section 43 4116

atmospheric tanks and vessels

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LANL MASTER SPECIFICATION SECTION

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| Rev. 2 Summary of Changes:Updated entire Part 1 to include multiple atmospheric low pressure tanks, 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, and other minor editorial changes. |

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

This section is a general specification section covering LANL tank applications for low pressure vessels storing fluids for laboratory or hi-tech manufacturing operations. It does not apply to fire protection systems covered under NFPA 20, 22, or 1142.

This Section is intended to be used for custom design of tanks (design/build procurement of tanks). This Section is not intended for specification of standardized tanks that are offered for sale also known as shelf stock. For the purposes of this section, a tank is defined as a container designed for not more than 15 psig internal pressure capability.

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.

Responsibility for application of this section to meet project-specific requirements lies with the organization modifying or implementing it. The organization shall apply a graded approach to quality assurance based on the management level designation of the project.

Alternatively, the ASME BPVC Section VIII Division 1 Section 43 4113, *Gas And Liquid Pressure Vessels* may be applied to items utilized as tanks.

The specifier editing this Section is required to define many aspects of the tank design, including management level designation of the tank.

Following the designation of management level, interpret the requirements for the designated management level and define those requirements in this Section.

Included standards are:

1. API 620, *Design and Construction of Large, Welded, Low-Pressure Storage Tanks* (addresses seismic)
2. API 650, *Welded Tanks for Oil Storage* (addresses seismic)
3. AWWA D100, *Welded Carbon Steel Tanks for Water Storage*
4. UL 58, *Steel Underground Tanks for Flammable and Combustible Liquids*
5. UL 80, *Steel Tanks for Oil-Burner Fuels and Other Combustible Liquids*
6. UL 142, *Steel Aboveground Tanks for Flammable and Combustible Liquids*
7. UL 1746, *External Corrosion Protection Systems for Steel Underground Storage Tanks*
8. UL 2085, *Protected Aboveground Tanks for Flammable and Combustible Liquids*

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

* Establish the service conditions and design requirements for the tank, also considering factors associated with startup, normal operation, and shutdown. Determine operating pressures and temperatures, and design pressures and temperatures. Determine maximum design liquid level in tank, and the specific gravity of the liquid to be stored.
* The technical requirements of this Section are applicable to containers used primarily for atmospheric or non-pressurized storage of fluids, or storage of fluids at very low gauge pressure. The upper limit of internal pressure for tanks built under this Section is 15 psig (34.6 ft water column).

NOTE: “Internal Pressure” refers to a uniformly distributed internal pressure in tank and is in addition to the normal varying pressure head due to depth of contained fluid.

NOTE: The referenced standards are not all applicable to 15 psig internal pressure.

NOTE: Tanks are **not** rated for vacuum service (external pressure).

* For uniform internal pressures (in addition to liquid head), the following apply:
	+ - * 1. API 620: Maximum positive gauge pressure shall be understood to be the nominal pressure rating for the tank (sometimes called the design pressure) and shall not exceed 15 psig.
				2. API 650: Welded oil storage tanks of various sizes and capacities for internal pressures not more than 21/2 pounds per square inch gauge.
				3. AWWA D100: Storage of water at atmospheric conditions.
				4. UL 58: Buckling based on Roark’s equation.
				5. UL 80: An atmospheric storage tank that has been designed to operate at pressures from 5 psig to 7 psig measured at the top of the tank.
				6. UL 142: An atmospheric storage tank that has been designed to operate at pressures from −0.5 psig to 1.0 psig measured at the top of the tank.
				7. UL 1746: An atmospheric storage tank that has been designed to operate at pressures from −0.5 psig to 1.0 psig measured at the top of the tank.
				8. UL 2085: An atmospheric storage tank that has been designed to operate at pressures from −0.5 psig to 1.0 psig measured at the top of the tank.
* Determine the materials of construction of the tank, as required by the service conditions.
* Radiological underground systems required double wall tanks.
* API 620 and API 650 address seismic design.
* UL 58 covers single-wall and double-wall, bare steel underground tanks.
* UL 1746 covers single-wall and double-wall tanks. These tanks consist of a steel tank complying with UL 58 with a nonmetallic external fiber-reinforced plastic (FRP) or thermoplastic jacket. The tank and jacket are separated by an interstitial space with the jacket acting as a secondary containment barrier. The jacket shall be fabricated using a material at least 0.100 inches thick.
* Consider corrosion allowances. Corrosion allowance will be based on corrosion rate and service life.
* Thermal stress relief is a recognized method for reducing the probability of brittle failures in the case of true pressure vessels. Most tanks covered by this Section will not be subjected to conventional post-weld heat treatment/thermal stress relief after fabrication. However, for more critical applications, consider thermal stress relief. For API 620 tanks, depending on service conditions--and thus the required tensile strength of the tank containment boundary material--determine if pre-weld or post-weld heat treatment is required. If so, specify the heat treatment(s) needed.
* Complete Appendix A, *Tank Data Sheet* in this Section, to summarize design requirements and tank configuration/nozzles. Blank tank data sheet forms are provided in Appendix L of API 650 or equal. Also specify plugged spare penetrations for possible future use, if desirable.
* Determine whether the tank will require any coatings, linings, or insulation. If so, specify or allow Manufacturer to recommend a system for LANL approval.
* Flat-bottom API tanks usually require full support across the tank bottom. Before beginning tank 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 tank. Determine if there are any clearance problems in moving the tank to its installation site.
* Normally tanks are not designed to include processing equipment like agitators or mixers. This type of equipment is better suited for Section 43 4113.
* API 650, covers the basic design of steel tanks operating at approximately atmospheric pressure (internal pressure up to an equivalent of lid weight is allowed). By following the additional requirements of Appendix F, the internal pressure limitation may be raised to 2-1/2 psig.
* If internal pressures greater than 2-1/2 psig are required, the additional requirements of API 620, shall be applied. This Section covers steel tanks up to a maximum internal pressure design limit of not greater than 250 degrees F at 15 psig.
* Tanks are not intended to support external pressure (internal vacuum). For closed tanks, incorporate a relieving device to prevent the formation of a vacuum inside the tank.
* When corrosion is expected on any part of the tank wall or on any external or internal supporting or bracing members upon which the safety of the completed tank depends, additional metal thickness in excess of that required by the design computations shall be provided, or some satisfactory method of protecting these surfaces from corrosion shall be employed.

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

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

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1. GENERAL
	1. SECTION INCLUDES
		1. This Section establishes the technical requirements for the design, materials of construction, fabrication, testing, shipment, and quality assurance (QA) of tanks (with internal pressures less than or equal to 15 psig), their supports, components, and appurtenances.
		2. The following is a summary of Subcontractor’s responsibilities described in this Section:
			1. Design and fabricate tanks in accordance with the following standards, this Section, Subcontractor’s LANL-approved drawings, and other referenced documents:
				1. [API 620, *Design and Construction of Large, Welded, Low-Pressure Storage Tanks*
				2. API 650, *Welded Tanks for Oil Storage*
				3. AWWA D100, *Welded Carbon Steel Tanks for Water Storage*
				4. UL 58, *Steel Underground Tanks for Flammable and Combustible Liquids*
				5. UL 80, *Steel Tanks for Oil-Burner Fuels and Other Combustible Liquids*
				6. UL 142, *Steel Aboveground Tanks for Flammable and Combustible Liquids*
				7. UL 1746, *External Corrosion Protection Systems for Steel Underground Storage Tanks*
				8. UL 2085, *Protected Aboveground Tanks for Flammable and Combustible Liquids*]
			2. Furnish design data required by the applicable standard and this Section to document design of the tank.
			3. Procure equipment, materials, or supplies to complete the work[, unless otherwise stated].
			4. Test and inspect as required by this Section, and the applicable standard.
			5. Furnish the data required by this Section to document that required tests and inspections have been performed.
			6. Package, ship, and deliver the tank.
			7. 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 tank 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 014000, *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 4455, *Onsite Welding, Brazing and Joining Requirements*
		7. Section 01 4525, *Nondestructive Examination* (*NDE) Requirements*
		8. [Section 01 8712, *Seismic Qualification of Equipment – Nuclear-Safety Related*]
		9. [Section 01 8734, *Seismic Qualification of Nonstructural Components (IBC)*]
		10. [Section 22 0548.23, *Vibration and Seismic Controls for Mechanical Systems*]
		11. [Section 43 4113, *Gas and Liquid Pressure Vessels*]

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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. 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.

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* 1. REFERENCES
		1. API 620, Design and Construction of Large, Welded, Low-Pressure Storage Tanks
		2. API 650, Welded Tanks for Oil Storage
		3. ASME B16.5, Pipe Flanges and Flanged Fittings
		4. ASME B16.47, Large Diameter Steel Flanges: NPS 26 Through NPS 60
		5. [ASME NQA-1 – [2008] /1A - [2009], Quality Assurance Requirements for Nuclear Facility Applications]
		6. ASNT SNT-TC-1A, Recommended Practice for Personnel Qualification and Certification in Nondestructive Testing
		7. ASTM A380, Standard Practice for Cleaning, Descaling, and Passivation of Stainless Steel Parts, Equipment and Systems
		8. ASTM D429, Standard Test Methods for Rubber Property – Adhesion to Rigid Substrates
		9. ASTM D2240, Standard Test Method for Rubber Property – Durometer Hardness
		10. ASTM D4417, Standard Test Methods for Field Measurement of Surface Profile of Blast Cleaned Steel
		11. ASTM D5162, Standard Practice for Discontinuity (Holiday) Testing of Nonconductive Protective Coating on Metallic Substrate
		12. ASTM G62, Standard Test Methods for Holiday Detection in Pipeline Coatings
		13. AWS D1.1/D1.1M, Structural Welding Code – Steel
		14. AWS D1.6/D1.6M, Structural Welding Code – Stainless Steel
		15. AWWA D100, Welded Carbon Steel Tanks for Water Storage
		16. NBBI, NB-23 (NBIC) Part 1, Installation
		17. UL 58, Steel Underground Tanks for Flammable and Combustible Liquids
		18. UL 80, Steel Tanks for Oil-Burner Fuels and Other Combustible Liquids
		19. UL 142, Steel Aboveground Tanks for Flammable and Combustible Liquids
		20. UL 1746, External Corrosion Protection Systems for Steel Underground Storage Tanks
		21. UL 2085, Protected Aboveground Tanks for Flammable and Combustible Liquids
	2. SYSTEM DESCRIPTION
		1. General Design Requirements
			1. For tank operating conditions, design data, and tank configuration, refer to Appendix A, *Tank Data Sheet*, or approved substitute.
			2. Design, fabricate, test, and label tanks in accordance with:
				1. [API 620: Maximum positive gauge pressure shall be understood to be the nominal pressure rating for the tank (sometimes called the design pressure) and shall not exceed 15 psig.
				2. API 650: Welded oil storage tanks of various sizes and capacities for internal pressures not more than 21/2 pounds per square inch gauge.
				3. AWWA D100: Storage of water at atmospheric conditions
				4. UL 58: Buckling based on Roark’s equation.
				5. UL 80: An atmospheric storage tank that has been designed to operate at pressures from 5 psig to 7 psig measured at the top of the tank.
				6. UL 142: An atmospheric storage tank that has been designed to operate at pressures from −0.5 psig to 1.0 psig measured at the top of the tank.
				7. UL 1746: An atmospheric storage tank that has been designed to operate at pressures from −0.5 psig to 1.0 psig measured at the top of the tank
				8. UL 2085: An atmospheric storage tank that has been designed to operate at pressures from −0.5 psig to 1.0 psig measured at the top of the tank.]
			3. Tanks 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 standards at the point of installation.
			4. 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.
			5. Minimum corrosion/erosion/wear/machining post construction allowance shall be 0.0625 inch (1/16 inch).
			6. 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 tank in accordance with the applicable standard.
		2. Containment Boundary Design Requirements
			1. Proposed weld joint configurations are to be approved by LANL prior to fabrication, unless LANL chooses to waive this requirement.
			2. Identify joints that are to be welded from one side only.

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Identify/define the piping systems that will interface with the tank and specify the necessary nozzles and connections required on the tank. Specify any maintenance access openings (manways), or other large openings needed on the tank. 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 (refer to API 650, Appendix L for data sheet forms) with a conceptual sketch to clarify requirements (Refer to Appendix A, *Tank Data Sheet*)

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* + 1. Flanges, Nozzle, Seals, and Manway Requirements
			1. Flanges for all flanged tank 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 are to 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 tank centerlines.
			6. Provide sufficient projection of flanged nozzles to allow removal of flange bolts from either side without removal of insulation (if used).
			7. Make nozzles that are used as drains flush with tank interior surface.
			8. Gasket flange joint designs shall provide outer confinement of the gasket.
			9. 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.
			10. All inside nozzle neck edges shall be rounded to 1/8 inch minimum radius.
			11. Nozzle loads are to be defined for each nozzle, see Appendix B, *External Piping Loads on Nozzles.*
			12. In establishing nozzle and manway projections, clearance shall be provided for removing flange stud bolts from between the flange and tank and for accessing flange stud nuts. Clearance for flange studs and nuts shall be considered when nozzles penetrate insulation or platforms.
			13. 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.
			14. Attach the davit-socket bracket to the nozzle neck when lap joint flanges are employed.
			15. Manways on the top of tanks oriented with a vertical nozzle neck axis shall be equipped with a davit.
			16. Tanks 3 feet ID and smaller that are subject to internal corrosion, erosion, or mechanical abrasion shall be equipped with inspection openings. Tanks in this size category may justify the use of body flanges.
			17. Tanks 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.
			18. Manways less than NPS 24 (DN 600) shall not be allowed.
			19. All manholes shall be readily accessible by platforms and ladders, stairways, or other suitable man-lift equipment.
			20. [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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Determine and specify tank lifting requirements, including any LANL-specific hoisting and rigging requirements for the tank design.

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* + 1. Structural/Supports
			1. Design tank and supports for wind, snow, seismic and other applicable loadings in accordance with [ESM Chapter 5](https://engstandards.lanl.gov/ESM_Chapters.shtml#esm5).
			2. Design tank for stress concentrations due to concentrated loads imposed on its walls in the region where the supports are attached. The design calculations are to include secondary stresses that may exist in the wall adjacent to the attachment of such supports and include but not limited to as applicable full and empty weight of the tank; the temperature of service; the internal pressure; the arrangement of the supporting structure; and the piping attached to the tank as installed.
			3. [Design and construct tank foundations in accordance with [API 620, API 650, AWWA D100, UL 58, UL 80, UL 142, UL 1746, UL 2085] or other requirements, as applicable. Consider wind, snow, seismic and other applicable loadings for the design of tank supports in accordance with [ESM Chapter 5](https://engstandards.lanl.gov/ESM_Chapters.shtml#esm5).
				1. Foundations and subgrade shall safely carry the weight of the tank and its contents when the tank is empty or full as required by the applicable standard.
				2. The tank supports shall be evaluated to ensure adequacy as required by the applicable standard.]
			4. Determine the overturning stability of the tank due to wind, seismic and other loadings, as applicable.
			5. On tanks that are supported by a skirt, extend the flange of bottom head nozzles outside of the skirt for access.
			6. Skirts shall have a minimum thickness of 1/4 inch.
			7. Incorporate lifting features into the tank design as required. Design and position lifting features to prevent any strain or distortion of the tank. Design lifting features to accept lifting by forklift, crane, or other appropriate device, and label these features appropriately as lifting points.
			8. If lifting lugs are not provided as a feature of the design, indicate suitable lifting points on the main tank framework. If necessary, provide external strong-backs or other bracing devices.

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

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* + 1. Tank Linings, Coatings, and Insulation
			1. Tank Manufacturer shall evaluate the design conditions supplied by LANL and determine whether tank linings, coatings, and/or insulation may be required. If so, Manufacturer shall recommend the preferred system to LANL for concurrence and approval.
		2. Pressure-Relieving Devices
			1. Tanks shall be protected by automatic pressure-relieving devices that shall prevent the pressure at the top of the tank from rising more than pressure specified by LANL (the specified pressure may be the design pressure or an over pressure as allowed by the applicable standard).
			2. Tanks shall be provided with vent opening intended to provide for both normal venting to equalize pressure from fill, withdraw and atmospheric changes, or overpressure protection and vacuum relieving devices. These devices shall be located on the tank so that they shall never be sealed off and shall ensure the tank is not pressurized or evacuated beyond the allowances of the applicable standard.
			3. Where an additional hazard can be created by the exposure of the tank to accidental fire or another unexpected source of heat external to the tank, supplemental pressure-relieving device(s) shall be installed. These device(s) shall be capable of preventing the pressure from rising more than allowed by the applicable standard.
	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, *Tank Data Sheet*
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*.
				1. Provide reference to LANL Project I.D. Number, LANL Subcontract Number, Tank Number, Tank 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 tank 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 tank data sheet (Appendix A, *Tank Data Sheet*) 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 tank in accordance with [API 620, API 650, AWWA D100, UL 58, UL 80, UL 142, UL 1746, or UL 2085] as applicable 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. [Product Data for any coatings, sealants, adhesives, insulation, and/or paint.]
			2. Lifting and Rigging Plan, showing lifting lug placement and lifting center of gravity
			3. Drawings
			4. Calculations
				1. US customary (English) units shall be regarded as standard for tanks 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 Standard, values used in the formulas, calculated results, and comparisons with acceptable values. Where calculations are based on formulas other than those in the Standard, 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 Standard for Cautionary Note regarding responsibility for the use of computer programs.)
				3. Calculations shall include:

Standard calculations

Wind and seismic calculations, as applicable

Support calculations (including those for postweld heat treatment, testing and shipping)

Calculations associated with shipping, lifting and erection of the tank

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. 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 Standard.
	* + 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* and/or 01 4455, *Onsite 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.
				2. Notifications: Notify LANL at least 7 days in advance for Acceptance Testing and Final Inspection.
			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: Prior to 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. Address in the procedure items such as procurement controls, segregation of materials, and traceability of materials from receipt at the shop through processing and final assembly.]
			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 tank cleaning operations. Provide a procedure that addresses cleaning tank 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) / Standard Compliance Certifications - Includes certification that all performance and quality control requirements established by the listed Standards, 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 tank 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 Standard to which the test/inspection is being performed.
				1. Tank 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. [Protective Coating Test Report, for fabricated steel components]
				8. Source Verification Test Report - Three certified copies of the source verification test results shall be furnished to LANL for approval before shipment.
				9. 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, 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.]
	* + - 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 standards, Section 01 4000, *Quality Requirements – [Non-nuclear, Nuclear*] for work defined in this Section.
		2. Tanks 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 tanks. Manufacturer shall maintain a Quality Control Program that complies with the applicable standard.

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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.
			5. 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.
			6. 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.
			7. 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.
			8. [Source Verification tests for rubber lined tanks include Discontinuity (Holiday) Test, Spark Test and Bond Test.]
			9. [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.]
			10. [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 tank environments. Manufacturer shall provide a recommended inspection frequency.]
		2. 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 tanks shall be per the applicable standard.
				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 the applicable standard.
				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 tank 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 standard.
				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, *Tank Data Sheet.*
				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 tank may be allowed to evaporate to dryness.
			3. Pressure Test:
				1. Test to the requirements of the applicable standard. Ensure that weld surfaces are free of coating materials during test. Hold hydrostatic test pressure for 15 minutes, minimum.
				2. Vent tank to atmosphere while filling or draining tank.
			4. [Special Testing
				1. Assembled tank 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. Alternative Design Proposals
				1. The Subcontractor shall provide a base bid in full compliance with LANL’s request for quotation.
				2. 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 tank. 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 Standard 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 shall not be used unless approved in writing.
	1. DELIVERY, STORAGE, & HANDLING
		1. Shipping mode and method of transporting, and the extent of tank assembly, are to be mutually agreed on by the Subcontractor and LANL prior to fabrication and delivery of the tank. 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 (covered storage, weather tight, leak tight, desiccants) if the equipment is to be stored for longer than one month prior to being installed.
	2. SITE CONDITIONS
		1. Design the tank 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.*

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Determine and specify the type of material to be used for the tank 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).

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* 1. MATERIALS
		1. Provide materials complying with [API 620, API 650, AWWA D100, UL 58, UL 80, UL 142, UL 1746 or UL 2085], as applicable.

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

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* + 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 tanks 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: \_\_\_\_\_\_\_\_.]

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

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* + 1. [Protective Linings, Coatings, and Insulation
			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, particularly 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 on stainless steel surfaces that contain more than 25 ppm of chloride content by weight.
			3. Welding: Ensure that welders, welding operators, and tackers are qualified in accordance with the applicable Standard. Reference Section 01 4444, *Offsite Welding, Brazing and Joining*, and/or Section 01 4455, *Onsite Welding, Brazing and Joining* for additional requirements pertaining to welding.
			4. Surface Finishes: Exercise care to prevent scratching, abrading, nicking, and denting of the tank during fabrication, receiving, storage, and handling.
			5. [Welding or fabrication of internal features or external supports, platforms, and ladders, stairways, or other items shall not be performed that will damage the internal or external coatings or insulation.]
		2. Cleaning:
			1. After fabrication is completed, and before testing and inspection, clean, de-scale, and degrease the tank and associated components.
			2. Clean exterior surfaces, but take particular care to clean the inside of the tank thoroughly. Methods may include cleaning by hot water spray, etc. Ensure tank 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 tank 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 tank. 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 tanks, 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 tank 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 tank.
			4. 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 tank 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 tank shell and/or contamination of the metal. Cables and chains are not permitted even with padding unless attached to clips provided on the tank 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 tank support skirts shall be adequately supported during shipping and handling.
		4. Handling, Packaging, Shipping
			1. Exercise care to prevent scratching, abrading, nicking, and denting of the tank 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 specification.

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

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* + - 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 tank 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) tanks 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 tanks 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 TANK - 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 tanks in accordance with the requirements of [API 620, API 650, AWWA D100, UL 58, UL 80, UL 142, UL 1746 or UL 2085], as applicable. The term “Inspector”, as used in the API Standards, refers to the LANL Inspector.
			2. Provide the test location, equipment, instrumentation of certified accuracy, and any supplementary temporary connections and auxiliary parts necessary to fully execute the tests.
			3. Provide test personnel qualified to conduct, record, and verify test results.
			4. Provide LANL with a minimum seven (7) working day advance written notice of shop acceptance tests.
			5. Submit the test results as part of the QA Document Package in accordance with Section 01 3300, *Submittal Procedures*.
		6. Weld Inspection
			1. Minimum radiography: Refer to [API 620, API 650, AWWA D100, UL 58, UL 80, UL 142, UL 1746, or UL 2085], as applicable, for details of requirements.
			2. Magnetic particle examination: If specified, perform magnetic particle examination in accordance with requirements in [API 620, API 650, AWWA D100, UL 58, UL 80, UL 142, UL 1746, or UL 2085], as applicable.
			3. Liquid penetrant inspection 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 [and Vacuum] Test:
			1. Pressure test tanks designed to [API 620, API 650, AWWA D100, UL 58, UL 80, UL 142, UL 1746, or UL 2085], as applicable.
			2. [Vacuum test tank annulus as required by [UL 58, UL 1746].]
			3. Vent tank to atmosphere while filling or draining tank. Weld surfaces are to be free of coating materials during test. Water for shop-testing austenitic stainless steel tanks is to be potable quality with a chloride ion content of less than 25 ppm. After testing, drain water from tank. Wipe standing water dry—do not allow it to evaporate to dryness, unless de-ionized water is used.
		8. Test Reports: Provide test reports as produced by [API 620, API 650, AWWA D100, UL 58, UL 80, UL 142, UL 1746, or UL 2085], the Subcontract documents, and this Section. Include the following information in the test report:
			1. Tank 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:
			1. Attach a Manufacturer’s Certification Nameplate to the tank in accordance with the requirements of [API 620, API 650, AWWA D100, UL 58, UL 80, UL 142, UL 1746, or UL 2085], as applicable
			2. Attach a nameplate to each tank for LANL identification. This information may be incorporated into a single nameplate with the API requirements, if desired. Clearly separate the LANL information from the [API 620, API 650, AWWA D100, UL 58, UL 80, UL 142, UL 1746, or UL 2085] information.
			3. Nameplate may be attached to the tank by welding, brazing, or soldering and in such a manner so as not to weaken tank strength or alter tank material properties. Nameplate cannot be removed without destruction of the nameplate.
			4. Nameplate is to be austenitic stainless steel and the attachment bracket shall have sufficient projection to clear tank insulation, when present.
1. EXECUTION
	1. INSTALLATION
		1. Installation of tanks is facility-specific and not covered in this Section. Install tanks in accordance with [API 620, API 650, AWWA D100, UL 58, UL 80, UL 142, UL 1746 or UL 2085], and NBIC NB-23 Part 1.

END OF MAIN SECTION [; APPENDICES FOLLOW]

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Do not delete the following reference information:

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THE FOLLOWING STATEMENT IS FOR LANL USE ONLY

This project specification section is based on LANL Master Specification Section 43 4116 Rev. 2, dated January 29, 2025.

**Appendix A**

Tank Data Sheet

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Designer shall provide information required by API 620, API 650, AWWA D100, UL 58, UL 80, UL 142, UL 1746, or UL 2085 equivalent to the Subcontractor. The table below in this Appendix is based on API 650, Annex L (provided for reference only).

The designer may also create a custom data sheet if more appropriate for a specialized tank.

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| --- | --- | --- | --- | --- |
| **Appendix A - Tank Data Sheet** | REV | BY | CHECKED | DATE |
|  |  |  |  |
|  |  |  |  |

\* For boxes marked with \*, if blank, Mfr. shall determine and submit per [API 650 Annex L]. For all lines, see [API 650 Annex L] for line-by-line instructions.

|  |
| --- |
| **GENERAL** Special Documentation Package Requirements: |
| Measurement Units to be used in [API Std 650]: SI US Customary |
| 1 | Manufacturer\* Subcontract No.\* Address\* Mfg. Serial No.\* Year Built\* Edition & Addendum to [*API 650]*\*  |
| 2 | Purchaser Subcontract No. Address Tank Designation  |
| 3 | Owner/Operator Location  |
| 4 | Size Limitations\* Tank Diameter\* Shell Height\* Capacity: Maximum\* Net Working\* Criteria:\*  |
| 5 | Products Stored:Liquid Design Specific Gravity: at F Minimum Design Specific Gravity: at F Blanketing Gas Vapor Pressure psia at Max. Operating Temp.% Aromatic Suppl. Spec. H2S Service? Yes [ ]  No [ ]  Suppl. Spec. Other Special Service Conditions? Yes [ ]  No [ ]  Suppl. Specs.  |
| **DESIGN AND TESTING** Purchaser to Review Design Prior to Ordering Material? Yes [ ]  No [ ]  |
| 6 | Applicable [API Standard 650] Appendices:\* A [ ]  B [ ]  C [ ]  F [ ]  G [ ]  H [ ]  I [ ]  J [ ]  L [ ]  M [ ]  O [ ]  P [ ]  S [ ]  U [ ]  V [ ]  W [ ]  |
| 7 | Max. Design. Temp. F Design Metal Temp.\* F Design Liquid Level\* Design Internal Pressure Design External Pressure Internal Pressure Combination Factor External Pressure Combination Factor Maximum Fill Rate Maximum Emptying Rate Flotation Considerations? Yes [ ]  No [ ]  Flot. Suppl. Spec:\* Applied Supplemental Load Spec.  |
| 8 | Seismic Design? Yes [ ]  No [ ]  Annex E Alternate Seismic Criteria Seismic Use Group MBE Site Class Vertical Seismic Design? Yes [ ]  No [ ]  Vertical Ground Motion Accelerator Av: Basis of Lateral Acceleration (Select one): Mapped Seismic Parameters? Ss S1 S0 [ ]  Site-Specific Procedures?: MCE Design Required? Yes [ ]  No [ ]  Other (Non-ASCE) Methods [ ]  Freeboard Required for SUG I Design Roof Tie Rods @ Outer Ring?\* Yes [ ]  No [ ]  |
| 9 | Wind Velocity for non-U.S. sites, 50-yr wind speed (3-sec Gust)\* Top Wind Girder Style\* Dimensions\* Use Top Wind Girder as Walkway? Yes [ ]  No [ ] Intermediate Wind Girders?\* Yes [ ]  No [ ]  Intermediate Wind Girder Style\* Dimensions\* Check Buckling in Corroded Cond.? Yes [ ]  No [ ]  |
| 10 | Shell Design: 1-Ft Mthd?\* Yes [ ]  No [ ]  Variable-Des-Pt Mthd?\* Yes [ ]  No [ ]  Alternate [ ] Elastic Anal. Mthd?\* Yes [ ]  No [ ]  Alternate [ ] Plate Stacking Criteria\* Centerline-Stacked? Yes [ ]  No [ ]  Flush-Stacked? Yes [ ]  No [ ]  Inside [ ]  Outside [ ]  Plate Widths (Shell course heights) and Thicknesses \* Numbers below Indicate Course Number.1. 2. 3. 4. 5. 6. 7. 8. 9. 10. 11. 12. 13. 14. 15. Joint Efficiency\* % Shell-to-Bottom Weld Type\* Shell-to-Bottom Weld Exam Mthd\* Exceptions to Seal-welded Attachments:  |

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| **Appendix A - Tank Data Sheet** | REV | BY | CHECKED | DATE |
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\* If box is blank, Manufacturer shall determine and submit as per [API 650, Annex L].

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| 11 | Open-Top and Fixed Roofs: (See Sheet for Floating Roofs) Open Top? \* Yes [ ]  No [ ] Fixed Roof Type\* Roof Support Columns\*: Pipe [ ]  Or Structural Shape [ ] Cone Slope\* . Dome or Umbrella Radius\* Weld Joints\* (Lap, Butt, Other)Seal Weld Underside of: Lap-Joints? Yes [ ]  No [ ]  Seal Weld Underside of Wind Girder Joints? Yes [ ]  No [ ]  Gas-tight? Yes [ ]  No [ ]  Joint Efficiency\* %Thickness\* In. Snow Load \* App. Suppl. Load Spec.\* Column Lateral Load Normal Venting Devices\* Emergency Venting Devices\* Free Vents in Areas Where Snow and Ice May Block Vent\* For Non-Frangible Roofs: Seal Weld Roof Plates to Top Angle on the Inside? Yes [ ]  No [ ]  Weld rafters to Roof Plates Yes [ ]  No [ ] Roof-to-Shell Detail\* Radial Projection of Horizontal Component of Top Angle\* Inward [ ]  Outward [ ]  |
| 12 | Bottom: Thickness\* Style\* Slope\* . Weld Joint Type\* Provide Drip Ring? Yes [ ]  No [ ]  Alternate Spec. Annular Ring? Yes [ ]  No [ ]  Annular Ring: Minimum Radial Width\* Thickness\*  |
| 13 | Foundation: Furnished by\* Type\* Soil Allow. Bearing Pressure\* Per Spec.\* Anchors: Size\* Qty\* Foundation Design Loads: Base Shear Force: Wind\* Seismic\* Overturning Moment: Wind\* Seismic\* *\* Ring Forces: Weight of Shell + Roof New\* Corroded\* Roof Live Load\* Internal Pressure\* Partial Vacuum\* Wind\* Seismic\* Hydrotest Exemption design Bottom Forces: Floor Wt. New\* Corroded\* Product Wt.\* Water Wt.\* Internal Pressure\* Partial Vacuum\* Other Foundation Loads\* Min. Projection of Fdn. Above Grade:  |
| 14 | Exemption from hydrotest? Yes[ ]  No[ ]  Responsibility for Heating Water, if Required: Purchaser [ ]  Manufacturer[ ] Hydro-Test Fill Height\* Settlement Measurements Required ? Yes [ ]  No [ ]  Extended Duration of Hydro-Test: [ ] Predicted Settlement Profile is AttachedApplication of coating on weld joints shall be performed after hydrostatic testing is performed, unless otherwise specified to be [ ]  before hydrostatic testing is performed.Responsibility for Setting Water Quality: Purchaser [ ]  Manufacturer [ ]  Supplemental Test Water Quality Spec. Test Water Source & Disposal Tie-In Locations Hydro-Test [API 650, Annex J] Tank? Yes[ ]  No [ ]  Post-Pressure-Test Activities Required of the Manufacturer: Broom Clean[ ]  Potable Water Rinse[ ]  Dry Interior [ ]  Other [ ]   |
| 15 | Inspection by in Shop; in FieldSupplemental NDE Responsibility Supplemental NDE Spec. (Purch., Mfg., Other)Positive Material Identification? Yes [ ]  No [ ]  PMI Requirements: Max. Plate Thickness for Shearing Must Welds not exceeding 6 mm (1/4 in.) Be Multi-Pass? Yes [ ]  No [ ]  Must Welds greater than 6 mm (1/4 in.) Be Multi-Pass? Yes [ ]  No [ ] Leak Test Mthd: Roof\* Shell\* Shell Noz./Manhole Reinf. Plt.\* Bottom\* Floating Roof Components\* Modify or Waive API Dimensional Tolerances? No [ ]  Yes [ ]  Specify: Specify Additional Tolerances, if any, and Circumferential and Vertical Measurement Locations:* + Allowable Plumbness: Measure and Record at a Minimum of Locations or Every m (ft) around the Tank, at the Following Shell Heights: (select one box): [ ]  1/3 H, 2/3 H and H [ ]  Top of Each Shell Course [ ]  Other:
	+ Allowable Roundness: Measure Radius and Record at a Minimum of Locations or Every m (ft)

around the Tank, at the Following Shell Heights (select one box):[ ]  Top of Tank, H [ ]  1/3 H, 2/3 H and H [ ]  Top of Each Shell Course [ ]  Other:  |

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| 16 | Coatings:Internal Coatings by: Per Spec.\* (Not Req’d., Others, Tank Mfg.)External Coating by: Per Spec.\* (Not Req’d., Others, Tank Mfg.)Under-Bottom Coating by: Per Spec.\* (Not Req’d., Others, Tank Mfg.) |
| 17 | Cathodic Protection System? Yes [ ]  No [ ]  Per Spec.\*  |
| 18 | Leak Detection System? Yes [ ]  No [ ]  Per Spec.\*  |
| 19 | Release Prevention Barrier? Yes [ ]  No [ ]  Per Spec.\*  |
| 20 | Tank Measurement System: Required? Yes [ ]  No [ ]  Type: Float and tape gauge Servo gauge: Hydrostatic gauge: MTG multifunction gauge: Other gauge: Remote Capability Required? Yes [ ]  No [ ] By:\* Per Spec.\*  |
| 21 | Weight of Tank: Full of Water\* Empty\* Shipping\* Brace/Lift Spec.\*  |
| 22 | References\*: [*API Std 650, Annex L*] |
| 23 | Remarks\*: |

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\* If box is blank, Manufacturer shall determine and submit as per [API 650, Annex L].

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| **TABLE 1 MATERIALS OF CONSTRUCTION** |
| **Component** | **Material\*/Thickness\*** | **C.A.** | **Component** | **Material\*** | **C.A.** |
| Shell, Course to  |  |  | Reinforcing Pads |  |  |
| Shell, Course to  |  |  | Manhole/Nozzle Necks |  |  |
| Shell, Course to  |  |  | Manhole/Nozzle Flanges |  |  |
| Shell, Course to  |  |  | Flange Covers |  |  |
| Shell, Course to  |  |  | Anchor Attachments |  |  |
| Roof |  |  | Submerged Piping |  |  |
| Bottom |  |  | Wetted Structurals |  | + |
| Annular Ring |  |  | Non-wetted Structurals |  | + |
| + Check here if C.A. is to apply to each exposed surface  . |
| **TABLE 2 BOLTS AND ANCHORS** |
| **Component** | **Head Type\*** | **Bolt or Anchor Material\*** | **Nut Material\*** | **Thread Series\*** | **C.A.** |
| Flange Bolting |  |  |  |  | ++ |
| Structural Bolting |  |  |  |  | ++ |
| Anchor Bolts |  |  |  |  | ++ |
|  |  |  |  |  |  |
| ++ Total C.A., on the nominal diameter. |
| **TABLE 3 NOZZLE AND MANHOLE SCHEDULE\* (for Fixed Roof, Shell, and Bottom)** |
| **Mark** | **Service** | **Size, NPS, or Dia. (In.)** | **Neck Sch or Wall Thick.** | **Reinf. Plate Dimensions** | **Full Pen.****On Open. (Y/N)** | **Flange Type** | **Flange Class or Thick.** | **Gasket Bearing Surf. Dimen. and Finish** | **Gasket Thick. and Dimen.** | **Gasket Mat’l. and Descript.** | **Proj. to FF or CL or from Datum Lines** |
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\* If box is blank, Manufacturer shall determine and submit as per [API 650, Annex L].

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| 24 | Platform, Stairway, and Railing: Galvanizing Req’d?\* Yes [ ]  No [ ]  Stairway Style\* Walk Surf. Type\*  (Straight or Helical)Handrail height (if required)\* (30 in.–38 in.) Tread rise/run\* Stair and Walkway Clear Width\* National Safety Standards\* Architectural/Structural Specification\* Material Specification(s): Gauger’s Platform Req’d? Yes [ ]  No [ ]  Qty Req’d.\* Per Spec. \*  |
| 25 | Jacket Required?\* Yes [ ]  No [ ]  Other Heaters/Coolers Required?\* Yes [ ]  No [ ] Supplemental Jacket, Heater, or Cooler Specifications\*  |
| 26 | Mixer/Agitator: Quantity Size\* Per Spec.\*  |
| 27 | Insulation: Required? Yes [ ]  No [ ]  Thickness\* Material\* Per Specs\* Responsibility for Insulation and Installation (Purchaser, Manufacturer, Others) |
| 28 | Structural Attachments: Lift Lugs?\* Yes [ ]  No [ ]  Desc.\* Shell Anchorage?\* Yes [ ]  No [ ]  Type\* Scaffold Cable Support? Yes [ ]  No [ ]  |
| 29 | Various Other Items: Welded Flush-Type: Shell Connection [ ]  Cleanout Fitting [ ]  Waive Application of [API 650, Annex P]? Yes [ ]  No [ ]  Miscellany #1 Miscellany #2 Miscellany #3 Miscellany #4 Miscellany #5 Miscellany #6  |
| **TABLE 4 OTHER TANK APPURTENANCES\*** |
| **Mark** | **Quantity** | **Service or Description** | **Size** | **Orientation** | **Height from Datum** | **Material** | **Remarks** |
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\* If box is blank, Manufacturer shall determine and submit as per [API 650, Annex L].

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| **FLOATING ROOF DATA** |
| 30 | Floating Roof SelectionDesign Basis: [API 650, Annex C] [ ]  Or [API 650, Annex H] [ ] Type of Roof: (External or Internal): Single Deck Pontoon\* [ ]  Double Deck\* [ ] (Internal Only): Tubular Pontoon\* [ ]  Metallic Sandwich Panel\* [ ] Other [ ]  Supplemental Spec.:  |
| 31 | SealsPrimary Seal: Shoe [ ]  Envelope [ ]  Wiper/Compression Plate [ ]  Other [ ]  Supplemental Spec: Shoe Mechanism: Mfg. Std. [ ]  Other [ ]  Electrically Isolate Mechanism from Shoes? Yes [ ]  No [ ]  Wax Scrapers Required? Yes [ ]  No [ ]  Minimum Shoe Thickness\* Carbon Steel Shoes to be Galvanized? Yes [ ]  No [ ] Secondary Seal: Shoe [ ]  Envelope [ ]  Wiper [ ]  None [ ]  Other [ ]  Supplemental Spec:  |
| 32 | Data for All Floating Roofs:Overflow Openings in Shell Acceptable? Yes [ ]  No [ ]  Shell Extension? Yes [ ]  No [ ] Roof-Drain Check Valves Required? Yes [ ]  No [ ]  Roof-Drain Isolation Valves Required? Yes [ ]  No [ ] Freeze Protection for Roof Drains Required? No [ ]  Yes [ ]  Supplemental Requirements: Roof-Drain Piping to External Nozzles: Mfg. Std. [ ]  Armored Flexible Pipe [ ]  Swivels in Rigid Pipe [ ]  Other [ ]  Foam Dam? Yes [ ]  No [ ]  Supplemental Spec. Minimum Deck Thickness\* Bulkhead Top Edges to be Liquid-Tight? Yes [ ]  No [ ]  Seal-weld Underside of Roof? Yes [ ]  No [ ] Electrical Bonding: Shunts: Yes [ ]  No [ ]  Cables: Yes [ ]  No [ ]  Supplemental Spec. Qty of Non-Guide-Pole Gauge Wells Required Qty of Sample Hatches Required Guide Pole for Gauging? Yes [ ]  No [ ]  Slots in Guide Pole? Yes [ ]  No [ ]  Datum Plates? Yes [ ]  No [ ]  Striking Plates? Yes [ ]  No [ ]  Guide Pole Emissions-Limiting Devices: Sliding Cover [ ]  Pole Wiper [ ]  Pole Sleeve [ ]  Float [ ]  Float Wiper [ ]  Pole Cap [ ] Qty. of Roof Manholes\* Alternative High-Roof Clearance Above Bottom: Alternative Low-roof Clearance Above the Highest Obstruction and the Floating Roof: Removable Leg Storage Racks? Yes [ ]  No [ ]  Leg Sleeves [ ]  or Fixed Low Legs [ ]  |
| 33 | Additional Data for External Floating Roofs:Weather Shield? Yes [ ]  No [ ]  Suppl. Spec. Rolling Ladder Req’d? Yes [ ]  No [ ]  Field Adjustable Legs? Yes [ ]  No [ ] Design Rainfall Intensity In./Hr. (mm/hr) Based on a Minute Duration Associated with the Storm Design Accumulated 24-Hour Rainfall In. (mm) Based on the StormOut-of-Service Drains Required? Yes [ ]  No [ ]  Supplemental Specification Distortion and Stability Determinations Required? Yes [ ]  No [ ]  Supplemental Specification Landed Live Load\*  |

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\* If box is blank, Manufacturer shall determine and submit as per [API 650, Annex L].

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| 34 | Additional Data for Internal Floating Roofs:Two-Position Legs? Yes [ ]  No [ ]  Cable-Supported Roof? Yes [ ]  No [ ]  Fixed-Roof Inspection Hatches Required?: Yes [ ]  No [ ]  Internal Roof Drain Required? Yes [ ]  No [ ]  Omit Distribution Pads Supporting Uniform Live Loads? Yes [ ]  No [ ] Corrosion Gauge Required? Yes [ ]  No [ ]  Fixed Ladder Required?: Yes [ ]  No [ ]  Type of Roof Vent: \* Modified Minimum Point Load? Yes [ ]  No [ ]  Supplemental Specification Mfr. to Leak Test \* % of Compartments [ ]  in Assembly Yard [ ]  in Erected Position [ ]  Unknown; see separate subcontract terms Roof Erector's Flotation Test: w/ tank hydro [ ]  at completion of roof [ ]  at later date [ ]  Not required [ ] Flotation Test Media: Water [ ]  Product [ ]  Water Quality: Potable [ ]  Other [ ]  See Supplemental Spec Flotation Test: Duration Fill Height: Flotation Test Items provided by Purchaser: None [ ]  List Attached [ ] Responsible Party for Inspecting Roof during Initial Fill: Purchaser [ ]  Other [ ]   |
| **TABLE 5 FLOATING ROOF MATERIALS** |
| **Component** | **Material\*/Thickness\*** | **C.A./Coating\*** | **Component** | **Material\*/Thickness\*** | **C.A./Coating\*** |
| Deck Plate |  |  | Datum Plate |  |  |
| Inner Rim Plate |  |  | Tubular Pontoon |  |  |
| Outer Rim Plate |  |  | Pontoon Bulkhead |  |  |
| Foam Dam |  |  | Submerged Pipe |  |  |
| Sandwich Panel Face Plate |  |  | Guide Pole |  |  |
| Sandwich Panel Core |  |  | Secondary Seal |  |  |
| Gauge Well |  |  | Secondary Seal Fabric |  |  |
| Drain Sumps |  |  | Wiper Tip |  |  |
| Opening Sleeves |  |  | Wax Scraper |  |  |
| Floating Suction Lines |  |  | Weather Seal |  |  |
| Primary Fabric Seal |  |  | Envelope Fabric |  |  |
| Foam Log Core |  |  | Shoe Mechanisms |  |  |
| Landing Legs |  |  | Primary Seal Shoe |  |  |
| Landing Leg Bottom Pads |  |  | Removable Covers |  |  |
| Manhole Necks |  |  | Rolling Ladder |  |  |
| Vents |  |  | Inlet Diffusers |  |  |

**Appendix B**

**External Piping Loads on Nozzles**

**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 tank/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 tank/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.
 |

END OF SECTION