and the dimensional requirements found in Figure UW–13.1.

[Amdt. 178–89, 54 FR 25031, June 12, 1989, as amended at 55 FR 37065, Sept. 7, 1990; Amdt. 178–89, 56 FR 27877, June 17, 1991; 65 FR 58632, Sept. 29, 2000; 68 FR 19285, Apr. 18, 2003; 68 fR 75756, Dec. 31, 2003]

§ 178.348–2 Material and thickness of material.

(a) The type and thickness of material for DOT 412 specification cargo tanks must conform to § 178.345–2, but in no case may the thickness be less than that determined by the minimum thickness requirements in § 178.320(a). The following Tables I and II identify the ''Specified Minimum Thickness'' values to be employed in that determination.

TABLE I—SPECIFIED MINIMUM THICKNESS OF HEADS (OR BULKHEADS AND BAFFLES WHEN USED AS TANK REINFORCEMENT) USING MILD STEEL (MS), HIGH STRENGTH LOW ALLOY STEEL (HSLA), AUSTENITIC STAINLESS STEEL (SS), OR ALUMINUM (AL)—EXPRESSED IN DECIMALS OF AN INCH AFTER FORMING

Volume capacity (gallons per inch)	10 or less				Over 10 to 14				Over 14 to 18			18 and over		
Lading density at 60 °F in pounds per gallon	10 lbs and less	Over 10 to 13 lbs	Over 13 to 16 lbs	Over 16 lbs	10 lbs and less	Over 10 to 13 lbs	Over 13 to 16 lbs	Over 16 lbs	10 lbs and less	Over 10 to 13 lbs	Over 13 to 16 lbs	10 lbs and less	Over 10 to 13 lbs	Over 13 to 16 lbs
Thickness (inch), steel	.100	.129	.157	.187	.129	.157	.187	.250	.157	.250	.250	.157	.250	.312
Thickness (inch), aluminum	.144	.187	.227	.270	.187	.227	.270	.360	.227	.360	.360	.227	.360	.450

TABLE II—SPECIFIED MINIMUM THICKNESS OF SHELL USING MILD STEEL (MS), HIGH STRENGTH LOW ALLOY STEEL (HSLA), AUSTENITIC STAINLESS STEEL (SS), OR ALUMINUM (AL)—EXPRESSED IN DECIMALS OF AN INCH AFTER FORMING

Volume capacity in gallons per inch	10 or less				Over 10 to 14				Over 14 to 18			18 and over		
Lading density at 60 °F in pounds per gallon	10 lbs and less	Over 10 to 13 lbs	Over 13 to 16 lbs	Over 16 lbs	10 lbs and less	Over 10 to 13 lbs	Over 13 to 16 lbs	Over 16 lbs	10 lbs and less	Over 10 to 13 lbs	Over 13 to 16 lbs	10 lbs and less	Over 10 to 13 lbs	Over 13 to 16 lbs
Thickness (steel):														
Distances between heads (and bulkheads baffles and ring stiffeners when used as tank reinforcement):														
36 in. or less	.100	.129	.157	.187	.100	.129	.157	.187	.100	.129	.157	.129	.157	.187
Over 36 in. to 54 inches	.100	.129	.157	.187	.100	.129	.157	.187	.129	.157	.187	.157	.250	.250
Over 54 in. to 60 inches	.100	.129	.157	.187	.129	.157	.187	.250	.157	.250	.250	.187	.250	.312
Thickness (aluminum):														
Distances between heads (and bulkheads baffles and ring stiffeners when used as tank reinforcement):														
36 in. or less	.144	.187	.227	.270	.144	.187	.227	.270	.144	.187	.227	.187	.227	.270
Over 36 in. to 54 inches	.144	.187	.227	.270	.144	.187	.227	.270	.187	.227	.270	.157	.360	.360
Over 54 in. to 60 inches	.144	.187	.227	.270	.187	.227	.270	.360	.227	.360	.360	.270	.360	.450

(b) [Reserved]

[Amdt. 178–89, 54 FR 25031, June 12, 1989; 54 FR 28750, July 7, 1989, as amended at 55 FR 37065, Sept. 7, 1990; 68 FR 19285, Apr. 18, 2003]

§ 178.348–3 Pumps, piping, hoses and connections.

Each pump and all piping, hoses and connections on each cargo tank motor vehicle must conform to § 178.345–9, except that the use of nonmetallic pipes, valves, or connections are authorized on DOT 412 cargo tanks.

[Amdt. 178–89, 55 FR 37065, Sept. 7, 1990. Redesignated by Amdt. 178–112, 61 FR 18934, Apr. 29, 1996]

§ 178.348–4 Pressure relief.

(a) Each cargo tank must be equipped with a pressure and vacuum relief system in accordance with § 178.345–10 and this section.

(b) *Type and construction.* Vacuum relief devices are not required for cargo tanks designed to be loaded by vacuum or built to withstand full vacuum.

(c) *Pressure settings of relief valves.* The setting of the pressure relief devices must be in accordance with § 178.345–10(d), except as provided in paragraph (d)(3) of this section.

(d) *Venting capacities.* (1) The vacuum relief system must limit the vacuum to less than 80 percent of the design vacuum capability of the cargo tank.

(2) If pressure loading or unloading devices are provided, the pressure relief system must have adequate vapor and liquid capacity to limit tank pressure to the cargo tank test pressure at the maximum loading or unloading rate. The maximum loading and unloading rates must be included on the metal specification plate.

(3) Cargo tanks used in dedicated service for materials classed as corrosive material, with no secondary hazard, may have a total venting capacity which is less than required by § 178.345–10(e). The minimum total venting capacity for these cargo tanks must be determined in accordance with the following formula (use of approximate values given for the formula is acceptable):

Formula in Nonmetric Units

$$Q = 37{,}980{,}000\ A^{0.82}\ (ZT)^{0.5} / (LC)(M^{0.5})$$

Where:

Q = The total required venting capacity, in cubic meters of air per hour at standard conditions of 15.6 °C and 1 atm (cubic feet of air per hour at standard conditions of 60 °F and 14.7 psia);
T = The absolute temperature of the vapor at the venting conditions—degrees Kelvin (°C+273) [degrees Rankine (°F+460)];
A = The exposed surface area of tank shell—square meters (square feet);
L = The latent heat of vaporization of the lading—calories per gram (BTU/lb);
Z = The compressibility factor for the vapor (if this factor is unknown, let Z equal 1.0);
M = The molecular weight of vapor;
C = A constant derived from (K), the ratio of specific heats of the vapor. If (K) is unknown, let C = 315.

$$C = 520[K(2/(K+1))^{[(K+1)/(K-1)]}]^{0.5}$$

Where:

$K = C_p / C_v$
C_p = The specific heat at constant pressure, in -calories per gram degree centigrade (BTU/lb °F.); and
C_v = The specific heat at constant volume, in -calories per gram degree centigrade (BTU/lb °F.).

[Amdt. 178–89, 54 FR 25032, June 12, 1989, as amended at 55 FR 37065, Sept. 7, 1990; Amdt. 178–104, 59 FR 49135, Sept. 26, 1994. Redesignated by Amdt. 178–112, 61 FR 18934, Apr. 29, 1996; 72 FR 55696, Oct. 1, 2007; 72 FR 59146, Oct. 18, 2007]

§ 178.348–5 Pressure and leakage test.

(a) Each cargo tank must be tested in accordance with § 178.345–13 and this section.

(b) Pressure test. Test pressure must be as follows:

(1) Using the hydrostatic test method, the test pressure must be at least 1.5 times MAWP.

(2) Using the pneumatic test method, the test pressure must be at least 1.5 times tank MAWP, and the inspection pressure is tank MAWP.

[Amdt. 178–89, 54 FR 25032, June 12, 1989. Redesignated by Amdt. 178–112, 61 FR 18934, Apr. 29, 1996]