

**§ 179.400-5**

**49 CFR Ch. I (10-1-07 Edition)**

**§ 179.400-5 Materials.**

(a) Stainless steel of ASTM A 240/A 240M (IBR, see §171.7 of this subchapter), Type 304 or 304L must be used for the inner tank and its appurtenances, as specified in AAR Specifications for Tank Cars, appendix M (IBR, see §171.7 of this subchapter), and must be—

(1) In the annealed condition prior to fabrication, forming and fusion welding;

(2) Suitable for use at the temperature of the lading; and

(3) Compatible with the lading.

(b) Any steel casting, steel forging, steel structural shape or carbon steel plate used to fabricate the outer jacket or heads must be as specified in AAR Specifications for Tank Cars, appendix M.

(c) *Impact tests* must be—

(1) Conducted in accordance with AAR Specifications for Tank Cars, appendix W, W9.01;

(2) Performed on longitudinal specimens of the material;

(3) Conducted at the tank design service temperature or colder; and

(4) Performed on test plate welds and materials used for inner tanks and appurtenances and which will be subjected to cryogenic temperatures.

(d) Impact test values must be equal to or greater than those specified in AAR Specifications for Tank Cars, appendix W. The report of impact tests must include the test values and lateral expansion data.

[Amdt. 179-32, 48 FR 27708, June 16, 1983, as amended at 67 FR 51660, Aug. 8, 2002; 68 FR 75763, Dec. 31, 2003]

**§ 179.400-6 Bursting and buckling pressure.**

(a) [Reserved]

(b) The outer jacket of the required evacuated insulation system must be designed in accordance with §179.400-8(d) and in addition must comply with the design loads specified in Section 6.2 of the AAR Specifications for Tank Cars (IBR, see §171.7 of this subchapter). The designs and calculations must provide for the loadings trans-

ferred to the outer jacket through the support system.

[Amdt. 179-32, 48 FR 27708, June 16, 1983, as amended by Amdt. 179-51, 61 FR 18934, Apr. 29, 1996; 65 FR 58632, Sept. 29, 2000; 68 FR 75763, Dec. 31, 2003]

**§ 179.400-7 Tank heads.**

(a) Tank heads of the inner tank and outer jacket must be flanged and dished, or ellipsoidal.

(b) Flanged and dished heads must have—

(1) A main inside dish radius not greater than the outside diameter of the straight flange;

(2) An inside knuckle radius of not less than 6 percent of the outside diameter of the straight flange; and

(3) An inside knuckle radius of at least three times the head thickness.

**§ 179.400-8 Thickness of plates.**

(a) The minimum wall thickness, after forming, of the inner shell and any 2:1 ellipsoidal head for the inner tank must be that specified in §179.401-1, or that calculated by the following formula, whichever is greater:

$$t = Pd / 2SE$$

Where:

t = minimum thickness of plate, after forming, in inches;

P = minimum required bursting pressure in psig;

d = inside diameter, in inches;

S = minimum tensile strength of the plate material, as prescribed in AAR Specifications for Tank Cars, appendix M, Table M1 (IBR, see §171.7 of this subchapter), in psi;

E = 0.9, a factor representing the efficiency of welded joints, except that for seamless heads, E = 1.0.

(b) The minimum wall thickness, after forming, of any 3:1 ellipsoidal head for the inner tank must be that specified in §179.401-1, or that calculated by the following formula, whichever is greater:

$$t = 1.83 Pd / 2SE$$

Where:

t = minimum thickness of plate, after forming, in inches;

P = minimum required bursting pressure in psig;

d = inside diameter, in inches;

S = minimum tensile strength of the plate material, as prescribed in AAR Specifications for Tank Cars, Appendix M, Table M1, in psi;

E = 0.9, a factor representing the efficiency of welded joints, except that for seamless heads, E=1.0.

(c) The minimum wall thickness, after forming, of a flanged and dished head for the inner tank must be that specified in §179.401-1, or that calculated by the following formula, whichever is greater:

$$t = [PL(3 + \sqrt{L/r})] / (8SE)$$

Where:

t = minimum thickness of plate, after forming, in inches;

P = minimum required bursting pressure in psig;

L = main inside radius of dished head, in inches;

r = inside knuckle radius, in inches;

S = minimum tensile strength of plate material, as prescribed in AAR Specifications for Tank Cars, appendix M, table M1, in psi;

E = 0.9, a factor representing the efficiency of welded joints, except that for seamless heads, E = 1.0.

(d) The minimum wall thickness, after forming, of the outer jacket shell may not be less than  $\frac{3}{16}$  inch. The minimum wall thickness, after forming, of the outer jacket heads may not be less than  $\frac{1}{2}$  inch and they must be made from steel specified in §179.16(c). The annular space is to be evacuated, and the cylindrical portion of the outer jacket between heads, or between stiffening rings if used, must be designed to withstand an external pressure of 37.5 psig (critical collapsing pressure), as determined by the following formula:

$$P_c = [2.6E(t/D)^{2.5}] / [(L/D) - 0.45(t/D)^{0.5}]$$

Where:

$P_c$  = Critical collapsing pressure (37.5 psig minimum) in psig;

E = modulus of elasticity of jacket material, in psi;

t = minimum thickness of jacket material, after forming, in inches;

D = outside diameter of jacket, in inches;

L = distance between stiffening ring centers in inches. (The heads may be considered as stiffening rings located  $\frac{1}{3}$  of the head depth from the head tangent line.)

[Amdt. 179-32, 48 FR 27708, June 16, 1983; 49 FR 42736, Oct. 24, 1984; 64 FR 51920, Sept. 27, 1999, as amended at 66 FR 45390, Aug. 28, 2001; 68 FR 75763, Dec. 31, 2003]

#### § 179.400-9 Stiffening rings.

(a) If stiffening rings are used in designing the cylindrical portion of the outer jacket for external pressure, they must be attached to the jacket by means of fillet welds. Outside stiffening ring attachment welds must be continuous on each side of the ring. Inside stiffening ring attachment welds may be intermittent welds on each side of the ring with the total length of weld on each side not less than one-third of the circumference of the tank. The maximum space between welds may not exceed eight times the outer jacket wall thickness.

(b) A portion of the outer jacket may be included when calculating the moment of inertia of the ring. The effective width of jacket plate on each side of the attachment of the stiffening ring is given by the following formula:

$$W = 0.78(Rt)^{0.5}$$

Where:

W = width of jacket effective on each side of the stiffening ring, in inches;

R = outside radius of the outer jacket, in inches;

t = plate thickness of the outer jacket, after forming, in inches.

(c) Where a stiffening ring is used that consists of a closed section having two webs attached to the outer jacket, the jacket plate between the webs may be included up to the limit of twice the value of "W", as defined in paragraph (b) of this section. The outer flange of the closed section, if not a steel structural shape, is subject to the same limitations with "W" based on the "R" and "t" values of the flange. Where two separate members such as two angles, are located less than "2W" apart they may be treated as a single stiffening ring member. (The maximum length of plate which may be considered effective is 4W.) The closed section between an external ring and the outer jacket must be provided with a drain opening.

(d) The stiffening ring must have a moment of inertia large enough to support the critical collapsing pressure, as determined by either of the following formulas:

$$I = [0.035D^3 LP_c] / E,$$

or