

§ 178.338-2

49 CFR Ch. I (10-1-01 Edition)

heated glowing platinum wire. The cargo tank must be marked in accordance with §178.338-18(b)(7).

(3) Each vacuum-insulated cargo tank must be provided with a connection for a vacuum gauge to indicate the absolute pressure within the insulation space.

(e) The insulation must be completely covered by a metal jacket. The jacket or the insulation must be so constructed and sealed as to prevent moisture from coming into contact with the insulation (see §173.318(a)(3) of this subchapter). Minimum metal thicknesses are as follows:

Type metal	Jacket evacuated		Jacket not evacuated	
	Gauge	Inches	Gauge	Inches
Stainless steel	18	0.0428	22	0.0269
Low carbon mild steel ..	12	0.0946	14	0.0677
Aluminum	0.125	0.1000

(f) An evacuated jacket must be in compliance with the following requirements:

(1) The jacket must be designed to sustain a minimum critical collapsing pressure of 30 psig.

(2) If the jacket also supports additional loads, such as the weight of the tank and lading, the combined stress, computed according to the formula in §178.338-3(b), may not exceed 25 percent of the minimum specified tensile strength.

[Amdt. 178-77, 48 FR 27703, June 16, 1983, as amended at 49 FR 24316, June 12, 1984; Amdt. 178-104, 59 FR 49135, Sept. 26, 1994; 66 FR 45387, Aug. 28, 2001]

§ 178.338-2 Material.

(a) All material used in the construction of a tank and its appurtenances that may come in contact with the lading must be compatible with the lading to be transported. All material used for tank pressure parts must conform to the requirements of the ASME Code. All material used for evacuated jacket pressure parts must conform to the chemistry and steelmaking practices of one of the material specifications of Section II of the ASME Code or the following ASTM Specifications: A 242, A 441, A 514, A 572, A 588, A 606, A 607, A 633, A 715.

(b) All tie-rods, mountings, and other appurtenances within the jacket and all piping, fittings and valves must be of material suitable for use at the lowest temperature to be encountered.

(c) Impact tests are required on all tank materials, except aluminum, and must be performed using the procedure prescribed in the ASME Code.

(d) The direction of final rolling of the shell material must be the circumferential orientation of the tank shell.

(e) Each tank constructed in accordance with part UHT of the ASME Code must be postweld heat treated as a unit after completion of all welds to the shell and heads. Other tanks must be postweld heat treated as required by the ASME Code. For all tanks the method must be as prescribed in the ASME Code. Welded attachments to pads may be made after postweld heat treatment.

(f) The fabricator shall record the heat and slab numbers and the certified Charpy impact values of each plate used in the tank on a sketch showing the location of each plate in the shell and heads of the tank. A copy of the sketch must be provided to the owner of the cargo tank and a copy must be retained by the fabricator for at least five years and made available, upon request, to any duly identified representative of the Department.

(Approved by the Office of Management and Budget under control number 2137-0017)

[Amdt. 178-77, 48 FR 27703 and 27713, June 16, 1983, as amended at 49 FR 24316, June 12, 1984]

§ 178.338-3 Structural integrity.

(a) *General requirements and acceptance criteria.* (1) Except as permitted in paragraph (d) of this section, the maximum calculated design stress at any point in the tank may not exceed the lesser of the maximum allowable stress value prescribed in section VIII of the ASME Code, or 25 percent of the tensile strength of the material used.

(2) The relevant physical properties of the materials used in each tank may be established either by a certified test report from the material manufacturer or by testing in conformance with a recognized national standard. In either case, the ultimate tensile strength of the material used in the design may not exceed 120 percent of the minimum

ultimate tensile strength specified in either the ASME Code or the ASTM standard to which the material is manufactured.

(3) The maximum design stress at any point in the tank must be calculated separately for the loading conditions described in paragraphs (b), (c), and (d) of this section. Alternate test or analytical methods, or a combination thereof, may be used in lieu of the procedures described in paragraphs (b), (c), and (d) of this section, if the methods are accurate and verifiable.

(4) Corrosion allowance material may not be included to satisfy any of the design calculation requirements of this section.

(b) The static design and construction of each tank must be in accordance with section VIII of the ASME Code. The tank design must include calculation of stresses due to design pressure, the weight of lading, the weight of structures supported by the tank wall, and the effect of temperature gradients resulting from lading and ambient temperature extremes. When dissimilar materials are used, their thermal coefficients must be used in calculation of the thermal stresses. Stress concentrations in tension, bending and torsion which occur at pads, cradles, or other supports must be considered in accordance with appendix G of the ASME Code.

(c) Stresses resulting from static and dynamic loadings, or a combination thereof, are not uniform throughout the cargo tank motor vehicle. The following is a simplified procedure for calculating the effective stress in the tank resulting from static and dynamic loadings. The effective stress (the maximum principal stress at any point) must be determined by the following formula:

$$S = 0.5 (S_y + S_x) \pm (0.25(S_y - S_x)^2 + S_z^2)^{0.5}$$

Where:

(1) S = effective stress at any given point under the most severe combination of static and dynamic loadings that can occur at the same time, in psi.

(2) S_y = circumferential stress generated by internal and external pressure when applicable, in psi.

(3) S_x = the net longitudinal stress, in psi, generated by the following loading conditions:

(i) The longitudinal tensile stress generated by internal pressure;

(ii) The tensile or compressive stress generated by the axial load resulting from a decelerative force applied independently to each suspension assembly at the road surface using applicable static loadings specified in §178.338-13 (b) and (c);

(iii) The tensile or compressive stress generated by the bending moment resulting from a decelerative force applied independently to each suspension assembly at the road surface using applicable static loadings specified in §178.338-13 (b) and (c);

(iv) The tensile or compressive stress generated by the axial load resulting from an accelerative force applied to the horizontal pivot of the fifth wheel supporting the vehicle using applicable static loadings specified in §178.338-13 (b) and (c);

(v) The tensile or compressive stress generated by the bending moment resulting from an accelerative force applied to the horizontal pivot of the fifth wheel supporting the vehicle using applicable static loadings specified in §178.338-13 (b) and (c); and

(vi) The tensile or compressive stress generated by a bending moment produced by a vertical force using applicable static loadings specified in §178.338-13 (b) and (c).

(4) S_z = The following shear stresses that apply, in psi.: The vectorial sum of the applicable shear stresses in the plane under consideration, including direct shear generated by the static vertical loading; direct lateral and torsional shear generated by a lateral accelerative force applied at the road surface, using applicable static loads specified in §178.338-13 (b) and (c)

(d) In order to account for stresses due to impact in an accident, the design calculations for the tank shell and heads must include the load resulting from the design pressure in combination with the dynamic pressure resulting from a longitudinal deceleration of "2g". For this loading condition the stress value used may not exceed the lesser of the yield strength or 75 percent of the ultimate tensile strength of

§ 178.338-4

49 CFR Ch. I (10-1-01 Edition)

the material of construction. For a cargo tank constructed of stainless steel, the maximum design stress may not exceed 75 percent of the ultimate tensile strength of the type steel used.

(e) The minimum thickness of the shell or heads of the tank must be 0.187 inch for steel and 0.270 inch for aluminum. However, the minimum thickness for steel may be 0.110 inches provided the cargo tank is:

(1) Vacuum insulated, or

(2) Double walled with a load bearing jacket designed to carry a proportionate amount of structural loads prescribed in this section.

(f) Where a tank support is attached to any part of the tank wall, the stresses imposed on the tank wall must meet the requirements in paragraph (a) of this section.

(g) The design, construction, and installation of an appurtenance to the cargo tank or jacket must be such that, in the event of its damage or failure, the lading retention integrity of the tank will not be adversely affected.

(1) A lightweight attachment, such as a conduit clip, brakeline clip or placard holder, must be constructed of a material of lesser strength than the cargo tank wall or jacket material and may not be more than 72 percent of the thickness of the material to which it is attached. The attachment may be secured directly to the cargo tank wall or jacket if the device is designed and installed in such a manner that, if damaged, it will not affect the lading retention integrity of the tank. The lightweight attachment must be secured to the cargo tank wall or jacket by continuous weld or in such a manner as to preclude formation of pockets, which may become sites for incipient corrosion. Attachments conforming with this paragraph are not authorized for cargo tanks constructed under part UHT of the ASME Code.

(2) Except as prescribed in §178.338-3(g)(1), the welding of any appurtenance to the cargo tank wall or jacket must be made by attachment of a mounting pad, so that there will be no adverse affect upon the lading retention integrity of the tank if any force is applied to the appurtenance, from any direction. The thickness of the mounting pad may not be less than

that of the shell or head to which it is attached, and not more than 1.5 times the shell or head thickness. However, a pad with a minimum thickness of 0.187 inch may be used when the shell or head thickness is over 0.187 inch. If weep holes or tell tale holes are used, the pad must be drilled or punched at its lowest point before it is welded. Each pad must—

(i) Extend at least 2 inches in each direction from any point of attachment of an appurtenance;

(ii) Be attached by a continuous weld around the pad except for a small gap at the lowest point for draining.

[Amdt. 178-89, 55 FR 37057, Sept. 7, 1990, as amended by Amdt. 178-89, 56 FR 27876, June 17, 1991; 56 FR 46354, Sept. 11, 1991]

§ 178.338-4 Joints.

(a) All joints in the tank, and in the jacket if evacuated, must be as prescribed in the ASME Code, except that a butt weld with one plate edge offset is not authorized.

(b) Welding procedure and welder performance tests must be made in accordance with Section IX of the ASME Code. Records of the qualification must be retained by the tank manufacturer for at least five years and must be made available, upon request, to any duly identified representative of the Department, or the owner of the cargo tank.

(c) All longitudinal welds in tanks and load bearing jackets must be located so as not to intersect nozzles or supports other than load rings and stiffening rings.

(d) Substructures must be properly fitted before attachment and the welding sequence must minimize stresses due to shrinkage of welds.

(e) Filler material containing more than 0.05 percent vanadium may not be used with quenched and tempered steel.

(f) All tank nozzle-to-shell and nozzle-to-head welds must be full penetration welds.

(Approved by the Office of Management and Budget under control number 2137-0017)

[Amdt. 178-77, 48 FR 27704 and 27713, June 16, 1983, as amended at 49 FR 24316, June 12, 1984]