section 43 4113

GAs and Liquid PRESSURE VESSELS

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LANL MASTER SPECIFICATION SECTION

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| Rev. 2 Summary of Changes:Corrected ESM Chapter 17 citations, updated the ASME BPVC code of record to 2023, updated entire Part 1 to define minimum requirements, updated Articles *References* and *Related Sections,* added critical characteristics requirements in Article *Materials* in Part 2, added more direction for *Fabrication* in Part 2, replaced Shop/Factory Acceptance test with Source Verification test, updated Appendix A, added Appendices B through D as reference, and other minor editorial changes. |

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

Review the LANL Engineering Standards Manual (ESM) STD-342-100 [Chapter 17, *Pressure Safety*](https://engstandards.lanl.gov/ESM_Chapters.shtml#esm17)*,* Section PS-REQUIREMENTS, 7.1 *Application of ASME Boiler and Pressure Vessel Code*,on how to edit this section.

This template was developed to meet the requirements of ASME BPVC-2023. If the Code of Record for the project refers to a different version of ASME BPVC, the designer is responsible to update this Section, as required.

This Section is intended to be used for custom design of specific pressure vessels (design/build procurements of pressure vessels) that are included under the scope of ASME BPVC Section VIII, Division 1. This section is not intended for specification of ASME BPVC Section VIII pressure vessels that are offered for sale that already have the ASME quality marking applied, also known as shelf stock.

Pressure Vessels may be constructed in accordance with ASME BPVC, Section VIII, Division 1, 2, or 3. This Section will need to be significantly revised for Pressure vessels fabricated to Division 2, or Division 3.

Other custom designed items that require ASME quality marking may use this Section as a template.

* ASME BPVC Section X
* ASME BPVC Section XII

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. To seek a variance from or an alternate method to requirements in this section, 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 POC with suggestions for improvement as well.

There are some configurations of pressure vessels that cannot be built to the requirements of the ASME code. 10CFR851 Appendix A Paragraph 4, *Pressure Safety*, requires the following:

“(c) When national consensus codes are not applicable (because of pressure range, vessel geometry, use of special materials, etc.), contractors must implement measures to provide equivalent protection and ensure a level of safety greater than or equal to the level of protection afforded by the ASME or applicable state or local code. Measures must include the following:

(1) Design drawings, sketches, and calculations must be reviewed and approved by a qualified independent design professional (i.e., professional engineer). Documented organizational peer review is acceptable.

(2) Qualified personnel must be used to perform examinations and inspections of materials, in-process fabrications, non-destructive tests, and acceptance test.

(3) Documentation, traceability, and accountability must be maintained for each unique pressure vessel or system, including descriptions of design, pressure conditions, testing, inspection, operation, repair, and maintenance.”

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

This template is suitable for ML-1 through ML-4 projects.

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1. GENERAL
	1. SECTION INCLUDES
		1. This Section covers the requirements of closed vessels containing pressurized fluids which fall under the requirements of ASME Boiler & Pressure Vessel Code (BPVC), Section VIII, Division 1. These are “unfired” pressure vessels, though they may operate at elevated temperatures within the limits allowed by ASME BPVC Section VIII, Division 1.
		2. This Section establishes the technical requirements for the design, materials of construction, fabrication, testing, shipment, and quality assurance (QA) of pressure vessels and their supports, components, and appurtenances.
		3. The technical requirements of this Section are applicable to containers used for the containment of pressure, either internal or external.
		4. For pressure vessels containing material, where the potential of a single exposure to a small leakage can cause serious personnel harm, the vessel shall be manufactured for lethal service.
		5. The following is a summary of Subcontractor’s responsibilities described in this Section:
			1. Design and fabricate pressure vessels in accordance with this Section, meeting ASME BPVC, Section VIII, Division 1,and the Subcontractor’s LANL-approved drawings, and other referenced documents.
			2. Furnish design data required by this Section to document design of the pressure vessel.
			3. Procure equipment, materials, or supplies to complete the work, unless otherwise stated.
			4. Test and inspect as required by this Section, ASME BPVC, Section VIII, Division 1
			5. Furnish the data required by this Section to document that required tests and inspections have been performed.
			6. Pressure vessel is to be stamped in accordance with ASME BPVC, Section VIII, Division 1, to show compliance with Code requirements.
			7. The ASME BPVC, Section VIII, Division 1, allows fabricator inspection under UG-90(c)(2). Authorized Inspector monitoring is required.
			8. Pressure Vessels shall be numbered and registered with the National Board of Boiler and Pressure Vessel Inspectors.

NOTE: A copy of the Manufacturer’s Data Report will be retained as a record in accordance with LANL policy.

* + - 1. Package, ship, and deliver pressure vessel.
			2. Provide LANL full access to the facility for performing random or scheduled inspections and/or surveillance of work performed.

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Edit LANL Sections listed below for applicability to meet the project requirements associated with the pressure vessel to be designed and fabricated. Add other Sections if needed.

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* 1. RELATED SECTIONS
		1. Section 01 2500, *Substitution Procedures*
		2. Section 01 3300, *Submittal Procedures*
		3. Section 01 4000, *Quality Requirements – [Non-nuclear, Nuclear]*
		4. Section 01 4115, *Pressure Safety Submittals*
		5. Section 01 4444, *Offsite Welding, Brazing and Joining Requirements*
		6. Section 01 4525, *Nondestructive Examination (NDE) Requirements*
		7. [Section 01 8712, *Seismic Qualification of Equipment – Nuclear-Safety Related*]
		8. [Section 01 8734, *Seismic Qualification of Nonstructural Components (IBC)*]
		9. [Section 22 0548.23, *Vibration and Seismic Controls for Mechanical Systems]*

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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 BPVC-2023. If the Code of Record for the project refers to a different version of 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. REFERENCES
		1. ASCE 7-[16], Minimum Design Loads and Associated Criteria for Buildings and Other Structures
		2. ASCE 43-[19], Seismic Design Criteria for Structures, Systems, and Components in Nuclear Facilities
		3. ASCE Task Committee on Anchorage Design, Anchorage Design for Petrochemical and Other Industrial Facilities
		4. ASCE Task Committee on Seismic Design, Seismic Evaluation and Design of Petrochemical Facilities
		5. ASCE Task Committee on Wind-Induced Forces, Wind Load Design for Petrochemical and Other Industrial Facilities
		6. ASME BPVC Section II - [2023], Materials, Part A - Ferrous Material Specifications (Beginning to SA–450)
		7. ASME BPVC Section II - [2023], Materials, Part A - Ferrous Material Specifications (SA–451 to End)
		8. ASME BPVC Section II - [2023], Materials, Part B - Nonferrous Material Specifications
		9. ASME BPVC Section II - [2023], Materials, Part C - Specifications for Welding Rods, Electrodes, and Filler Metals
		10. ASME BPVC Section II - [2023], Materials, Part D - Properties
		11. ASME BPVC Section V - [2023], Nondestructive Examination
		12. ASME BPVC Section VIII - [2023], Rules for the Construction of Pressure Vessels, Division 1
		13. [ASME BPVC Section VIII - [2023], Rules for the Construction of Pressure Vessels, Division 2, Alternative Rules].
		14. [ASME BPVC Section VIII - [2023], Rules for the Construction of Pressure Vessels, Division 3, Alternative Rules for Construction of High Pressure Vessels].
		15. [ASME BPVC, Section IX - [2023], Qualification Standard for Welding, Brazing and Fusing Procedures; Welders; Brazers; and Welding, Brazing, and Fusing Operators
		16. [ASME BPVC Section X - [2023], Fiber-Reinforced Plastic Pressure Vessels]
		17. [ASME BPVC Section XII - [2023], Rules for Construction and Continued Service of Transport Tanks]
		18. ASME B1.1 - [2001], Unified Inch Screw Threads (UN and UNR Thread Form)
		19. ASME B16.5 - [2020], Pipe Flanges and Flanged Fittings NPS ½ Through NPS 24
		20. ASME B16.47 - [2018], Large Diameter Steel Flanges: NPS 26 Through NPS 60
		21. [ASME NQA-1 – [2008] /1A - [2009], Quality Assurance Requirements for Nuclear Facility Applications]
		22. ASME PCC-1, Pressure Boundary Bolted Flange Joint Assembly
		23. ASNT SNT-TC-1A, Recommended Practice for Personnel Qualification and Certification in Nondestructive Testing
		24. ASTM A36/A36M, Standard Specification for Carbon Structural Steel
		25. ASTM A193/A193M, Standard Specification for Alloy-Steel and Stainless Steel Bolting for High Temperature or High Pressure Service and Other Special Purpose Applications
		26. ASTM A307, Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60000 PSI Tensile Strength
		27. ASTM A380, Standard Practice for Cleaning, Descaling, and Passivation of Stainless Steel Parts, Equipment and Systems
		28. ASTM D429 - [2014], Standard Test Methods for Rubber Property – Adhesion to Rigid Substrates
		29. ASTM D2240 - [2015], Standard Test Method for Rubber Property – Durometer Hardness
		30. ASTM D4417 - [2019], Standard Test Methods for Field Measurement of Surface Profile of Blast Cleaned Steel
		31. ASTM D5162 - [2015], Standard Practice for Discontinuity (Holiday) Testing of Nonconductive Protective Coating on Metallic Substrates
		32. ASTM F1554 - [2018], Standard Specification for Anchor Bolts, Steel, 36, 55, and 105-ksi Yield Strength
		33. ASTM G62 - [2001], Standard Test Methods for Holiday Detection in Pipeline Coatings
		34. AWS D1.1/D1.1M - [2020], Structural Welding Code – Steel
		35. AWS D1.6/D1.6M - [2017], Structural Welding Code – Stainless Steel
		36. [*Dynamic Response of Tall Flexible Structures to Wind Loading*. Joseph Vellozzi, Ph.D., P.E. U.S. Department of Commerce, National Bureau of Standards, Building Science Series Number 32, 1966]
		37. ICC-IBC-[2021], International Building Code
		38. [ISO 1940-1 - [2005], Mechanical Vibration - Balance Quality Requirements For Rotors In A Constant (Rigid) State]
		39. NBBI, NB-23 (NBIC) Part 1 - [2023], Installation
		40. [PIP VECV1001,Vessel/S&T Heat Exchanger Design Criteria ASME Code Section VIII, Divisions 1 and 2]
		41. PIP VEDV1003, Vessel Drawing/Data Sheet and Instructions
		42. [PIP VEDV1003\_EEDS, Electronic Entry Documentation Requirements Data Sheets for Vessels ASME Code Section VIII, Divisions 1 and 2]
		43. [PIP VEFV1100, Vessel/Shell & Tube Heat Exchanger Standard Details (U.S. Customary Units)]
		44. [PIP VEFV1101, Vessel Nameplate Bracket]
		45. [PIP VEFV1102, Vessel Tolerances]
		46. [PIP VEFV1103, Vessel Grounding Lug]
		47. [PIP VEFV1105, Horizontal Vessel Saddles Supported on Concrete]
		48. [PIP VEFV1106, Horizontal Vessel Saddles Supported on Structural Steel]
		49. [PIP VEFV1116, Vessel Manway Hinges]
		50. [PIP VEFV1117, Vessel Vertical Manway Davits]
		51. [PIP VEFV1118, Vessel Horizontal Manway Davits]
		52. [PIP VEFV1124, Vessel Vortex Breaker]
		53. [PIP VEFV1125, Vessel Internal Rungs]
		54. [PIP VEFV1129, Vessel Studded Joints]
		55. [PIP VESSM001 - Specification for Small Pressure Vessels and Heat Exchangers with Limited Design Conditions]
		56. PIP VESV1002,Vessel Fabrication Specification ASME Code Section VIII, Divisions 1 and 2
		57. [Process *Equipment Design*. Brownell and Young. Wiley & Sons Publishers, 1959]
		58. [Stresses *in Large Cylindrical Pressure Vessels on Two Saddle Supports*, L.P. Zick, Pressure Vessels and Piping: Design and Analysis, A Decade of Progress. Vol. 2, 1972]

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The specifier of this Section is required to define many aspects of the pressure vessel design, including management level designation of the pressure vessel. Following the designation of management level, interpret the requirements for the designated management level and define those requirements in this Section. Ensure that the pressure vessel meets the requirements of [LANL Engineering Standards Manual (ESM) Chapter 17, *Pressure Safety*](https://engstandards.lanl.gov/ESM_Chapters.shtml#esm17).

Perform the following analyses or define requirements for the following within the Section:

1. The design pressure and coincident maximum metal temperature shall be determined by the Designer by carefully considering all operating phases and associated loadings (e.g., liquid head and other sources of pressure variation, such as that resulting from flow) that the vessel may experience during the specified service life, such as but not limited to:
	1. Initial startup
	2. Normal operations
	3. Temporary operations
	4. Emergency shutdown
	5. Emergency operations
	6. Normal shutdown
	7. Startup following a turnaround or an emergency shutdown
	8. Cleaning, steam out, and decontamination
	9. Upset conditions
	10. Safety, health and environmental restrictions on material release during a relief event causing increased pressure in the vessel.
2. Evaluate the need for a vacuum rating.
3. Determine the materials of construction of the pressure vessel, as required by the service conditions including the nonmetallic materials like gaskets and fasteners i.e., stud, bolt, nut, and washer.
4. Determine whether the pressure vessel requires corrosion, erosion, or other wear allowances based on the expected service conditions and expected service duration. Add thickness to the vessel based on the evaluation to provide a good service life. The expected service duration is determined as the length of operational time until the pressure vessel does not meet the minimum wall thickness.
5. Determine if the pressure vessel is to contain lethal substances. Refer to [ESM Chapter 17, Pressure Safety](https://engstandards.lanl.gov/ESM_Chapters.shtml#esm17), Section PS-REQUIREMENTS, Attachment REQ-1, Category M Fluid Service and Lethal Service. If yes, the pressure vessel must be specified as *Lethal Service*.
6. Specify any additional post-weld heat treatment required depending on service conditions (the required tensile strength of the pressure vessel shell material) determine if post-weld heat treatment beyond the requirements of ASME BPVC, Section VIII, Division 1, will be required. If yes, specify the post-weld heat treatment needed.
7. Consider what relief protection is required for the application. Specify the required relief protection. Relief protection may or may not be provided by the ASME pressure vessel subcontractor. Review overpressure protection requirements in ASME BPVC, Section VIII, Division 1, paragraphs UG-150 through UG-156.
8. Determine whether the pressure vessel may be exempt from the requirements of ASME BPVC, Section VIII, Division 1, or whether it falls under the scope of another Section of ASME Code. (Pressure vessels exempt from the requirements of Section VIII may still be stamped with the Code “U” Symbol, if desired, as long as it meets all applicable requirements of the Code.)
9. For ASME BPVC, Section VIII, Division 1 vessels used in a boiler application, for example a superheater, verify the requirements of ASME BPVC, Section I are met.
10. Pressure vessel is to be stamped in accordance with ASME BPVC, Section VIII, Division 1, to show compliance with Code requirements.
11. Provide a data sheet for the pressure vessel, and a conceptual sketch or drawing of the pressure vessel with this Section to summarize requirements and improve clarity. (Refer to Appendix A, Pressure Vessel Data Sheet and Sketch Example. In some cases, a larger sketch than the one on the data sheet may be needed for clarity).
12. Determine whether the pressure vessel will require any coatings, linings, or insulation. If so, specify or allow the Subcontractor to recommend a system for LANL approval.
13. For multi-chamber vessels, common component(s) of multi-chamber or compartmented vessels shall be designed for the most severe combinations of pressure, temperature, and other loadings which may occur during operation (see above bullet list in 1) and test conditions. Design solely on the basis of simultaneous loading of internal pressure in adjacent compartments is not acceptable.
14. Non-jacketed vessels subjected to pressure less than atmospheric shall be designed and Code stamped for full vacuum. Vessels shall be designed for 5 psig external pressure at 300 degrees F to accommodate the altitude at LANL. Vessels that are subjected to steam-out conditions shall be designed for full vacuum. Consideration shall also be given to external pressures caused by sudden cool down of gases or vapors in the vessel or by the sudden emptying of the vessel contents.
15. Jacketed or compartmented vessels that are designed for vacuum in the compartment under consideration shall have the common components designed for an external pressure equal to the sum of internal design pressure of the adjacent compartment plus the vacuum design pressure of the compartment under consideration.
16. The required service for all vessels shall include consideration by the Designer of cyclic service. ASME BPVC, Section VIII, Division 1, Paragraph UG-22(e) mandates that cyclic and dynamic reactions from any mechanical or thermal loading source be considered in design.
17. Unless otherwise specified at the point of installation, wind, snow and seismic loads shall conform to [ESM Chapter 5, *Structural*](https://engstandards.lanl.gov/ESM_Chapters.shtml#esm5).
18. Before beginning pressure vessel procurement, review the designated installation site for any building, facility floor, concrete slab, or soil loading limitations. Determine what foundation structures may be needed to support the vessel. Determine if there are any clearance problems in moving the pressure vessel to its installation site.

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* 1. SYSTEM DESCRIPTION
		1. General Design Requirements
			1. For pressure vessel Maximum Allowable Working Pressure, Corrosion Allowance, operating conditions, design data, and vessel configuration refer to Appendix A, *Pressure Vessel Data Sheet and Sketch*.
			2. Minimum corrosion/erosion/wear/machining post construction allowance shall be 0.125 inch (1/8 inch).
			3. Design and fabricate pressure vessels in accordance with this Section, ASME BPVC, Section VIII, Division 1, and the Subcontractor’s LANL-approved drawings.

Note: If there is a conflict among the above listed requirements, compliance with ASME BPVC, Section VIII, Division 1, and applicable regulations will take precedence. Bring any conflicts to LANL STR’s attention for resolution.

* + - 1. LANL will review and comment on design calculations and drawings, unless LANL chooses to waive this right. LANL review does not release the Subcontractor from responsibility to design and fabricate the pressure vessel in accordance with ASME BPVC, Section VIII, Division 1, applicable regulations, and this Section.
			2. Stamp pressure vessels per ASME BPVC, Section VIII, Division 1.
			3. The pressure vessel shall be numbered and registered with the National Board of Boiler and Pressure Vessel Inspectors.
			4. Detailed design requirements are defined in Appendix A, *Pressure Vessel Data Sheet and Sketch*.
			5. Vessels and their supports shall be designed to meet the most severe of the combined load combinations, with the controlling load combination indicated in design calculations, unless other combinations are required by the applicable code at the point of installation.
			6. Insulated austenitic stainless steel equipment that is susceptible to atmospheric chloride stress corrosion cracking shall be protected by a suitable external protective coating and the use of a low chloride insulation.
			7. Where weld overlay is specified, the deposited weld overlay shall have a composition that corresponds to that of the composition and depth specified on the subcontract documents.
		1. Shell and Head Design Requirements
			1. General
				1. Unless specified otherwise by LANL, design pressure vessels for a minimum external pressure of 5 psig at 300 degrees F to accommodate the altitude at LANL.
				2. [A vacuum rating of 15 psig external pressure or Full Vacuum is required]
				3. Obtain LANL approval for use and design of internal stiffeners for higher external pressure applications.
				4. Conical transition sections shall have knuckles, unless specified otherwise.
			2. Pressure Retaining Joints
				1. Identify joints that are to be welded from one side only.
				2. Obtain LANL approval of proposed weld joint configurations prior to fabrication, unless LANL chooses to waive this requirement.

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Define the piping systems that will interface with the pressure vessel and specify the necessary nozzles and connections required on the pressure vessel. Specify any maintenance access openings (manways), or other large openings, needed on the pressure vessel. Include small penetrations, such as pressure and temperature monitoring ports. Check whether level monitoring instrumentation is required. Also specify plugged spare penetrations for possible future use, if desirable. Provide a data sheet with nozzle schedule and a conceptual sketch to clarify pressure vessel configuration (Refer to Appendix A, *Pressure Vessel Data Sheet and Sketch*).

Custom-designed flanges may be required. They must meet the design conditions of the pressure vessel and ASME BPVC Section VIII Division 1, 2, or 3.

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* + 1. Flanges, Nozzle, Seals, and Manway Requirements
			1. Flanges for all flanged vessel nozzles equal to or smaller than NPS 24 (DN 600) shall meet the requirements of ASME B16.5.
			2. Slip-on, threaded, and socket weld flanges shall not be used.
			3. Unless specified otherwise, external nozzle flanges shall conform to [ASME B16.5] [ASME B16.47].
			4. External flanges are to be weld-neck type attached with full-penetration welds. Obtain LANL approval before using other types of flanges.
			5. Bolt holes in all fixed flanges and studding outlets shall straddle the natural centerlines. For nozzles in heads, the bolt holes shall straddle centerlines parallel to, or coincident with, the natural vessel centerlines.
			6. Gasket flange joint designs shall provide outer confinement of the gasket.
			7. Flange bolts shall be provided along with gasket and assembly instructions including the fastener assembly method, for example, torque values with or without lubrication.
				1. Hardened washers shall be provided under nuts for all bolts having diameters of 1-1/4 inches or larger to prevent damaging the back side of the flange. The washers shall be at least 1/4 inch thick.
			8. All inside nozzle neck edges shall be rounded to 1/8 inch minimum radius.
			9. Nozzles that are used for pressure relief devices and for drainage shall be flush with the vessel interior surface.
			10. Each pad segment shall have one American Standard Taper Pipe Thread (NPT) 1/4 inch telltale hole for testing purposes. Holes shall be located as low as possible with the vessel in its operating position to promote drainage.
			11. On vessels that are supported by a skirt, extend the flange of bottom head nozzles outside of the skirt for access.
			12. Skirts shall have a minimum thickness of 1/4 inch.

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See Appendix C, *External Piping Loads on Carbon Steel and Stainless Steel, Alloy Steel Vessels*.

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* + - 1. Nozzle loads are to be defined for each nozzle.
			2. Nozzle to vessel welds shall be full-penetration welds.
			3. In establishing nozzle and manway projections, clearance shall be provided for removing flange stud bolts between the flange and vessel and for accessing flange stud nuts. Clearance for flange studs and nuts shall be considered when nozzles penetrate insulation or platforms.
			4. Minimum projection from the outside of the vessel wall to the nozzle face shall be:
				1. 8 inches for nozzles up to and including NPS 8 (DN 200)
				2. 10 inches for nozzles larger than NPS 8 (DN 200)

Note: Round up the dimension from the face of the nozzle to the vessel centerline or reference line in 1/2-inch increments.

* + - 1. Manways shall be equipped with either a davit or a hinge to facilitate handling of the blind flange. Manways oriented with the nozzle neck axis in a horizontal plane shall be equipped with a hinge. Hinged manways require LANL STR’s approval due to potential pinch point.
			2. Attach the davit-socket bracket to the nozzle neck when lap joint flanges are employed.
			3. Manways on the top of vessels oriented with a vertical nozzle neck axis shall be equipped with a davit.
			4. Vessels 3 feet ID and smaller that are subject to internal corrosion, erosion, or mechanical abrasion shall be equipped with inspection openings as described in ASME BPVC, Section VIII, Division 1, Paragraph UG-46 . Vessels in this size category may justify the use of body flanges.
			5. Vessels larger than 3 feet ID that are subject to internal corrosion, erosion, or mechanical abrasion shall be equipped with one or more flanged and blinded manways.
			6. Manways less than NPS 24 (DN 600) shall not be allowed.
			7. Joints shall be assembled in accordance with ASME PCC-1.
			8. [Custom-Designed Flanges
				1. Specification: ConFlat (CF)
				2. Material: [austenitic stainless steel types 304L, 316L, 316LN, and surfaced hardened aluminum (made from a weldable Al alloy)]
				3. Leak-tight seal operates to < 1x10-13 Torr, and within the temperature range -196 degrees C to 450 degrees C. The seal mechanism is a knife-edge that is machined.

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The North America (NA) flange sizes are determined by outside diameter (O.D.).

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* + - * 1. Sizes are: [1-1/3 inch ("mini"), 2-3/4 inch, 4-1/2 inch, 6 inch, 8 inch, 10 inch, 12 inch, 13-1/4 inch, 14 inch and 16-1/2 inch]]

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Provide the Subcontractor with a reasonably detailed sketch of the pressure vessel that will serve as a baseline for the design. Provide interface and other information important to LANL requirements that would be unknown to the Subcontractor. As part of the sketch, determine and specify the material used for the pressure vessel support structure to meet LANL facility requirements. Determine and specify other support stand requirements such as required strength, height, field location requirements of anchoring, etc.

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* + 1. Structural/Supports
			1. Pressure Vessel Supports
				1. Unless otherwise specified by LANL, design all vessels as self-supporting units, including legs, skirts, saddles, etc., as necessary to provide the required vessel elevation. Consider wind, snow, seismic and other applicable loadings for the design of pressure vessel supports in accordance with [ESM Chapter 5](https://engstandards.lanl.gov/ESM_Chapters.shtml#esm5), installation method and location. Allow for thermal expansion and thermal expansion loads during support design. Assume that a field hydrostatic test will occur where the vessel will be filled completely full of water, and account for this extra weight in the support design. Also allow for temporary erection loads on pressure vessel structure.
				2. Support pressure vessels by welded or bolted leg and brace arrangements, mounting pads, skirts, or saddles, depending on vessel size and configuration. Horizontal pressure vessels are to be supported with two saddles, minimum 120 degree saddle angle. If bearing plates are used, do not locate on top of girth or long seam welds.
				3. Leg supports shall be limited to spherical and cylindrical vessels that meet the following:

Operating temperature does not exceed 450 degrees F (230 degrees C)

Service is noncyclic and non-pulsating (See Note 1 below.)

Vessel h/D ratio does not exceed 5 (Height is the distance from base of support to the top tangent line of the vessel.) (See Note 2 below.)

Note 1: Vessels having agitators experience transient transverse forces due to dynamic bending moments from the agitator and sloshing of the liquid. Therefore, the design of leg-supported vessels with agitators requires the application of experience based engineering judgment aided by Finite Element Analysis to ensure that stiffness and stress levels essential to satisfactory operation are provided.

Note 2: Caution is advised for leg-supported vessels that may be within h/D ≤ 5 but could have excessive axial and/or bending loads on the legs or an overstress condition in the vessel wall.

* + - * 1. Design and fabricate pressure vessel supports and attachments in accordance with good structural design and practice, and ASME BPVC, Section, VIII, Division 1, Appendix G.
				2. The attachments shall be of the same material (ASME Code P-number) as the pressure part to which attached except austenitic stainless steel external welded attachments may be any 300-series stainless steel.

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Determine and specify pressure vessel lifting requirements, including any LANL-specific hoisting and rigging requirements for the pressure vessel design.

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* + - 1. Lifting Points – Pressure Vessel Structure
				1. Incorporate lifting features into the pressure vessel design as required. Design and position lifting features to prevent any strain or distortion of the pressure vessel. Design lifting features to accept lifting by forklift, crane, or other appropriate device, and label these features appropriately as lifting points.
				2. If lifting lugs are not provided as a feature of the design, indicate suitable lifting points on the main pressure vessel framework. If necessary, provide external strong-backs or other bracing devices.
				3. Lifting and rigging plans shall be established to ensure installation of the pressure vessel in place will be damage free.

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Where applicable, specify floor response spectra, peak accelerations, damping ratios, etc. necessary for the Subcontractor to perform seismic analyses.

Depending on the quantity and characteristics of the material being contained, design pressures and temperatures, and SDC, design pressure vessels and attached process piping to withstand the applicable seismic forces per [ESM Chapter 5, *Structural*](https://engstandards.lanl.gov/ESM_Chapters.shtml#esm5).

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* + - 1. Seismic Design
				1. Determine and specify the applicable natural phenomena hazard (NPH) design category (NDC) of the pressure vessel.
				2. Seismic analysis and design of the pressure vessel shall be in accordance with ASME BPVC, ASCE 7 or ASCE 43, as applicable.
				3. If the mass and center of gravity of the fluid inside the pressure vessel fluctuates, use the maximum possible fluid level (e.g., full) of the heaviest fluid that will be used in the pressure vessel for the seismic calculation. Also check “splashing/sloshing” inertial loads due to a partially full vessel. Account for valves and accessories attached to vessel
				4. Allow for a possible accidental offsetting of the center-of-gravity by [5%] of the plan dimensions from the calculated location, and a potential increase in weight of [25%] (valves/equipment attached to vessel may change).
				5. Provide drawings with empty and full center of gravity determinations.
			2. Anchoring
				1. Materials for anchor bolts shall be selected from one of the following:
1. [Carbon steel: [ASTM A36, ASTM A307 Grade A, or ASTM F1554 Gr 36]]
2. [Low-alloy steel: ASTM A193 Grade B7. (Note: Stress corrosion cracking of Grade B7 anchor bolts as a result of material susceptibility, high stresses and a corrosive environment has been reported.)]
	* + - 1. For corrosive conditions, stainless steel or other high alloy materials may be used, with due consideration for possible chloride exposure, as well as the yield strength.
				2. Anchor bolts shall be designed in accordance with [ESM Chapter 5](https://engstandards.lanl.gov/ESM_Chapters.shtml#esm5), and applicable ACI code.
				3. Anchor bolts shall be selected with the following threads and the tensile stress area shall be selected accordingly:
3. Bolts 1 inch and smaller in diameter: Coarse thread series, ASME B1.1
4. Bolts larger than 1 inch in diameter: 8 thread series, ASME B1.1
	* + - 1. Anchor bolts embedded in concrete foundations shall be zinc-coated (hot dip galvanized or mechanically zinc-coated), unless the bolts are stainless steel, so that the addition of a corrosion allowance is not required. If J-bolts are used, they shall be fully stress relieved at 1100 degrees F for one hour per inch of diameter prior to hot dip galvanized coating. Threaded J-bolts in the bent area are not allowed.
				2. Anchor bolts for vessels shall not be less than 3/4 inch. Anchor bolts shall straddle normal centerlines.
				3. The anchor bolt circle shall be selected to provide radial clearance for the bolt tensioning device when low-alloy steel bolting is required.
				4. Anchor bolting shall be furnished and installed by the Subcontractor.
			1. Vessel Attachments
				1. In services LANL defines as corrosive, welding of vessel internals attached to a pressure boundary component shall be continuous on all surfaces in order to eliminate corrosion pockets. All seams and corner joints shall be sealed. The size of welds shall include allowance for corrosion when a vessel corrosion allowance is specified. The minimum weld size shall be 3/16 inch in the corroded condition.
				2. All external supports, support rings, pads, and structural brackets attached to the vessel shall be seal-welded all around to prevent corrosion between the vessel and attachments. When seal welding all around is not practical, provision for drainage shall be made (e.g., a gap in the low-point weld).
				3. Temporary Welded Attachments
5. Attachment point of spiders, braces, or other temporary attachments shall be of the same material alloy as the point on the vessel to which it is attached.
6. All temporary attachments shall be removed prior to hydrotest.
7. Temporary attachments shall be removed flush with the vessel shell and nondestructively examined using Magnetic Particle Examination (MT) or Dye Penetrant Examination (PT), in addition to visual examination, to ensure no cracks have been generated.
	* + - 1. No galvanized clips or attachments shall be welded to a vessel.
			1. Welding
				1. All welding must be in accordance with the requirements of ASME BPVC, Section VIII, Division 1 and Section IX and Section 01 4444, *Offsite Welding, Brazing and Joining Requirements*.
				2. All welds, including those for non-pressure parts and attachments (including temporary attachments and shipping attachments), shall be made by welders, welding operators, and welding procedures qualified under the provisions of ASME BPVC, Section IX.
				3. Continuity Records are required for the individual welders in accordance with the ASME BPVC Codes.
				4. Welds shall meet the supplementary provisions of the ASME BPVC Codes, plus recognized and generally accepted good welding practices (including, but not limited to, the use of clean and dry materials, good techniques, and the proper chemistry).
				5. Shielded metal arc electrodes used for pressure-retaining welds shall be of the low-hydrogen type and maintained appropriately to prevent moisture accumulation.
				6. Gas Metal Arc Welding (GMAW) shall be used only in the spray transfer range. Pulse arc is considered spray transfer. The short arc transfer mode is acceptable for carbon steel materials up to and including 3/16 inch thick and for the root pass in carbon steel material of any thickness with the following provisions:
8. Vertical welding is done in the uphill progression.
9. The root pass is backgouged.
10. GMAW-S is not used on branch connections, o-let, socket-type welds, or pipe less than or equal to 3 inches OD.
	* + - 1. Where different alloyed materials are specified and used, the weld procedures must specifically address this approach. It is expected that this includes poison pads (pads installed to prevent carbon intrusion into the main vessel body of stainless steel during welding), support pads, and any fabrication involving different "P" materials.

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Determine and specify the type, thickness and configuration of pressure vessel linings, coatings where needed or request Manufacturer’s recommendation for LANL approval.

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* + - 1. Pressure Vessel Protective Linings, Coatings and Insulation (Where Required)
				1. Pressure vessel Manufacturer shall evaluate the design conditions supplied by LANL and determine whether vessel linings and/or coatings may be required. If yes, Manufacturer shall recommend the preferred lining and/or coating system to LANL for concurrence and approval
	1. [REFERENCE DOCUMENTS
		+ 1. The following references are provided as a source of information that contain additional technical information related to this Section. These documents also form part of this Section.
1. See Appendix A, *Pressure Vessel Data Sheet and Sketch*
2. [Sketch][Drawing] [\_\_\_\_\_\_]]
	1. SUBMITTALS
		1. General
			1. Do not fabricate products or begin Work before the submittals are approved.
			2. Provide submittals in accordance with the requirements of Section 01 3300, *Submittal Procedures* and 01 4115*, Pressure Safety Submittals*.
				1. Provide reference to LANL Project I.D. Number, LANL Subcontract Number, Pressure Vessel Number, Pressure Vessel Title, and Drawing Number on correspondence. LANL may choose to waive some of these submittals if the Subcontractor has been granted prior approval by LANL for recent Subcontract submittals.
				2. Submit design drawings, calculations, and supporting data prior to beginning vessel fabrication. Subcontractor design submittals shall provide a level of detail commensurate to ensuring that applicable codes, standards, and the intent of the design have been met. In addition to design submittals, Subcontractor shall provide an as-built vessel data sheet (Appendix A, Pressure Vessel Data Sheet and Sketch) with design data completed.
3. LANL will review and comment on design calculations and drawings. The LANL review does not release the Subcontractor from responsibility to design and fabricate the vessel in accordance with ASME BPVC, applicable regulations and this Section.
4. Subcontractor provided calculations must include assumptions and input/output data with the calculations. If computer calculations are performed, include the name of the calculation program and the version number.

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Add or delete project specific requirements as required.

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* + 1. Action Submittals
			1. [Ancillary Equipment (i.e., mixers, spray nozzles) lists/schedules that depict model, horsepower, electrical requirements.]
			2. [Ancillary Equipment manufacturer’s datasheets and/or cut sheets.]
			3. [Product Data for any coatings, sealants, adhesives and/or paint.]
			4. Lifting and Rigging Plan, showing lifting lug placement and lifting center of gravity
			5. Drawings
			6. Calculations
				1. US customary (English) units shall be regarded as standard for vessels to be installed in domestic US locations; metric (SI) units may be included for reference only and shall not be interpreted as a precise conversion.
				2. Design calculations shall include relevant formulas and source paragraphs from the ASME BPVC Code, values used in the formulas, calculated results, and comparisons with acceptable values. Where calculations are based on formulas other than those in the Code, the source of the formulas shall be referenced. Where calculations are done by a computer program, a program description shall be given, including name and version of the program. If the program is not commercially available to industry, the Subcontractor shall maintain and provide program documentation, upon request. (See Foreword of the ASME BPVC Code for Cautionary Note regarding responsibility for the use of computer programs.)
				3. Calculations shall include:

Code calculations

Wind and seismic calculations, as applicable

Support calculations (including those for post-weld heat treatment, testing and shipping)

Calculations associated with shipping, lifting and erection of the vessel

Nozzle load analysis for local and gross effect, when required

Design of attachments, internal and external, including PIP or any other standard details used

Fatigue analysis as applicable for fatigue services. For ASME BPVC, Section VIII, Division 1 vessels the calculations shall include the following:

1. Loading conditions and boundary conditions used to address the load combinations
2. Description of the numerical analysis procedure and whether a geometrically linear or nonlinear option is invoked
3. Graphical display of results
4. Method used to validate the numerical model
5. A summary of the numerical analysis results showing the acceptance criteria utilized to meet the requirements of the Code
	* + 1. Fabrication schedule with all inspection and test hold points.

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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*, submit:
				1. Welding procedure specification (WPS) and supporting procedure qualification record (PQR)
				2. Welder performance qualification records (WPQR) including continuity
				3. [Weld Filler Material Control Procedure for ML-1 and ML-2 applications]
				4. [Filler Material Certified Material Test Reports (CMTRs) for ML-1 and ML-2 applications]
				5. [Post-Weld Heat Treatment Procedures]
			2. 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.
			3. Test and Inspection Plan and Procedures
				1. The Subcontractor shall provide an Inspection and Test Plan and Procedures. All inspections and tests, including inspection and testing forms, logs shall be documented and submitted.
			4. Source Verification Test
				1. Before performing the source verification test, a source verification procedure shall be submitted to LANL for review and approval.
				2. The results of the source verification test shall be documented and submitted to LANL for review and approval before final acceptance.
				3. Subcontractor shall provide the test location, equipment, instrumentation of certified accuracy, and any supplementary temporary connections and auxiliary parts necessary to fully execute the tests.
				4. Provide test personnel qualified to conduct, record, and verify test results.
				5. The Subcontractor shall provide LANL with a minimum of seven (7) working day advance written notice of shop acceptance tests.

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For high-risk applications such as ML-1 or ML-2, add submittals for “Material Control Procedure”. Note if the supplier is on the Institutional Evaluated Supplier List (IESL), the Material Control Procedure is not required.

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* + - 1. [Material Control Procedure
				1. Before fabrication, submit for LANL approval a material control procedure to be used in the execution of the Work. Describe the control methods and traceability documentation in the procedure used by the Subcontractor to handle and monitor the use of controlled materials, such as stainless steel and welding filler rod.]
			2. Fabrication Procedures. Submit a copy of:
				1. [Destructive and] Non-Destructive Examination (NDE) Procedures
				2. Handling, Packaging and Shipping Procedure including specific requirements
			3. Cleaning Procedure:
				1. Submit for LANL review and approval a cleaning procedure describing the methods, materials, controls, and inspections to be used to perform pressure vessel cleaning operations. Provide a procedure that addresses cleaning pressure vessel surfaces to remove dirt, oils, and marking pen ink. Include a specification of the solvents and/or detergents that will be used.
			4. Certifications. Certifications must meet the minimum requirements provided in 01 4000, *Quality Requirements – [Non-nuclear, Nuclear]*.
				1. CMTRs
				2. Material Traceability Records
				3. Instrument Calibration Certificates for equipment used during the Source Verification Test
				4. Certificate of Conformance (CoC) / Code Compliance Certifications - Includes certification that all performance and quality control requirements established by the listed Codes, the Subcontractor and this Section have been met.
			5. Exceptions and Deviations
				1. Submit an Supplier Deviation Disposition Request (SDDR) ([Form 2178](https://irm.lanl.gov/forms/Shared/2178.docx)) to LANL for any proposed technical changes, exceptions, and/or deviations to this Section or other Subcontract documents. Do not implement proposed changes, exceptions, or deviations until the LANL Subcontract Technical Representative (STR) provides written approval.
				2. Conflicts: Notify LANL STR as soon as possible in the event of conflicts among the specification sections, drawings, and/or the manufacturer’s recommended processes or instructions.
				3. Ensure that any substitutions are in conformance with Section 01 2500, *Substitution Procedures*.
			6. Nonconformances
				1. Nonconformances to items provided under this Section must be reported to LANL in accordance with the Subcontract documents.
			7. [Quality Assurance/Quality Control
				1. Submit an uncontrolled copy of the Manufacturer’s QA/QC manual for LANL approval. LANL may waive this requirement if the Manufacturer’s QA/QC program has been previously reviewed and approved.
				2. Submit a Lower Tier Services Plan if sub-tier subcontractors will perform some of the work. Provide LANL with the name, address, telephone number, and point of contact for sub-tier subcontractor that the Subcontractor intends to use on this project. Identify the specific work requirements of this Section that will be performed by the sub-tier subcontractor.]
		1. Informational Submittals at Closeout:
			1. General
				1. Operation and Maintenance Data
				2. Warranty: Manufacturer is to guarantee the pressure vessel and associated equipment at design conditions and warrant that materials and workmanship, plus apparatus supplied (if any), are in accordance with subcontract document requirements.
				3. Spare Parts List to include pricing and lead times.

Note: Electronic Native file format (e.g., CAD) shall be provided with all drawings.

* + - 1. Shipping Submittals: Submit a copy of
				1. Shipping plan to include delivery logistics
				2. Bill of Lading with shipment.
			2. Test Reports. Test and Inspection reports must meet the minimum requirements provided in 01 4000, *Quality Requirements – [Non-nuclear, Nuclear]* and the associated code/standard to which the test/inspection is being performed.
				1. Pressure vessel identification
				2. Date of test
				3. Name and signature of qualified/certified personnel
				4. Location and description of test
				5. Leak Test Report
				6. Pressure Test Report
				7. [Motor Test Report]
				8. [Protective Coating Test Report, for fabricated steel components]
				9. [Vessel installed Spray Nozzle and Mixer Performance – Source Verification Test Report]
				10. Source Verification Test Report - Three certified copies of the source verification test results shall be furnished to LANL for approval before shipment.
				11. Electronic pdf copies of documentation.
			3. Manufacturer’s Data Package shall be printed or folded to 8-1/2” x 11” size and suitably bound.
				1. Manufacturing Record Book (MRB) to be delivered at the completion of equipment testing but prior to or at shipment. The MRB shall include: Index, completed inspection and test plan, ASME data report, nameplate photograph, material test reports, certificates of compliance, NDE reports, hydrostatic or pneumatic test reports and chart, specification section waivers, as-built drawings, and inspection release certificates
1. [Heat Numbers: Note heat numbers on weld maps using low-chloride content marking pens on each piece part and transfer the material identifications to the as-built drawings.]

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Final Manufacturer’s documents shall include, but are not limited to, the items listed in Appendix D, Manufacturers Data

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* + - * 1. [Final Manufacturer’s documents.]
	1. QUALITY ASSURANCE
		1. Management Level
			1. The Management Level designation for the work and procurements associated with this Section is [ML-1, ML-2, ML-3, ML-4].
			2. The Subcontractor shall perform work to the applicable national codes and standards, Section 01 4000, *Quality Requirements – [Non-nuclear, Nuclear*] for work defined in this Section.
		2. Pressure vessels shall be furnished by a firm qualified, accredited, and regularly engaged in this type of work for a period of no less than [3] years. Manufacturer shall maintain shop and facilities suitable for fabrication of pressure vessels. Manufacturer shall maintain a Quality Control Program that complies with ASME BPVC, Section VIII Division 1 requirements.

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Note that Shop/Factory Acceptance Test is called Source Verification Test per LANL Policy Procedure P841-1

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* + 1. Inspection and Testing
			1. The Manufacturer shall perform inspection and testing to verify conformance to the specified requirements defined in this Section, as well as any Manufacturer requirements as defined as part of the Manufacturer’s QA/QC program.
			2. The Manufacturer shall provide a Test and Inspection Plan indicating all testing and inspection functions to be performed, including hold points during fabrication and assembly, as well as during the source verification testing.
			3. Certified personnel using certified procedures in accordance with specified requirements shall perform all inspection and testing functions.
			4. Hold points are required during the fabrication process to allow inspection, verification, or approval by LANL before the Manufacturer does further work.

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Hold and witness points shall be identified per Appendix B, *Inspection and Hold Points*, or equivalent.

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* + - 1. Hold and witness points shall be identified. Hold points shall be identified on the Test and Inspection Plan, with provisions for LANL review and acceptance. LANL has the right to waive Hold Points at their discretion.
			2. Inspection Records: The Manufacturer 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. Any tools, gages, instruments and other measuring and test equipment used for activities affecting quality shall be controlled, calibrated at specific periods, adjusted and maintained to required accuracy limits.
			4. [Source Verification tests for rubber lined vessels include Discontinuity (Holiday) Test, Spark Test and Bond Test.]
			5. [Pre-Coating / Rubber Lining Inspection: Resolve any non-conforming items from preliminary inspection. Weld inspection to include radiography for full penetration welds, and acceptable grinding of welds. The surface profile to be verified per ASTM D4417.]
			6. [Post-Rubber Lining Inspection: Inspection of critical dimensions, overall dimensions, disposition of out of tolerance dimensions, and acceptance/rejection of dimensional control map. The rubber lining adhesion testing and hardness testing to be per ASTM D429 (Method E to 25 pounds minimum), and ASTM D2240, respectively. All rubber lined parts shall be thoroughly inspected and 100% spark-tested both before and after cure per ASTM D5162, Method B, to ensure continuity. It is recognized that there are restrictions on in-service inspections due to the building and vessel environments. Manufacturer shall provide a recommended inspection frequency.]
		1. Required Quality Control
			1. Required Fabrication Hold Points
				1. Hold points are required during fabrication process to allow inspection, verification, or approval by LANL before the Manufacturer does further work.
				2. LANL has the right to waive Hold Points at their discretion.
				3. Manufacturer shall include their standard quality assurance hold points. At a minimum the following hold points shall be included:
1. Nondestructive examination of welds and any weld repairs.
2. Hydrostatic testing of pressure containing components.
3. Source Verification Test.
4. Final inspection prior to shipment.
5. LANL retains the ability to add hold or witness points to the Fabrication Schedule after submittal.
	* + 1. Nondestructive Examinations:
				1. Nondestructive examinations associated with vessels designed to ASME Code shall be per ASME BPVC, Section V, in accordance with ASME BPVC, Section VIII as applicable.
				2. Nondestructive examinations shall be performed in accordance with the Manufacturer’s standard practices defined in their quality manual and this Section.
				3. Inspection personnel and procedures are to be qualified in accordance with ASME BPVC, Section V.
				4. Structural-steel welds shall be examined, as a minimum, in accordance with AWS D1.1 for Structural Steel or AWS D1.6 for Stainless Steel and shall meet the acceptance criteria stated in AWS D1.1 or AWS D1.6 as applicable. Additional NDE testing requirements shall be as shown on the drawings.
				5. [Welds for lethal service shall be 100% radiographed.]
			2. Weld Inspection
				1. Inspection is required to verify all joint fit up for correct gap and joint preparation, 5% of weld tacks, correct orientation of ports/appurtenances, and overall dimensions.
				2. Welds in the vessel must be inspected to ensure adequate size, that welds are free of undercutting and any un-fused overlap of the weld deposit.
				3. Minimum radiography: Unless specified otherwise, the minimum radiography shall be as required by the applicable design Code.
				4. Magnetic Particle and Liquid Penetrant Examination: If specified, perform magnetic particle examination on the following welds:
6. Fillet welds on the pressure boundary,
7. Back-chipped surface of full penetration welds, and finished weld surface of full penetration welds.
	* + - 1. When a surface NDE exam is required, liquid penetrant examination shall be used on non-magnetic material.
				2. Document and repair and re-test detected defects.
			1. Final Inspections:
				1. Final inspection shall be performed in accordance with the Manufacturer’s quality manual. At a minimum, the Manufacturer shall verify that the critical dimensions are as identified in Appendix A, *Pressure Vessel Data Sheet and Sketch.*
				2. The results of weld inspections including final dimensions of welds, weld joint verification, and weld map documentation, surface finish, critical dimensions, nondestructive examination results shall be documented and submitted to LANL for review and approval before acceptance. LANL’s approval indicates concurrence that results verify compliance with the associated design requirements.
			2. Testing
				1. The Subcontractor shall provide certified Inspectors per ASNT SNT-TC-1A for all NDE inspections and for functional tests in this Section.
				2. Testing shall be performed in accordance with the manufacturer’s quality manual and this Section.
				3. The Manufacturer shall provide certified Inspection Personnel performing acceptance inspections. In addition, the Manufacturer shall document all qualifications.
				4. Use fresh water with less than 25 ppm chloride content for wash and final rinse. After final rinse, dry inside surfaces using heat, lint-free cloth or other means to ensure cleanliness. If deionized water is used for the final rinse, the vessel may be allowed to evaporate to dryness.
			3. Pressure Test:
				1. Test to the requirements of ASME BPVC, Section VIII, Division 1. Ensure that weld surfaces are free of coating materials during test. Hold hydrostatic test pressure for 15 minutes, minimum.
				2. Vent vessel to atmosphere while filling or draining vessel.
			4. [Special Testing
				1. Assembled pressure vessel shall pass an assembly helium leak test with less than 1x10-6 leakage std cc/sec.
				2. Vacuum leak test using pressure decay method to 1x10-6 leakage std cc/sec
				3. Coating test per [ASTM D5162] [ASTM G62].]
			5. Nameplates and Labeling:
				1. A vessel made in accordance ASME BPVC will be identified by a nameplate as specified in the Code.
				2. Attach an identification nameplate to each vessel in accordance with the requirements stated in ASME BPVC, Section VIII, Division 1, as applicable. Also attach a nameplate containing LANL identification information to each pressure vessel. ASME and LANL nameplates may be incorporated into a single nameplate, if desired. Clearly separate the ASME information from the LANL information.
				3. Nameplate may be attached to the vessel by welding, brazing, or soldering and in such a manner so as not to weaken storage vessel strength or alter vessel material properties. Nameplate cannot be removed without destruction of the nameplate.
			6. Alternative Design Proposals
				1. The Subcontractor shall provide a base bid in full compliance with LANL’s request for quotation. The Subcontractor may submit an alternative design if, in the Subcontractor’s judgment, economy and/or improved schedule can be realized without loss of capability and without shortening the anticipated life of the vessel. The Subcontractor shall comply with the following requirements when submitting an alternate bid:
8. Alternative design quotations shall be accompanied by the base quotation and be clearly noted as an alternate, including the intended use of ASME BPVC Code cases.
9. Alternative designs shall be fully and clearly described and substantiated by sketches or drawings. Specific exceptions shall be identified as such.
10. An alternative design including the use of ASME BPVC Code cases shall not be used unless approved in writing.
	1. DELIVERY, STORAGE & HANDLING
		1. Shipping mode and method of transporting, and the extent of pressure vessel assembly, are to be mutually agreed on by the Subcontractor and LANL prior to fabrication and delivery of the vessel. The LANL approved handling, packaging and shipping procedure will be used.
		2. Provide LANL with a copy of the bill of lading concurrent with the shipment. Properly and clearly describe the shipment on the bill of lading.
		3. At the final destination, LANL will inspect the shipment as necessary to ensure that received items have not been damaged during shipment and that required items and supporting documentation have been received.
		4. Subcontractor shall provide a procedure for long term storage (desiccants, motor rotations, etc.) if the equipment is to be stored for longer than one month prior to being installed.
	2. SITE CONDITIONS
		1. Design the pressure vessels to operate in the environmental conditions specified below:
			1. Temperature:
				1. Winter – 5 degrees F dry bulb and
				2. Summer – 89 degrees F dry bulb, 60 degrees F wet bulb.
			2. Elevation: 7,500 ft.
			3. Barometric Pressure (average): 11.10 psia.
			4. Air Density: 0.057 lb/ft3.
			5. Snow, Wind, and Seismic Loads: Refer to [ESM Chapter 5, *Structural*](https://engstandards.lanl.gov/ESM_Chapters.shtml#esm5).
11. PRODUCTS
	1. PRODUCT OPTIONS AND SUBSTITUTIONS
		1. Comply with Section 01 2500, *Substitution Procedures*.

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

Determine and specify the type of material to be used for the pressure vessel shell, nozzles, connections, hatches, supports and other appurtenances. Specify material based upon application and compatibility with the process and corrosive environments. Some structural shapes may be difficult to obtain in certain materials, without special order (allow for longer lead times). Add thickness to the vessel based on the corrosion rate and the expected service duration.

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

* 1. MATERIALS
		1. Provide materials complying with ASME BPVC, Section II.

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

Specify safety related materials and components and provide critical characteristics for safety related material and components for pressure vessels for ML-1/2 applications for use in Commercial Grade Dedication.

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

* + 1. [Critical characteristics for the components specified by part number in drawings or specifications that provide a nuclear safety function include the specified part number if the part number provides a method to link the item with the manufacturer’s product description and published data. The published description and data are used to determine additional material, configuration, and performance critical characteristics for the components. The part number shall not be used as the only critical characteristic to be verified. The following components are nuclear safety related: \_\_\_\_\_\_\_\_.
		2. Critical characteristics for the raw materials used in fabrication of pressure vessels and its appurtenances are defined in the first paragraph above in this article. Based on the provided standards, the critical characteristics are the configuration/appearance, material chemical properties, mechanical properties, and dimensional properties. The following materials are nuclear safety related: \_\_\_\_\_\_\_\_.]

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

Determine and specify the type, thickness and configuration of pressure vessel linings, coatings where needed or request Manufacturer’s recommendation for LANL approval.

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

* + 1. [Protective Linings, Coatings, and Insulation (Where Required)
			1. \_\_\_\_\_\_\_\_.]
	1. FABRICATION
		1. General
			1. Protect stainless steel against carbon steel contamination from tooling and fixtures during fabrication.
			2. Exercise control during stages of fabrication to minimize exposure of stainless steel to contaminants, in particular any chloride that might cause stress-corrosion cracking. Avoid chloride-bearing compounds; however, if used, completely remove by thorough cleaning. Do not use compounds, liquids, or markers with more than 25 ppm of chloride content by weight on stainless steel surfaces.
			3. Welding: Ensure that welders, welding operators, and tackers are qualified in accordance with ASME BPVC, Section IX. Use welding procedures per ASME BPVC, Section IX. Reference Section 01 4444, *Offsite Welding, Brazing and Joining*, for additional requirements pertaining to welding.
			4. No welding shall be performed at the construction site.
			5. Exercise care to prevent scratching, abrading, nicking, and denting of the pressure vessel during fabrication and handling.
		2. Cleaning
			1. After fabrication is completed and before testing and inspection, clean, de-scale, and degrease the pressure vessel and associated components.
			2. Clean exterior surfaces, but take particular care to clean the inside of the vessel thoroughly. Methods may include cleaning by hot water spray, etc. Ensure pressure vessel cleanliness meets the approval of LANL at the time of the final inspection. If a detergent is needed to ensure thorough cleaning, use a detergent that is less than 25 ppm of chloride content by weight for stainless steel. Use fresh water for final wash and rinse. Ensure the detergent, wash, and rinse contains less than 25-ppm chloride content. After the water rinse, dry inside surfaces using heat, lint-free cloth, or other means to ensure cleanliness.
			3. Before shipping, the vessel shall be thoroughly cleaned inside and outside. Grit, scale, oil, grease, weld rod stub ends, sand, water, free moisture, and all other foreign material shall be removed from the vessel. Painting shall be complete as required by the purchase order.
			4. Only stainless steel brushes and clean, iron-free sand, ceramic or stainless steel grit shall be used for cleaning stainless steel and non-ferrous surfaces. Cleaning tools or materials shall not have been previously used on carbon steel.
			5. [The following cleaning requirements shall be met:
				1. Solvent or detergent wash
				2. Rinse
				3. Perform wet-dry test per ASTM A380
				4. Acid clean with passivation solution if rust stains appear in wet-dry test. The appropriate application method of hand wipe, spray, or circulating will be chosen based on the extent of rusting.
				5. Repeat wet-dry test. Consider pickling solution if rusting reappears.
				6. Rinse
				7. Dry - If heat is used for drying stainless steel vessels, do not allow metal temperature to rise above 250 degrees F and use de-ionized water for the final rinse.]
			6. Ensure that the cleanliness of the pressure vessel meets the approval of LANL at the time of final inspection
		3. Preparation and Closure
			1. Machined surfaces, flange faces, threaded surfaces, and other finished or delicate parts shall be well-greased and protected against rusting and damage during shipment.
			2. Telltale holes in reinforcing pads shall be plugged with chloride-free Room Temperature Vulcanizing (RTV) silicone sealer or rust preventative grease that is compatible with the base material.
			3. For flanged joints specified to be furnished with service gaskets, a spare gasket (in addition to any required for initial field assembly) shall be furnished and suitably packaged, marked, and shipped with the vessel for the following joints: flanged joints having other than ASME B16.5 or ASME B16.47 flanges with other than commercially available sheet or laminate gaskets.
			4. Unless otherwise specified, one set of unused service gaskets shall be furnished by the Subcontractor for standard and non-ANSI body flanges and other non-standard flanges. Service gaskets used for testing shall be left installed for all blind flanged connections.
			5. Blind flanged connections, including manways, shall have the blinds attached with a full complement of new bolts.
			6. All flange faces other than those furnished with permanent blinds shall be covered with 1/2 inch thick wood or 1/8 inch thick suitable metal plate and soft rubber gasket, no smaller than the flange OD and secured with a minimum 25% complement of (but no fewer than 4) bolts.
			7. Welding stub ends shall be provided with bevel protecting caps.
			8. Threaded couplings shall be fitted with bull plugs and socket weld fittings shall be fitted with plastic caps.
			9. Internals which cannot be safely shipped in place shall be identified, tagged, and shipped separately. For those internals which have specified clearances or tolerances, the Manufacturer shall trial assemble at least one of each type (e.g., tray type or distributor type) into the vessel to ensure proper fit prior to shipment.
			10. All bolting and other loose parts shall be suitably packaged and identified to the purchase order. Uncoated bolts and nuts shall be coated with a suitable thread lubricant to prevent corrosion during transportation and storage. The lubricant shall be easily removable with mineral spirits or a solvent.
			11. Ropes, chains and straps may be used to secure the equipment to the transporter deck. However, padding shall be placed between any cables or chains and any stainless steel or high alloy equipment to prevent discoloration of the vessel shell and/or contamination of the metal. Cables and chains are not permitted even with padding unless attached to clips provided on the vessel for tie down purposes. In addition, only padded saddles shall be used with stainless or high alloy equipment where the saddles are carbon steel.
			12. Nozzles (including attached piping) within or passing through vessel support skirts shall be adequately supported during shipping and handling.
			13. Any special provisions for shipping saddles shall be a matter of agreement between the LANL and the Subcontractor.
			14. The saddles of horizontal vessels may be used for support during shipment. If boot or nozzle projections extend below the existing saddle base plate, saddle extensions constructed of timber or other suitable materials shall be secured to the saddles to provide adequate ground clearance for the projecting part.
		4. Handling, Packaging, Shipping
			1. Exercise care to prevent scratching, abrading, nicking, and denting of the pressure vessel during receiving, storage, and handling.
			2. Subcontractor and Manufacturer must provide protection against the weather, acceleration forces, airborne contamination, and physical damage for the equipment procured under this Section.

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

Subparagraph below applies to ML-1/ML-2 only

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

* + - 1. [Package, ship, receive, store, and handle in accordance with the Level C requirements provided in ASME NQA-1 2008/2009 Part II, Subpart 2.2 as required by 01 4000, *Quality Requirements - Nuclear*. Ensure extra protection is provided for electrical and electronic components.]
			2. A means of pressure relief is to be provided on the pressure vessel during shipping to prevent any internal or external pressure buildup and/or to equalize pressure due to elevation or temperature changes.
			3. [All Post-weld heat treated (PWHT) vessels shall have the following notice painted on two sides of the shell and insulation covering, if present, in three-inch high letters visible in the shipping position from grade: POSTWELD HEAT TREATED - DO NOT BURN OR WELD]
			4. [All vessels with non-metallic linings shall have the following notice painted on two sides of the shell and insulation covering, if present, in three-inch high letters visible in the shipping position from grade: LINED VESSEL - DO NOT BURN OR WELD]
	1. SOURCE QUALITY CONTROL
		1. Material controls will be in accordance with the Manufacturer’s quality plan and this Section.
		2. Test and inspection points shall be in accordance with the Manufacturer’s quality plan and this Section.
		3. Personnel qualifications shall be in accordance with the Manufacturer’s quality plan and this Section.
		4. Welding shall be in accordance with the Manufacturer’s quality plan and this Section.
		5. Source Verification Tests:
			1. Perform inspection and testing of the completed pressure vessel in accordance with the requirements of this Section and ASME BPVC, Section VIII, Division 1.
			2. [The agitator assembly shall be dynamically balanced, at a minimum, to the requirements of ISO 1940-1, G6.3.]
			3. [The Manufacturer shall make all attempts to balance the Agitator Assembly to the requirements of ISO 1940-1, G2.5]
			4. [Additional testing:
				1. Helium mass spectrometer testing 1 x 10-3 std cc/sec.
				2. Vacuum decay testing 1 x 10-3 std cc/sec]
		6. Weld Inspection
			1. Radiography: Unless specified otherwise, the minimum radiography required is spot radiography in accordance with UW-52 of ASME BPVC, Section VIII, Division 1.
			2. [Magnetic Particle Examination in addition to ASME BPVC code minimum NDE: If specified, perform examination on the following welds:
				1. Fillet welds on the pressure boundary,
				2. Back-chipped surface of full penetration welds, and finished weld surface of full penetration welds.]
			3. [Liquid Penetrant inspection in addition to ASME BPVC code minimum NDE may be substituted for non-magnetic material, or if approval is obtained from LANL. Perform liquid penetrant testing after any grinding and polishing operations.]
			4. Repair and re-test detected defects.
		7. Pressure Test:
			1. Perform to the requirements of ASME BPVC, Section VIII, Division 1, Ensure that weld surfaces are free of coating materials during test. Hold test pressure for 15 minutes, minimum.
			2. Water for shop-testing austenitic stainless steel vessels shall be potable quality with a chloride ion content of less than 25 ppm. After testing, drain water and dry — standing water is not allowed to evaporate to dryness, unless de-ionized water is used as a final rinse.
		8. Test Reports: Provide test reports as required by the Subcontract documents and this Section. Include the following information in the test report:
			1. Pressure Vessel identification
			2. Date of test
			3. Name and signature of the certified test operator
			4. Location and description of indications
			5. Description of repairs and retest
			6. Signature of witness.
		9. Nameplates & Labeling:
		10. Attach an identification nameplate to each pressure vessel in accordance with the requirements stated in ASME BPVC, Section VIII, Division 1.
		11. [Also attach a nameplate containing LANL identification information to each pressure vessel. ASME and LANL nameplates may be incorporated into a single nameplate, if desired. Clearly separate the ASME information from the LANL information. Nameplate cannot be removed without destruction of the nameplate.]
1. EXECUTION
	1. INSTALLATION
		1. Installation of pressure vessels is facility-specific and not covered in this Section. Install pressure vessels in accordance with ASME BPVC, Section VIII, Division 1, and NBIC NB-23 Part 1.

END OF MAIN SECTION [; APPENDIX FOLLOWS]

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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 43 4113 Rev. 2, dated January 29, 2025.

**Appendix A**

**Pressure Vessel Data Sheet and Sketch**

| **SPECIFICATION SHEET****LOS ALAMOS NATIONAL LABORATORY** | **PRESSURE VESSEL DATASHEET** |
| --- | --- |
| **ITEM No:** |
| CUSTOMER: | UNIT NAME: |
| JOB NO: |
| PLANT LOCATION: | PROJECT: | REV | BY | CHECKED | DATE |
|  |  |  |  |
|  |  |  |  |
| **DESIGN DATA** |
| CAPACITY |  | GALLONS |
| OPERATING PRESSURE |  | PSIG @ |  | F |
| DESIGN PRESSURE – EXTERNAL |  | PSIG @ |  | F |
| DESIGN PRESSURE – INTERNAL |  | PSIG @ |  | F |
| CORROSION ALLOWANCE | SHELL: | HEADS: |
| DESIGN | [ ]  ASME SECTION VIII | [ ]  OTHER |
|  | [ ]  STRESS RELIEVE | [ ]  X-RAY |
| SNOW LOAD |  |
| WIND LOAD |  |
| SEISMIC LOAD |  |
| **PART** | **MATERIAL** | **DESCRIPTION** |
| SHELL |  | [ ]  VERTICAL | [ ]  HORIZONTAL |
| HEADS |  | [ ]  SEMI-ELLIP | [ ]  DISHED |
| LINING |  |  |
| SUPPORTS |  | [ ]  LEGS | [ ]  SKIRT |
| MANHOLES |  | [ ]  HINGE | [ ]  DAVIT |
| NOZZLES |  |  |
| COUPLINGS |  |  |
| INTERNALS |  |  |
|  |  |  |
| CLIPS |  |  |
| LUGS |  |  |
| RINGS |  | [ ]  INSULATION | [ ]  VACUUM |
| DAVIT |  | LOADING |
|  |
| LINING: SPEC. SECTION | THK | IN |
| FIREPROOFING: SPEC. SECTION | THK | IN |
|  | [ ]  BY VENDOR | [ ]  BY PURCHASER |
| INSULATION: SPEC. SECTION | THK | IN |
|  | [ ]  BY VENDOR | [ ]  BY PURCHASER |
| SURFACE PREPARATION: SPEC. SECTION | THK | IN |
|  | [ ]  BY VENDOR | [ ]  BY PURCHASER |
| PAINTING: SPEC. SECTION | THK | IN |
|  | [ ]  BY VENDOR | [ ]  BY PURCHASER |
| FAB. WT.: | OPERATING WT.: | TEST WT.: |
|  |
| **NOZZLES** |
| **MARK** | **SERVICE** | **QTY** | **SIZE** | **RATING** | **FACING** |
|  | Inlet |  |  |  |  |
|  | Outlet |  |  |  |  |
|  | Relief Valve |  |  |  |  |
|  | Drain |  |  |  |  |
|  | Pressure Gauge |  |  |  |  |
|  | Level Gauge |  |  |  |  |
|  | Spare Instrumentation |  |  |  |  |
| REMARKS: |

Pressure Vessel Datasheet

(Reference: PIP VEDV1003-D (Provided for Reference Only))

|  |
| --- |
| Issued for: [ ]  Proposal [ ]  Purchase [ ]  As Built Date:  |
| Facility Name/Location:Item Name: Purchaser/Location: Item Tag No.: Job No: Requistion No: Service: Purchaser Order No.: Unit: Manuf./Location: P&ID No.: Manuf. Order/Serial Nos: / |
| **A. ENGINEERING REQUIREMENTS**1. Design Pressure-Internal: Vessel: **psig** @ **F** Jacket: **psig** @ **F** Coil: **psig** @ **F**
2. Design Pressure-External: Vessel: **psi** @ **F** Jacket: **psi** @ **F** Coil: **psi** @ **F**
3. Minimum Design Metal Temperature, Vessel: **°F** @ **psig** Jacket: **°F** @ **psig**

Coil: **°F** @ **psig**.Low Temperature Due to: Low Ambient [ ] , Process Excursion [ ] , Normal Process Conditions [ ] .1. Design Specific Gravity of Fluid: Vessel: Jacket: Coil: .
2. MAWP Basis: Calculated [ ] , Same as Design [ ] .
3. Construction Code: ASME Section VIII, Division **1**, Edition , Addenda Including Stamping. Code Special Marking: Lethal Service: , Code Case(s): .

Special Service Requirements: . Registration: National Board [ ]  (Required for U or U2 Stamps)1. Vessel Position: Maximum Liquid Level in the Vessel in the Installed Position: **ft**.
2. Vessel Size: Capacity: **Gallons Inside** Diameter: **ft Tangent Length**: **ft**.
3. Corrosion allowance, **in**: Vessel Internal: , External: , Nozzles: , Internals: . Jacket Internal: , External: , Coil: Supports: , External Attachments: . For Non-Corrosive Service: Seal Weld Internal Parts to Pressure Boundary: .
4. High Cyclic Service per Code [ ]  Cycles per Life of Unit: Vessel: Jacket: Coil: . Design Life: Years Fatigue Analysis/Evaluation by Manufacturer: .
5. Welded Pressure Joint Requirements: Vessel: , Jacket: , Coil: .
6. Post Weld Heat Treatment: Specification: .
7. Wind Design: **ASCE 7**  Classification Category: Basic Wind Speed: **mph**. Exposure Category: Topographic Factor: Elevation above Grade: **ft**.
8. Seismic Design: **ASCE 7**  Soil Profile Classification: Aa: Av: , R: .
9. Other Loadings: .
10. Shell Thickness, **in**: Vessel: Jacket: Coil: .
11. Head Thickness (Minimum after Forming), **in**: Vessel: Jacket: .
12. Type of Heads: Top/Ends: Bottom: .
13. Type of Body Flange: Shell: Body Flange Facing: .
14. Flange Face Finish (Ra) Process Side: **micro-inches** Service Side: **micro-inches**.
15. Vortex Breaker: [ ]  Vortex Breaker Nozzle Projection: Type: .
16. Hardness Control: Maximum Hardness Value: **Brinell**.
17. Shop Prime: [ ]  Specification: Shop Painting: Specification: .
18. Insulation by Thick.: **in** Type: Density: **lb/cu ft** Specification: .
19. Fireproofing: [ ]  Thickness: **in** Type: Density: of Skirt Anchors Req’d: [ ]
20. No. of Supports: Type of Supports: Lifting Lugs: [ ]  Tailing Lugs: [ ]
 |
| **No.** | **Date** | **Description** | **By** | **Check.** | **App.** |
|  |  |  |  |  |  |

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| **B. SUPPLEMENTARY DATA TO BE PROVIDED BY THE MANUFACTURER**1. Calculated MAP (New & Cold): Vessel: **psig** Limited by: Jacket: **psig** Limited by: .
2. Shop Test Pressure (New & Cold): Vessel: **psig** Jacket: **psig** Coil: **psig**.
3. Tested in Position Maximum Permitted Vessel Future Field Hydrotest Pressure: **psig**.
4. MAWP: Vessel **psig**, @ **°F** Limited by: Jacket **psig**, @ **°F** Limited by: Coil **psig**, @ **°F** Limited by: .
5. MDMT: Vessel **°F** @ **psig** Limited by: Jacket **°F** @ **psig** Limited by: Coil **°F** @ **psig** Limited by: .
6. As Built Thickness, **in**: Shell: , Heads: , Jacket: , Coil: .
7. Estimated Weight: Shipping: **Lbs.**, Empty: **Lbs.**, Operating (w/Operating Fluid): **Lbs.**, Full of Water: **Lbs.**

**C. SUMMARY OF REFERENCES** |
| **PIP****Practice No.** | **Check If****Applicable Title** | **PIP &****Other Standards** | **Check If****Applicable Title** |
| VECV1001 | [ ]  Vessel/S&T Exchanger Design Criteria | VEFV1116 | [ ]  Vessel: Manway Hinges |
| VESV1002 | [ ]  Vessel/S&T Exchanger Fabrication Specification | VEFV1117 | [ ]  Vessel: Manway Vertical Davit |
| VESV1101 | [ ]  Vessel: Nameplate Bracket  | VEFV1118 | [ ]  Vessel: Manway Horizontal Davit |
| VEFV1102 | [ ]  Vessel: Tolerances | VEFV1119Type  | [ ]  Vessel: Column Davit |
| VEFV1103 | [ ]  Vessel: Grounding Lug | VEFV1120Type  | [ ]  Vessel: Pipe Supports |
| VEFV1104 | [ ]  Vessel: Horizontal, Thin Wall Saddle Supports | VEFV1121Type  | [ ]  Vessel: Pipe Guides |
| VEFV1105 | [ ]  Vessel: Horizontal, Saddles Supported on Concrete | VEFV1122 | [ ]  Vessel: Horizontal Insulation Supports |
| VEFV1106 | [ ]  Vessel: Horizontal, Saddles Supported on Steel | VEFV1123 | [ ]  Vessel: Vertical, Insulation and Fireproofing Supports |
| VEFV1107 | [ ]  Vessel: Vertical, Type “A” Base Plate W/ Gussets | VEFV1124 | [ ]  Vessel: Vortex Breakers |
| VEFV1108 | [ ]  Vessel: Vertical, Type “B” Base Plate W/ Cap Plate and Gussets | VEFV1125 | [ ]  Vessel: Internal Ladders |
| VEFV1109 | [ ]  Vessel: Vertical, Type “C” Base Plate W/ Cap Plate and Offset Gussets | VEFV1128Type  | [ ]  Vessel: Skirt Attachment Details |
| VEFV1110 | [ ]  Vessel: Vertical, Type “D” Base Plate W/ Top Ring and Gussets | VEFV1129 | [ ]  Vessel: Studded Joint |
| VEFV1111 | [ ]  Vessel: Vertical, Beam Type Leg Supports | STF05520 | [ ]  Pipe Railing for Walking and Working Surfaces Details |
| VEFV1112 | [ ]  Vessel: Angle W/O Pad Type Leg Supports | STF05521 | [ ]  Angle Railing for Walking and Working Surfaces Details |
| VEFV1113 | [ ]  Vessel: Vertical, Angle W/ Pad Type Leg Supports | STF05535 | [ ]  Vessel Platform Details |
| VEFV1114 | [ ]  Vessel: Vertical, Type “A” Support Lug Base Plate W/ Cap and Gussets | STF05501 | [ ]  Fixed Metal Ladders and Cages Details |
| VEFV1115 | [ ]  Vessel: Vertical, Type “B” Support Lug Base Plate W/ Cap or Top Ring and Gussets |  |  |

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| **D. MATERIALS**All materials must be specified in accordance with ASME Pressure Vessel Code. |
|  | **Material** | **ASME Specification /UNS No.** |
| 1. Shell |  |  |
| 2. Jacket |  |  |
| 3. Heads |  |  |
| 4. Reinforcing Pads |  |  |
| 5. Nozzle Necks: Jacket |  |  |
| Shell |  |  |
| 6. Nozzle Flanges: Jacket |  |  |
| Shell |  |  |
| 7. Manhole Neck |  |  |
| 8. Manhole Flange and Cover |  |  |
| 9. Internal Bolting: Bolts |  |  |
| Nuts |  |  |
| 10. External Bolting: Bolts |  |  |
| Nuts |  |  |
| 11. Gaskets: Vessel |  |  |
| Jacket |  |  |
| Coil |  |  |
| 12. Supports:  |  |  |
| 13. Lifting Lugs |  |  |
| 14. Internals |  |  |
| 15. Body Flanges |  |  |
| 16. Jacket Closure Ring |  |  |
| 17. Stiffening Rings |  |  |
| 18. Insulation Rings |  |  |
| 19. Coil |  |  |
| 20. Lining |  |
| 21. Special Requirements |  |
| Notes: |

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| --- |
| **E. NOZZLE SCHEDULE**The Purchaser will orient and locate nozzles orientation on the Manufacturer’s approval drawings. |
| **MARK** | **NO. REQ’D** | **SIZE** | **CLASS** | **TYPE** | **CL PROJECTION** | **DESCRIPTION** |
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| Notes: |

(Reference: PIP VEDV1003 (Provided for Reference Only))

The Design Data items on the Vessel Drawing/Data Sheet are a reproduction of this sheet.

|  |
| --- |
| **Design Data**1. Design Internal Pressure: PSIG at: F
2. Design External Pressure: PSIG at: F
3. Minimum Design Metal Temperature: F at PSIG Low Ambient Excursion Process
4. Design S. G. of Liq.: Liq. Level:
5. Internal Operating Pressure: PSIG at F
6. External Operating Pressure: PSIG at F
7. Construction Code: ASME Sec. VIII, Division 1, Ed. , Addenda
	1. Code Stamp Required: Yes No
	2. Code Special Service Ug-116(C): No Yes
	3. Code Case: No Yes
8. Name Plate MAWP Stamping: Calculated Same as Design
9. National Board Registration: Yes No
10. PIP Specifications: See Ref. Spec/Dwg Block This Sheet.
11. Other Specs: See Ref. Spec./Dwg Block This Sheet None
12. Corrosion Allowance:

Shell: Heads: Nozzles: Supports: Internals: 1. Welded Pressure Joint Requirement:
2. For Noncorrosive Service: Yes No
3. Seal Weld Internal Parts to Pressure Boundary: Yes No
4. Cyclic Service: See Ref. Specification this Sheet No
5. Other Special Service Requirements:
6. P.W.H.T.: Yes No Per Code Per Service
7. Material Specifications:

Shell: Formed Heads: Cladding Or Lining: Reinf Pads: Stiffening Rings: Nozzle/Manway Necks: Pipe: Plate: Forgings: Weld Fittings: Pressure Retaining Bolts: Nuts: Internal Bolts: Nuts: Gaskets: Parts Welded to Pressure Boundary: Internal: External: Supports: Trays: Other:  |
| 20. Vortex Breaker: | Yes | No |
| Type: | Flush | Inside Projection 3 Blade 4 Blade |
| 21. Hardness Control: | No | Yes |
| 22. Shop Prime: | No | Yes |
| Shop Paint: | No | Yes |
| 23. Insulation By Others: | No | Yes Thick; Type |

The Design Data items on the Vessel Drawing/Data Sheet are a reproduction of this Sheet.

Calc. MAP (New & Cold): PSIG Limited by: Shop Hydrostatic Test Pressure (New & Cold): PSIG MAWP: PSIG, @ F

Limited by: MDMT: F @ PSIG

Limited by:

Est. Weight: Shipping Lbs., Empty Lbs.

Operating (w/Operating Liquid) Lbs., Full H2O Lbs.

Total Capacity in Gallons:

6.

7.

5.

No

Yes

MAWP Calculation Is Required:

1.

2.

3.

4.

Classification Category: Basic Wind Speed: MPH Exposure Category: Topographic Factor:

26. Seismic Design: ASCE7 Other:

Aa: Av: S: R:

**Supplementary Data To Be Provided By Fabricator**

Other:

Yes Thick; Type

No

Outside Skirt ASCE7

1. Fireproof By Others:

Inside Skirt

1. Wind Design:

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

**Appendix B**

**Inspection and Hold Points**

(Reference: PIP VESV1002 (Provided for Reference Only))

**Quality Overview Plan for Section VIII, Divisions 1 and 2 Vessels**

Equip. No. P. O. No. S. O. No.

Equip. Description Project Engineer Phone No. Inspection Contact Phone No.

Activities checked apply to the above item (see Quality Overview Notes). In most cases, the User/Purchaser representative will require five (5) days notification to make arrangements for hold point inspections.

|  |  |  |
| --- | --- | --- |
| References are either to Division 1 *Code* paragraphs or applicable *Code* Table U-3 {AG-150.1} reference standards. All additional requirements covered by the purchase specifications also apply. | **QUALITY OVERVIEW ACTIVITY** | **DOCUMENTATION** |
| **REVIEW** | **WITNESS** | **INSPECT** | **HOLD POINT** | **REQUIRED** |
| No. |  | **Yes** | **No** | **Yes** | **No** | **Yes** | **No** | **Yes** | **No** | **Yes** | **No** |
| 1. | Material Receipt (Prior to Fab) |  |  |  |  |  |  |  |  |  |  |
| 2. | MTR's/Certificate of Compliance (Prior to Fab) (UG-93{AF-101}) |  |  |  |  |  |  |  |  |  |  |
| 3. | Positive Material Identification (PMI) |  |  |  |  |  |  |  |  |  |  |
| 4. | Impact Test Values |  |  |  |  |  |  |  |  |  |  |
| 5. | Lap Joint Flange (ASME B16.5) |  |  |  |  |  |  |  |  |  |  |
| 6. | Machined Surfaces (Prior to Assembly) |  |  |  |  |  |  |  |  |  |  |
| 7. | WPS/Welder/Welding Operator Qualifications (UW-28 and UW-29 {AF-210}) |  |  |  |  |  |  |  |  |  |  |
| 8. | Weld Map |  |  |  |  |  |  |  |  |  |  |
| 9. | Inside Nozzle Corners Rounded [UG-36(a)(2) {AD-600}] |  |  |  |  |  |  |  |  |  |  |
| 10. | Welded Joint Fit-Up (UW-33 {AF-221.3}, UG-76{AF-112.2}, UG-77 {AF-102}) |  |  |  |  |  |  |  |  |  |  |
| 11. | Initial Welding (UW-32 {AF-141}, UW-37 {AF-210}) |  |  |  |  |  |  |  |  |  |  |
| 12. | Final Welding (UW-35 {AF-142}, UW-36 {AF-225}, UW-37 {AF-210}) |  |  |  |  |  |  |  |  |  |  |
| 13. | Machined Surfaces (After Assembly & Welding) |  |  |  |  |  |  |  |  |  |  |
| 14. | Magnetic Particle Examination (MT) (App. 6 {Art. 9-1} ) |  |  |  |  |  |  |  |  |  |  |
| 15. | Liquid Penetrant Examination (PT) (App. 8 {Art. 9-2} ) |  |  |  |  |  |  |  |  |  |  |
| 16. | Radiographic Examination (RT) (UW-11 {App. 8} ) |  |  |  |  |  |  |  |  |  |  |

|  |  |  |
| --- | --- | --- |
| References are either to Division 1 *Code* paragraphs or applicable *Code* Table U-3 {AG-150.1} reference standards. All additional requirements covered by the purchase specifications also apply. | **QUALITY OVERVIEW ACTIVITY** | **DOCUMENTATION** |
| **REVIEW** | **WITNESS** | **INSPECT** | **HOLD POINT** | **REQUIRED** |
| No. |  | **Yes** | **No** | **Yes** | **No** | **Yes** | **No** | **Yes** | **No** | **Yes** | **No** |
| 17. | Ultrasonic Examination (UT) (App. 12 {Art. 9-3}) |  |  |  |  |  |  |  |  |  |  |
| 18. | Other NDE |  |  |  |  |  |  |  |  |  |  |
| 19. | Material Repairs (UG-78 {AF-104} |  |  |  |  |  |  |  |  |  |  |
| 20. | Weld Repairs (UW-38 {AF-250}) |  |  |  |  |  |  |  |  |  |  |
| 21. | Out-of-Roundness (UG-80 {AF-130}) |  |  |  |  |  |  |  |  |  |  |
| 22. | Peaked Seam [UG-79(b) {AF-120}] |  |  |  |  |  |  |  |  |  |  |
| 23. | Weld Reinforcement/Weld Contour (UW-35{AF-142}) |  |  |  |  |  |  |  |  |  |  |
| 24. | Dimensional Check |  |  |  |  |  |  |  |  |  |  |
| 25. | Installation of Internals |  |  |  |  |  |  |  |  |  |  |
| 26. | Internal Inspection (Prior to Pressure Test) |  |  |  |  |  |  |  |  |  |  |
| 27. | PWHT (UW-40 {AF-635}) |  |  |  |  |  |  |  |  |  |  |
| 28. | NDE (After PWHT, When Required) |  |  |  |  |  |  |  |  |  |  |
| 29. | Machined Surfaces (After PWHT) |  |  |  |  |  |  |  |  |  |  |
| 30. | Gasket/Gasket Installation/Bolted Joint Assembly |  |  |  |  |  |  |  |  |  |  |
| 31. | Nameplate Bracket |  |  |  |  |  |  |  |  |  |  |
| 32. | Pressure Test (UG-99 {Art. T-3}, UG-100 {Art. T-4}) |  |  |  |  |  |  |  |  |  |  |
| 33. | Gas Leak Test |  |  |  |  |  |  |  |  |  |  |
| 34. | Formed Head Knuckle (After Pressure Test) |  |  |  |  |  |  |  |  |  |  |
| 35. | Internal Inspection (After Pressure Test) |  |  |  |  |  |  |  |  |  |  |
| 36. | Coating Inspection |  |  |  |  |  |  |  |  |  |  |
| 37. | Final Dimensional Check |  |  |  |  |  |  |  |  |  |  |
| 38. | Description of Nonconformance(s) |  |  |  |  |  |  |  |  |  |  |
| 39. | Preparation for Shipment |  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |  |
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**Appendix C**

 **External Piping Loads on Carbon Steel and Stainless Steel, Alloy Steel Vessels**

**Table 1: Carbon Steel Pipe Loads**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Nozzle Size****(Inch)** | **Flange Rating****#** | **Radial****(Lbs)** | **Shear Force Circ.****(Lbs)** | **Shear Force Long.****(Lbs)** | **Tors. Moment****(Ft-Lbs)** | **Circ. Moment****(Ft-Lbs)** | **Long. Moment****(Ft-Lbs)** |
| 1.5 | 150 | 337 | 354 | 354 | 270 | 168 | 211 |
| 300 | 405 | 425 | 425 | 360 | 224 | 282 |
| 2 | 150 | 450 | 472 | 472 | 480 | 298 | 376 |
| 300 | 540 | 566 | 566 | 640 | 398 | 501 |
| 3 | 150 | 674 | 708 | 708 | 1080 | 672 | 846 |
| 300 | 809 | 850 | 850 | 1440 | 895 | 1128 |
| 4 | 150 | 899 | 944 | 944 | 1920 | 1194 | 1503 |
| 300 | 1079 | 1133 | 1133 | 2560 | 1592 | 2005 |
| * + - 1. Piping loads at the face flange.
			2. Circumferential and longitudinal bending refer to vessel axes.
			3. External loads are in addition to internal pressure loads.
			4. Occasional loads (wind, seismic etc.) are not included. Allow 20% more for occasional loads.
 |

**Table 2: Stainless Steel and Alloy Steel Pipe Loads**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Nozzle Size****(Inch)** | **Flange Rating****#** | **Radial****(Lbs)** | **Shear Force Circ.** **(Lbs)** | **Shear Force Long.****(Lbs)** | **Tors. Moment****(Ft-Lbs)** | **Circ. Moment****(Ft-Lbs)** | **Long. Moment****(Ft-Lbs)** |
| 1.5 | 150 | 270 | 283 | 283 | 216 | 134 | 169 |
| 300 | 303 | 319 | 319 | 288 | 179 | 226 |
| 2 | 150 | 360 | 378 | 378 | 384 | 239 | 301 |
| 300 | 405 | 425 | 425 | 512 | 318 | 401 |
| 3 | 150 | 540 | 566 | 566 | 864 | 537 | 677 |
| 300 | 607 | 637 | 637 | 1152 | 716 | 902 |
| 4 | 150 | 719 | 755 | 755 | 1536 | 955 | 1203 |
| 300 | 809 | 850 | 850 | 2048 | 1274 | 1604 |
| * + - 1. Piping loads at the face flange.
			2. Circumferential and longitudinal bending refer to vessel axes.
			3. External loads are in addition to internal pressure loads.
			4. Occasional loads (wind, seismic etc.) are not included. Allow 20% more for occasional loads.
 |

**Appendix D**

**Manufacturer’s Data**

(Reference: PIP VESV1002 (Provided for Reference Only))

**Documentation Schedule**

Equip. No. P.O. No. S.O. No. \_\_\_\_\_\_ Equip. Description

Project Engineer \_\_ Phone No.

“WKS” Column = Number of Weeks Required from P.O. Date “P” Column = Number of Legible Prints Required

“E” Column = Number of Electronic Files Required (5)

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | **WITH BID** | **FOR APPROVAL** | **FINAL (2) CERTIFIED** | **DATA (3) BOOKS** | **WITH EQUIP** | **ALLOW FOR USER APPROVAL** |
| **ITEM** | **E** | **P** | **WKS FROM PO** | **E** | **P** | **WKS FROM PO** | **E** | **P** | **WKS FROM PO** | **E/P** | **P** | **WEEKS FROM DATE OF DATA RECEIPT** |
| Completed Data Sheets |  |  |  |  |  |  |  |  |  |  |  |  |
| Vessel Dimension Outlines |  |  |  |  |  |  |  |  |  |  |  |  |
| Vessel Details |  |  |  |  |  |  |  |  |  |  |  |  |
| Vessel Structural Attachments for Ladders, Platforms, etc. |  |  |  |  |  |  |  |  |  |  |  |  |
| Column Tray and Downcomer Support Details |  |  |  |  |  |  |  |  |  |  |  |  |
| Weld Procedures with Weld Maps |  |  |  |  |  |  |  |  |  |  |  |  |
| Nondestructive Examination and PWHT Procedures |  |  |  |  |  |  |  |  |  |  |  |  |
| Design Calculations |  |  |  |  |  |  |  |  |  |  |  |  |
| Shipping Diagram and Rigging Instructions |  |  |  |  |  |  |  |  |  |  |  |  |
| Manufacturer's Data Package (see Page B-3) |  |  |  |  |  |  |  |  |  |  |  |  |
| Fabrication Sequence and Schedule |  |  |  |  |  |  |  |  |  |  |  |  |
| Sub-Supplier List |  |  |  |  |  |  |  |  |  |  |  |  |
| Progress Report (Monthly) |  |  |  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |  |  |

**NOTES:**

1. Drawings and data are to be mailed to unless submitted with quotation.
2. Final certified drawings are to be submitted within two (2) weeks of receipt of “Approved” or “Approved As Noted” prints.
3. All data shall be supplied prior to submission of final invoice.
4. All questions of a technical nature shall be directed to .
5. All records shall be provided in electronic media, in a format as agreed upon by the User, and be of legible quality.
6. Each copy of all data (e.g., drawings, manuals) shall be **certified by Manufacturer** with equipment or instrument **Tag Number** and **Purchase Order Number** written or typed on the face of each copy.

**Manufacturer’s Data Package**

The Manufacturer’s Data Package is to include:

* 1. Final certified fabrication drawings
	2. Manufacturer’s Data Report (U Forms)
	3. Certified material (mill) test reports and/or certificates of compliance (provide index when appropriate)
	4. Impact test values including production weld test results
	5. Heat treatment charts (time/temperature record)
	6. Pressure test charts (time/pressure/water temperature record) when a recording device is used

6a. Statement of test water quality (potability, chloride content for austenitic stainless steel vessels)

* 1. Nondestructive examination records and reports (PT, MT, RT, BHN, PMI chemistry)
	2. Nameplate facsimile
	3. If requested, weld procedures, qualifications, and weld maps
	4. Description of non-conformities accepted by the User, if any
	5. Required bolted joint assembly procedures including bolt preload for custom flanges
	6. Any other documentation required by Purchaser
	7. Operating instructions, performance data, and parts list (when applicable)
	8. Manufacturer’s design calculations

**Manufacturer’s Drawing Information**

Manufacturer shall provide certified assembly and working drawings for all vessels. Drawings shall be complete and shall include, but not necessarily be limited to, the following information:

1. Maximum allowable working pressure {design pressure} and coincident maximum design temperature (internal and external if applicable)
2. Minimum design metal temperature and coincident maximum allowable working pressure
3. Design specific gravity, maximum liquid level, and other operating loads
4. Reference to *Code* Section VIII, Division 1 or 2, Edition, and Addenda. Include any *Code* Cases used and special service restrictions
5. Special service notes (e.g., “for cyclic service” followed by a description of the cyclic loadings and number of cycles used in the design)
6. Applicable *Code* paragraphs for impact test exemption [e.g., UG-20(f), UCS-66(a), UCS-66(b), UCS-66(c)] or for impact test requirements (e.g., UHA-51 or UHT-6)
7. National Board registration number (U- or U2-symbol stamped vessels)
8. ASME material specifications for all pressure-resisting components and all attachments to pressure-resisting components
9. Wind/seismic design criteria
10. Corrosion allowance. When a corrosion allowance is specified and the service is specified on Data Sheet Item 13 as non-corrosive, the notation “for non-corrosive service” shall be added to the drawing notes.
11. Weld details. All welds shall be either detailed or identified by use of the standard welding symbols of the American Welding Society ANSI/AWS A2.4
12. Nondestructive examination requirements of welded pressure joints
13. Joint efficiency for each butt-welded joint (or seamless equivalent) in the vessel, including nozzles and communicating chambers. A joint efficiency map may be useful.
14. Nondestructive examination of non-pressure-resisting welds
15. Postweld heat treatment requirements
16. Hydrostatic or pneumatic test pressures, as applicable:
	1. Shop test in horizontal position (referenced to top of vessel)
	2. Shop test in vertical position (referenced to top of vessel) (except for horizontal vessels)
	3. Future test in operating position (referenced to top of vessel) (in the corroded condition for vessels having a corrosion allowance)
17. Minimum permissible metal temperature during hydrostatic testing
18. Sensitive leak tests, if any
19. Nominal thickness of all components [minimum thickness after forming (includes corrosion allowance) for formed heads]
20. All pertinent dimensions, including location of weld seams, location and projection of nozzles, location of vessel and insulation supports, and any other information necessary for a complete description of the vessel
21. Manufacturer’s drawings shall have the same designation for nozzles, manways, skirt openings, and column trays as shown on Purchaser’s drawings.
22. Complete description of all vessel flanges (including both standard and custom design), pressure bolting, and gaskets
23. Relevant fabrication, inspection, testing, and painting requirements
24. Vessel support details
25. Surface preparation and painting or other protective coating specifications
26. Estimated weight of vessel: empty, operating, full of water, and shipping
27. Capacity of vessel (or each compartment)
28. Facsimiles of Manufacturer’s nameplate as stamped by Manufacturer
29. Purchaser’s vessel identification number(s)
30. Reference to specifications. Manufacturer shall include on drawings a reference to all applicable codes, standards, and specifications, including date of issue. References shall include all applicable PIP Practices and any applicable Manufacturer standards. When reference is made to Manufacturer’s own standards, copies of such standards shall be included with the submitted working drawings.

Special Notes

Manufacturer’s drawings shall also include the following notes as applicable:

1. All Vessels - the following note: “Substances containing chlorine or which will decompose to hydrogen chloride (e.g., coatings to prevent adhesion of weld spatter) shall not be applied to any part of the vessel.”
2. Stainless Steel or Nickel-Alloy Vessels - the following note: “Zinc-coated (galvanized or painted) components shall not be in contact (welded, bolted, or loose) with any alloy parts of the vessel.”
3. Hastelloy, Monel, Nickel, or Nickel-Alloy Vessels - the following note: “Substances containing sulfur (e.g., lubricants to aid machining) shall not be applied to alloy parts of the vessel.”
4. Clad-Steel Vessels - Drawing notes shall specify whether or not the thickness of cladding metal has been included in the design calculations for strength.
5. Balance point location - for horizontal equipment, the balance point location shall be noted and dimensioned from a permanent reference point (e.g., main body flange etc.).
6. All PWHT vessels shall have the following notice painted on two sides of the shell and insulation covering, if present, in three inch high letters visible in the shipping position from grade:

POSTWELD HEAT TREATED - DO NOT BURN OR WELD

1. All vessels with non-metallic linings shall have the following notice painted on two sides of the shell and insulation covering, if present in three inch high letters visible in the shipping position from grade:

LINED VESSEL - DO NOT BURN OR WELD

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

END OF SECTION