ASTM D2241, PVC (SDR Series) Cell Classification 12454]
       2. Fittings: [ASTM D2467, ASTM D2672]
       3. Fluid Service: Category D
       4. System Application(s): Deionized water system less than 150 psig and between -20 degrees F and 366 degrees F
       5. Location: [Above grade, Below grade]
       6. Assembly Methods: [welded, MNPT ASME B1.20.1 (schedule 80 up only)]
       7. Size: [4 inch]
    2. CPVC Pipe
       1. Pipe: [ASTM F441/F441M CPVC Plastic Pipe, Schedule [40] [ 80], cell class 23447, ASTM F442/F442M CPVC Plastic Pipe (SDR PR) cell class 23447]
       2. Fittings: Material: [ASTM D2846/D2846M, ASTM D3350], Standard: [ASTM F438, ASTM F439]
       3. Fluid Service: Category [Normal, D]
       4. System Application(s): [RLW, Deionized water system less than 150 psig and between -20 degrees F and 366 degrees F]
       5. Location: [Above grade, Below grade]
       6. Assembly Methods: [welded, MNPT ASME B1.20.1 (schedule 80 up only)]
       7. Size: [4 inch]
    3. Double Wall Hi-Density Polyethylene (HDPE) Pipe
       1. Pipe: ASTM F714 with Cell Classification PE445574C per ASTM D3350, HDPE PE4710
       2. Wall Thickness: Internal wall thickness shall conform to dimension ratio DR 11. Exterior or containment pipe wall shall 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 NPT]
       9. Size: [4x6 inch]
    4. Stainless Steel Tubing
       1. Tubing: ASTM A269, Dual Grade 316/316L, Seamless
       2. Fluid Service: Category [Normal, D]
       3. System Application(s): [Specialty Gases (Argon, Nitrogen, Helium, P-10, Regen Gas) above 150 psig or below -20 degrees F or above 366 degrees F, Radioactive Liquid Waste, \_\_\_\_\_\_\_\_]
       4. Location: [Above grade, Below grade]
       5. Assembly Methods: [welded, flanged, CF flanges (Conflat), Lok-Ring ®, Swagelok compression fittings, flare fittings \_\_\_\_\_\_]
       6. Size: [1 inch]
       7. Wall Thickness: [\_\_\_\_\_]
    5. Copper tubing ASTM [B68] [B75] [B88] [B280], Alloy [102] [122], Temper [O50] [O60] [O61] [O62] [H55] [H58] [H80].
       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. Unions: Copper Tube and Pipe: ASME B16.22, Class 150, bronze unions with soldered joints.
          3. Comply with Section [01 4444, *Offsite Welding, Brazing and Joining Requirements*, 01 4455, *Onsite Welding, Brazing and Joining Requirements,* 01 4631*, Welding, Brazing, and Soldering of ASME B31 Piping*]*.*

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Solder joints are only permitted for ASME B31.3 Category D fluid service.

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* + - 1. Solder 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.
   * + 1. 45-degree Flare Joints

Fittings: SAE J513. Description: a 45-degree flare flared body and nut for use with annealed copper tubing. Materials are SAE 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 (1/8 through ¾ inch). Fittings are available based on outside diameter tube.

* + - 1. 37-degree Flare Joints

1. Fittings: SAE J514: 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 (1/8 through 2 1/2 inch). Fittings are available based on outside diameter tube.
   * + 1. Fluid Service: Category D
       2. System Application(s): [Inert laboratory gas less than 150 psig and between -20 degrees F and 366 degrees F]
       3. Location: Above grade
       4. Size: [3/4 inch]
     1. Stainless Steel Tubing, 37-degree Flare Fittings
        1. Flare Joint Fittings: SAE J514. 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 (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 degrees F or above 366 degrees 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 degrees F
        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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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: [ ]
        3. Working-Pressure Rating: 150 psig minimum
        4. End Connections: [MNPT ASME B1.20.1, Compression, \_\_\_\_\_\_]
        5. Fluid Service: Category [Normal, D]
        6. System Application(s): [Flammable gases, and specialty gases above 150 psig or outside the range of -20 degrees F to 366 degrees F, Deionized water system less than 150 psig and between -20 degrees F and 366 degrees 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: [Global Passive Safety Systems Lifeguard][Hose and U.S. Hose Corporation 402X with Spring Guard]
        1. Material: [ ]
        2. Working-Pressure Rating: 150 psig minimum
        3. End Connections: [MNPT ASME B1.20.1, Compression, \_\_\_\_\_]
        4. Fluid Service: Category [Normal, D]
        5. System Application(s): [Flammable gases, and specialty gases above 150 psig or outside the range of -20 degrees F to 366 degrees F, Deionized water system less than 150 psig and between -20 degrees F and 366 degrees F]
        6. Location: Above grade
        7. Assembly Methods: [ ]
        8. Size: [¾ inch]
        9. 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: [ \_\_\_\_\_]
        5. Part number: [ ]
     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, 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. Material: [Low Carbon Steel]
        3. Finish: [Brass Glo, Zinc Plated]
        4. Size: [0.12-inch] diameter material
        5. Load: [205 lbf] working load limit
  4. BALL VALVES (THERMOPLASTIC ½ TO 8 INCH)
     1. Manufacturer: Spears True Union 2000
        1. Example Part Number: 1829-005 (1/2-inch Socket/ ASME B1.20.1 NPT; 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 inch through 2 inch valves shall be pressure rated to 235 psi, all 2-1/2 inch through 8 inch venturied, and all flanged valves shall be pressure rated to 150 psi for water at 73 degrees F.
        4. Fluid Service: Normal
        5. System Application(s): RLW
        6. Location: Above grade
        7. Assembly Methods: [welded, ASME B1.20.1 NPT]
  5. PNEUMATIC-ACTUATED BALL VALVES (THERMOPLASTIC ½ TO 8 INCH)
     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 ASME B31.3 (the standards of manufacture and construction are equivalent).

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* + 1. Description
       1. 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.
       2. Rating: All 1/2 inch through 2 inch valves shall be pressure rated to 235 psi, all 2-1/2 inch through 8 inch venturied, and all flanged valves shall be pressure rated to 150 psi for water at 73 degrees F
       3. Fluid Service: Normal
       4. System Application(s): RLW
       5. Location: Above grade
       6. Assembly Methods: [welded, ASME B1.20.1 NPT]

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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 articles 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 inch
        5. Outlet Size: ¼ inch
        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 NPT
  2. GAS RELIEF VALVES
     1. Manufacturer/Model: [Kingston Valves, M/N 118, Part Number: 118CSS-2-045]
        1. Description: [stainless steel] [brass] ASME Section XIII stamped relief device
        2. Fluid Service: [Category D]
        3. System Application(s): [Compressed Air]
        4. Inlet Size: [¼ inch]
        5. Set Pressure: [45 psig]
        6. Location: Above grade
        7. Assembly Methods: ASME B1.20.1 NPT
        8. Manufacturers rating: [69 SCFM air]
  3. DIAPHRAGM VALVES (THERMOPLASTIC ½ TO 8 INCH)
     1. Manufacturer: Spears
        1. Example Part Number: 2729-005 (1/2-inch, EPDM, Socket/ ASME B1.20.1 NPT)
        2. Description: Weir-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. 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 ½ inch through 2 inch valves shall be pressure rated to 235 psi, all 2-1/2 inch through 4 inch and all flanged valves shall be pressure rated to 150 psi, all 6 inch valves shall be pressure rated to 100 psi, and all 8 inch valves shall be pressure rated to 75 psi for water at 73 degrees F.
        4. Fluid Service: Normal
        5. System Application(s): RLW
        6. Location: Above grade
        7. Assembly Methods: [welded, ASME B1.20.1 NPT]
  4. STRAINERS
     1. Manufacturer: Spears (Thermoplastic)
        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 ½ inch - 2 inch pressure-rated to 150 psi, sizes 3 inch - 4 inch to 90 psi for water at 73 degrees F
        4. Fluid Service: Normal
        5. System Application(s): RLW
        6. Location: Above grade
        7. Assembly Methods: [welded, ASME B1.20.1 NPT]
     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, ASTM A182-316 plug, Teflon gasket, ½ inch size, 0.032-inch screen opening
        3. Rating: 275 psig non shock, 200 psig at 400 degrees F, sizes: [1/2 inch - 3 inch]
        4. Fluid Service: Normal
        5. System Application(s): RLW
        6. Location: Above grade
        7. Assembly Methods: [socket welded, ASME B1.20.1 NPT]
  5. INDUSTRIAL BALL CHECK VALVES (THERMOPLASTIC ½ TO 8 INCHES)
     1. Manufacturer/Model: Spear True Union 2000
        1. Example Part Number: 4529-005 (1/2-inch EPDM, Socket/ ASME B1.20.1 NPT)
        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 inch through 2 inch valves shall be pressure rated to 235 psi, 2-1/2 inch through 8 inch venturied, and flanged valves pressure rated to 150 psi for water at 73 degrees F.
        4. Fluid Service: Normal
        5. System Application(s): RLW
        6. Location: Above grade
        7. Assembly Methods: [welded, ASME B1.20.1 NPT]
  6. DIELECTRIC CONNECTIONS
     1. Threaded/Soldered
        1. Manufacturer: Watts
        2. Model: [3001A]
        3. Description: ASME B16.39 union female iron pipe thread per ASME B1.20.1 to copper solder joint
        4. Rating: 250 psig at 180 degrees F
        5. Size: [½ inch to 2 inch]
        6. Fluid Service: Category D
        7. System Application(s): Process Water
        8. Location: Above grade
        9. Assembly Methods: [ASME B1.20.1 NPT, braze, solder]
     2. Flanged
        1. Manufacturer: Watts
        2. Model: [3100]
        3. Description: Galvanized or plated steel threaded end, copper braze (solder) end, and water impervious isolation barrier, minimum rating 250 psig at 250 degrees F. Watts Series 3000. Flange bolts to be used with bolt insulators.
        4. Rating: 175 psig at 180 degrees F
        5. Size: [2 inch] [4 inch]
        6. Fluid Service: Category D
        7. System Application(s): Process Water
        8. Location: Above grade
        9. Assembly Methods: ASME B16.42 (iron), ASME B16.24 (bronze) class 125 flanges

PART 3 EXECUTION

* 1. PREPARATION
     1. Square, ream pipe and tube ends. Remove burrs.

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Consult manufacturer’s recommendation for the use of acids and cleaning agents to prevent damage.

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.

A suitable chemical and/or mechanical cleaning method shall be used, if necessary, to clean all surfaces to be fabricated.

Review LANL Engineering Standards Manual (ESM) STD-342-100 [Chapter 17, Pressure Safety](https://engstandards.lanl.gov/ESM_Chapters.shtml#esm17), Section PS-REQUIREMENTS, 8.8, General Pressure System Design, for information on cleaning.

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* + 1. Cleaning:
       1. Remove scale and dirt on inside and outside before assembly.
       2. Cleaning will consist of removing all non-adhering material such as loose scale, sand, weld spatter particles, rust, cutting chips, grinding residue, etc. from the inside of the piping assembly by suitable means. This level of cleaning will allow the presence of mill scale and surface rust.
       3. [specify any special cleaning requirement]
    2. Prepare piping connections to equipment with flanges or unions.
    3. Fastener materials shall be free of nicks, burrs, chips, dirt, and damage (inspect threads, shank, and nuts). All damaged fasteners must be replaced.
  1. INSTALLATION
     1. General
        1. Install piping in conformance with ASME B31.3.
        2. Welding, brazing, or soldering shall be in accordance with Section 01 4631, *Welding, Brazing and Soldering of ASME B31 Piping*.
        3. Unless noted otherwise on the isometric drawing, field fit-up welds shall include 6 inches of pipe beyond the length required.
        4. Weld/braze joints shall meet the approved WPS/BPS joint requirements.
        5. Assemble flange joints per Section 01 4731, *Flange Assembly for ASME B31 Piping*.
        6. [Prior to operation: fill, clean, and chemically treat piping system. Refer to Section 23 2500, *HVAC Water Treatment*.]
        7. Label piping system in accordance with Section 22 0554, *Identification for Plumbing, HVAC, and Fire Piping and Equipment*.
        8. Insulate piping system in accordance with Section 22 0713, *Piping and HVAC Insulation*. Provide clearance for installation of insulation and access to valves and fittings.
        9. Support piping system in accordance with 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.
        10. [Prior to operation: fill, clean, and chemically treat piping system. Refer to Section 23 2500, *HVAC Water Treatment*.]
        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.). See Section 07 8400, *Firestopping*. Install chrome-plated steel escutcheons where pipes are not insulated in finished areas.]
        12. Route piping in orderly manner and maintain gradient. Route parallel and perpendicular to walls.
        13. For multiple openings in piping mains, the distance between their centers shall be at least the sum of their inside diameters.
        14. Branch connections shall utilize fittings (tee, lateral, or cross) in accordance with listed codes.
        15. Provide non-conducting dielectric connections wherever jointing dissimilar metals. Matching of bronze with steel or copper does not require dielectrics.
        16. Install piping to maintain headroom and neither interfere with use of space nor take more space than necessary. Piping shall not block access to manholes, access covers, etc.
        17. Group piping whenever practical at common elevations.
        18. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.
        19. All valves shall be installed in accordance with 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.
        20. Slope liquid piping at least 1 inch per 40 feet (0.25 percent) in direction of flow and 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.
        21. Install pressure gauges vertically.
        22. Keep open ends of pipe free from scale and dirt. Whenever work is suspended during construction, protect open ends with temporary plugs, caps, or residue-free tape.
        23. Install flexible connections for [\_\_\_\_\_\_\_\_\_] where shown on drawings.
     2. Fabrication
        1. Piping shall be fabricated in accordance with the provided [Construction] Drawings.

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

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* + - 1. No pipe or tube bends are allowed. Fittings are to be used instead of bends.
    1. Erection
       1. Swagelok compression joints shall be installed per Swagelok Tube Fitter’s Manual, MS-13-03 (latest edition).
       2. Install all piping shown on the construction drawings per manufacturer’s recommended procedures and this Section.
       3. Deviations from locations identified on the drawings must be approved by LANL and documented for incorporation into as-built drawings.
       4. Wedges shall not be used to laterally contain or position pipe for closure fit-ups.
       5. Flanged dielectric connections shall be installed with dielectric bolt insulators.
       6. 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.
       7. 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.
       8. Threaded Joints:

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. Refer to manufacturer’s recommendations for suitable compounds and lubricants. Lubricant for stainless steel shall contain no chloride.

Provide non-conducting dielectric connections whenever joining dissimilar metals in liquid systems with corrosion potential.

The threaded joint assembly shall be in accordance with ASME B1.20.1 paragraph 3.1.9 *Wrench-Tight Engagement between External and Internal Taper Threads*.

No more than six and no less than two threads visible after makeup of the joint.

1. No severe chipping or tearing of visible threads.
   * + 1. Flare Joint 45-Degree (SAE J513):
2. Cut tubing squarely and clean tube end thoroughly to remove burrs.
3. Place nut onto tube. Place threaded end of nut toward end of tube.
4. Flare tube end with flaring tool to provide 45-degree flare.
5. No scratches, breaks, or other mars at sealing surface of flare shall be permitted.
6. 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.
   * + 1. Flare Joint, 37-Degree (SAE J514):
          1. Flaring of the tubing will meet the manufacturer’s 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. 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:
7. 2 ft-lbs if torque value is 50 ft-lbs or less
8. 4 ft-lbs if torque value is greater than 50 but less than 100 ft-lbs
9. 4% of torque value if greater than 100 ft-lbs.
   * + - 1. Torque to manufacturer’s assembly requirements
       1. Underground Piping
10. Do not install underground piping when the bedding is wet or frozen.
11. Verify that excavations are to the required grade and depth.
12. Trenching, backfill, soil compaction and testing for underground pipe shall be in accordance with Section 31 2000, *Earth Moving*.
13. Provide cover, bedding, warning tape, and tracer wire per trench details and below-grade piping details in accordance with Section 31 2000, *Earth Moving*.
    * + 1. Double-Wall Piping
14. 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. B31.3 Code Cases, B31 Case 180 may be used when examination of carrier pipe joints is not feasible; see *New Construction Pressure/Leak Testing* paragraph in Article [3.3] *Examination, Inspection, and Testing* below.
    1. EXAMINATION, INSPECTION, AND TESTING
       1. For the purposes of this Section, the Subcontractor (Constructor) is responsible for all tasks identified as examination and testing. LANL Owner’s Inspector activities are considered inspection.
       2. All welding, brazing and soldering: Inspected, examined, and tested in accordance with Section 01 4631 *Welding, Brazing, and Soldering of ASME B31 Piping* [and Section 01 4525 *Nondestructive Examination* (*NDE) Requirements*].
       3. Externally the pressure system will be free of weld slag, flux, and weld spatter.
       4. Contact LANL Owner’s Inspector to determine the initial inspection points (minimum hold points).
       5. LANL Owner’s Inspector shall have access to any and all design, fabrication, manufacture, fabrication, heat treatment, assembly, erection, examination, testing, records, documentation and 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.
       6. LANL Owner’s Inspector is the final authority on acceptance of the project examination or test.
       7. 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.
       8. 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.
       9. Pipe examinations shall be performed after fabrication, after required heat treatment, and before leak testing.
       10. 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.
       11. When pneumatic testing is planned 100% of all threaded, bolted, and other mechanical joints shall be examined.
       12. Any items rejected because of defects shall be repaired, replaced, and examined per this Section and ASME B31.3.
       13. Methods of examination shall be per ASME B31.3 Section 344.
       14. In-process examination of welds [may, may not] replace radiographic [or, and] ultrasonic volumetric analysis for [all, specify welds] welding per ASME B31.3 paragraph 344.7 in-process examination.
       15. New Construction Pressure/Leak Testing

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

Certified examiners are not required for code leak tests except when specified by the code, for example ASME B31.3 para. 345.8 Sensitive Leak Testing.

The designer has the discretion to require certified leak test examiners and examination procedures.

When multiple process piping systems of the same type are present, specify testing requirements for each individual system.

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

* + - 1. Pressure/leak test piping system per Section 22 0813, *Testing Piping Systems*.
      2. Vacuum Piping: Evacuate to 1mm Hg (1 Torr or 1000 microns) measured with an electronic manometer or thermocouple gauge. After 2 hours, if vacuum level has risen to no higher than 2.5 mm Hg (2.5 Torr or 2500 microns), the leak test is acceptable.
      3. Piping subject to external pressure shall be tested at 1.5 times the external differential pressure, but not less than 15 psig.
      4. In all cases when testing above design pressure, reduce pressure to design prior to checking for leakage.

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

Note: ASME B31.3 paragraph 345.2.2 only requires the test pressure to be maintained a minimum of 10 minutes. **Sensitive leak test for double-wall containment piping is required to meet B31.3 Code Cases, B31 Case 180** **for the carrier (inner) pipe.** ASTM E1003 Section 10 Pressure Drop method must be held for 100 minutes minimum (recommend 200 minutes) for this method.

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

* + - 1. Hazardous Waste, Radioactive Liquid Waste (RLW), and Vent Double-Wall Containment Piping:

Inner Pipe and Vent: If inner pipe joints can be examined, test with water at [5] psig +/- [ ] psig for [10] minutes. If inner pipe joints cannot be examined, test with water at [5] psig +/- [ ] psig for at least 100 minutes in accordance with B31.3 Code Cases, B31 Case 180.

Outer Pipe: Test with water at [5] psig +/- [ ] psig for [10] minutes including requirements specified in manufacturer’s written instructions, if applicable.

* + - 1. Reverse Osmosis (RO) Water Piping:

RO piping shall be leak tested with potable water at 1.5 times system design pressure. Test pressure [ ] psig +/- [ ] psig per ASME B31.3 para. 345.4 and shall show no drop in pressure in a two-hour period. Calibrated gauges are required.

Upon completion of the leak testing, all piping installed shall be cleaned with chlorinated water (sodium hypochlorite, 500 ppm) for a four-hour period. After the four-hour cleaning, drain the chlorinated water and thoroughly flush piping with deionized water.

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

ASME B31.3 pneumatic test pressure shall be between 1.1 and 1.33 times design pressure.

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

* + - 1. Laboratory Gas Piping (Category Normal)
         1. Test piping with oil-free, dry cylinder [nitrogen][air] at [ ] psig +/- [ ] psig per ASME B31.3 paragraph 345.5 Pneumatic Leak Test for at least 10 minutes.
      2. Laboratory Gas Piping (Category D)
         1. Test piping with service fluid [(fluid)] at [ ] psig +/- [ ] psig per ASME B31.3 paragraph 345.7 Initial Service Leak Test for at least 10 minutes.

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

For any process fluids not addressed above, test pressure and duration may be specified below. Designer shall provide a unique set of testing requirements for each unique pressure system.

Category Normal piping may be tested per ASME B31.3 when possible hydrostatically per ASME B31.3 para. 345.4. Pneumatic leak tests per ASME B31.3 para. 345.5 when hydrostatic leak tests are impracticable (see ASME B31.3 para. 345).

PVC and CPVC piping shall not be pneumatically tested.

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

* + - 1. Other Process Piping (ASME B31.3):
         1. Category Normal, Metallic Pipe – [system fluid]

1. Category Normal piping shall be [hydrostatically] [pneumatically] leak tested at [225] psig +/- [ ] psig. Leak test shall be maintained for at least 10 minutes.
   * + - 1. Category D, Metallic Pipe – [system fluid]
2. Category D piping shall be tested per ASME B31.3 para. 345.7 Initial Service Leak Test. Leak test at [150] psig +/- [ ] psig for at least 10 minutes.
   * + - 1. [Category M, Metallic Pipe – [system fluid]
3. Category M piping shall be leak tested at [  ] psig +/- [  ] psig per ASME B 31.3 paragraph [354.4][345.5] for at least 10 minutes.
4. Category M piping shall also be sensitive leak tested per ASME B31.3 paras. M345 and 345.8. A certified examiner with a procedure that can demonstrate sensitivity not less than 10-3 std mL/s is required for the sensitive leak test.]
   * + - 1. Non-Metallic Pipe – [system fluid]
5. Test non-metallic (plastic) pipe per ASME B31.3, para. A345 [for the applicable ASME B31.3 Fluid Category, designer shall specify here]. Leak test at [225] psig +/- [ ] psig for at least 10 minutes.

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

When connecting to existing piping, piping joints for ASME B31.3 pressure systems shall be leak tested in accordance with the LANL Engineering Standards Manual (ESM) STD-342-100 [ESM Chapter 17](https://engstandards.lanl.gov/ESM_Chapters.shtml#esm17), Pressure Safety, Section PS-REQUIREMENTS, 10.3 Pressure and Leak Testing.

This includes the bagging of potentially radioactive contaminated pressure or vacuum joints where bags are used to cover the joint to verify the joint is leak free as part of an initial service leak test of the joint. The bag is then evaluated using standard radiological processes to verify there is no contamination before the gas is removed.

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

* + 1. Leak/Pressure Testing Connections to Existing Piping
       1. For modifications to existing piping, test the connection between new and existing piping 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.

END OF MAIN SECTION [; APPENDICES FOLLOW]

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

Do not delete the following reference information:

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

THE FOLLOWING STATEMENT IS FOR LANL USE ONLY

This project specification section is based on LANL Master Specification Section 40 0504, Rev. 2, dated January 15 2025.

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

The following appendices include a collection of typical piping specifications used at LANL for process piping. 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 materials and components defined in the body of the Section above and in a referenced Appendix. 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 degrees F or above 366 degrees F, Radioactive Liquid Waste, \_\_\_\_\_\_]

|  |  |
| --- | --- |
| **Code of Record:** | ASME B31.3 |
| **Fluid service:** | Category [Normal, D, \_\_\_\_] |
| **System application(s):** | [Specialty gases (argon, nitrogen, helium, p-10, regen gas) above 150 psig or below -20 degrees F or above 366 degrees 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 NPT, Lok-Ring ®, \_\_\_\_\_\_] |

DESIGN PARAMETERS

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

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

ALLOWABLE PIPE MATERIALS

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Component** | **Size (NPS)**  **inch** | **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 | TP316/316L  dual certified | Seamless,  (Threaded or Plain end) |

REQUIRED PIPE SCHEDULES

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Corrosion Allowance (inch)** | **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)**  **inch**  **inch** | **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)**  **inch** | **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 (NPS)**  **inch** | **Rating** | **Standard** | **Material** | **Material Grade** | **Additional Requirements** |
| Fasteners | ½ - 12 | Class 150 | ASME B18.2.1  ASME B1.1 | ASTM A193 | B7 | None |
| Nuts | ½ - 12 | Class 150 | ASME B18.2.2  ASME 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 ®, \_\_\_\_\_\_\_\_]

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 degrees F to 200 degrees 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 degrees F to 200 degrees F

\*Gear operator required for NPS 8 inch 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 degrees F to 400 degrees 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 degrees F to 200 degrees F

GASKETS:

Size: ½ to 12

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

90 DEGREE 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 Deionized (DI) Water above 150 psig, Radioactive Liquid Waste, \_\_\_\_\_\_]

\*Manufacturer shall be Swagelok or approved equal

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

DESIGN PARAMETERS

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

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

ALLOWABLE TUBE MATERIALS

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Component** | **Size (NPS)**  **inch** | **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:

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Corrosion**  **Allowance (in.)** | **Size (NPS)**  **inch** | **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)**  **inch** | **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 degrees F to 100 degrees F, 1715 psig up to 200 degrees 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 psig from -20 degrees F to 100 degrees F, 1850 psig up to 150 degrees 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 psig from -20 degrees F to 100 degrees F, 1210 psig up to 150 degrees F

Manufacturer: Swagelok

Model Number: 60 Series

90 DEGREE 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 degrees F and 366 degrees F]

|  |  |
| --- | --- |
| **Code of Record:** | ASME B31.3 |
| **Fluid service:** | Category [D, \_\_\_\_\_] |
| **System application(s):** | [Deionized Water System less than 150 psig and between -20 degrees F and 366 degrees F] |
| **Location:** | [Above grade, Below grade] |
| **Assembly method:** | [welded, brazed, solder, flanged, threaded, \_\_\_\_] |

DESIGN PARAMETERS

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Design Pressure (psig)** | 150 | 118 | 95 | 70 | 50 |
| **Design Temperature (degrees F)** | 73 | 100 | 120 | 130 | 140 |
| **Minimum Temperature (degrees 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**  **(NPS)**  **inch** | **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 (NPS) inch** | **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 (NPS) inch** | **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 (NPS) inch** | **Rating** | **Standard**1 | **Material** | **Cell Classification** | **Additional Requirements** |
| Socketweld Flange | ½ - 8 | Schedule Tables | ASTM D2467 | ASTM D1784 PVC 1120,  Type I, Gr. 1 | 12454 | Flat Faced |
| Socketweld Van Stone Flange | ½ - 8 | Schedule Tables | ASTM D2467 | ASTM D1784 PVC 1120,  Type I, Gr. 1 | 12454 | Flat Faced |
| Blind Flange | ½ - 8 | Schedule Tables | ASTM D2467 | 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 (NPS)**  **inch** | **Rating** | **Standard** | **Material** | **Material Grade** | **Additional Requirements** |
| Fasteners | ½ - 8 | Class 150 | ASME B18.2.1  ASME 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 DEGREE 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 |
| **Fluid service:** | Category [Normal, D, \_\_\_\_\_\_\_] |
| **System application(s):** | [Radioactive Liquid Waste] |
| **Location:** | [Above grade, Below grade] |
| **Assembly method:** | [welded, brazed, solder, flanged, threaded, \_\_\_\_\_] |

DESIGN PARAMETERS

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Design Temperature (degrees F)** | 73 | 100 | 120 | 140 |
| **Minimum Temperature (degrees F)** | 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 Class  125 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 Class  125 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 (IPS)** | **Rating** | **Standard** | **Material** | **Material Grade** | **Additional Requirements** |
| Fasteners | 2-12 | Class 150 | ASME B18.2.1  ASME B1.1 | ASTM A193 | B8 Cl. 2 | - |
| Nuts | 2-12 | Class 150 | ASME B18.2.2  ASME B1.1 | ASTM A194 | 8 | - |

90 DEGREE 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