(iii) Extended around the face of any flange.

(3) Joints and seams in the lining must be made by fusing the material together or by other equally effective means.

[Amdt. 178–65, 46 FR 9895, Jan. 29, 1981, as amended by Amdt. 178–65, 46 FR 24184, Apr. 30, 1981; Amdt. 178–97, 56 FR 66284 and 66287, Dec. 20, 1991; 66 FR 45386, 45389, Aug. 28, 2001]

§ 178.270–3 Materials of construction.

(a) Each portable tank must be constructed of carbon or alloy steels. Materials included in part UHT of the ASME Code or equivalent materials are not authorized. Any materials used in the tank shell must conform to a recognized national standard and must be suitable for the external environments in which the tank will be carried. The minimum elongation for any material must be 20 percent or greater.

(b) The maximum stress allowed for a material shall be determined using one of the following methods:

(1) 1.5 times the specified values for the material at 93 °C (200 °F) in Section VIII, Division 1 of the ASME Code;

(2) Derived by test for the actual yield and tensile strengths at 93 °C (200 °F) for the actual group of plates used to fabricate the tank using the methods described in §178.270–3(d); or

(3) Derived from the minimum yield and tensile strengths at 93 °C (200 °F) specified by the national standard to which the material is manufactured using the methods described in §178.270–3(d).

(c) Maximum allowable stress values, derived for an actual group of plates, that are based on actual tensile and yield strengths of the material at 93 °C (200 °F) shall not be greater than 120 percent of the specified minimum yield and tensile strength specified in the national standard to which the material is manufactured.

(d) The maximum allowable stress values must be derived from the following criteria:

(1) For austenitic steels;

(i) When the yield strength is determined using the 0.2 percent offset, 93.75 percent of the yield strength.

(ii) When the yield strength is determined using the 1.0 percent offset, 75 percent of the yield strength.

(2) For carbon and low alloy steels, the yield strength is determined using the 0.2 percent offset. The maximum allowable stress value is the lower of 93.75 percent of the yield strength or 37.5 percent of the tensile strength.

(e) For purposes of these specifications, tensile strength, yield strength and elongation must be determined using a specimen having a gauge length:

$$L_0 = 5.65(S_0)^{1/2}$$

where:

L_0 = the gauge length of the specimen—millimeters (inches); and

S_0 = the cross sectional area of the specimen—square millimeters (square inches).

Tensile tests and analysis of results must be in accordance with ''ISO 82 Steels-Tensile Testing.'' The yield strength in tension shall be the stress corresponding to a permanent strain of 0.2 percent of the gauge length, except that for high alloy austenitic steels the yield strength shall be the stress corresponding to a permanent strain of 0.2 or 1.0 percent of the gauge length as appropriate. The elongation must be at least 20 percent.

(f) If maximum allowable stress values or minimum tank wall thicknesses are based on the actual yield strength, the actual tensile strength, or the actual elongation for the material used to fabricate the tank, the test records or certification of test results by the material producer or tank manufacturer must be approved by the approval agency, retained by the tank manufacturer for a period not less than 15 years, and made available to any duly identified representative of the Department or the owner of the tank.

[Amdt. 178–65, 46 FR 9895, Jan. 29, 1981, as amended at 64 FR 10782, Mar. 5, 1999]

§ 178.270–4 Structural integrity.

(a) *Maximum stress values.* The maximum calculated stress value in a tank at the Test Pressure must be less than or equal to that specified for the material of construction at 93 °C. (200 °F.) in §178.270–3 of this part.

(b) *Tank shell loadings.* Tank shells, heads, and their fastenings shall be designed to prevent stresses in excess of two thirds those specified in §178.270–3

of this part. The design calculations must include the forces imposed by each of the following loads:

(1) An internal pressure equal to the MAWP less 1 bar (14.5 psig) in combination with the simultaneously applied loadings of 3W vertically downward, 2W longitudinally, and 1W laterally acting through the center of the tank (W is the maximum permissible weight of the loaded tank and its attachments), and the requirements of paragraphs (b) (4), (5) and (6) of this section;

(2) An internal pressure equal to the MAWP less 1 bar (14.5 psig), in combination with the simultaneously applied loadings of 1W vertically upward, 2W longitudinally, and 1W laterally acting through the center of the tank (W is the maximum permissible weight of the loaded tank and its attachment), and the requirements of paragraphs (b) (4), (5) and (6) of this section;

(3) The load on the tank head resulting from an internal pressure equal to the MAWP, less 1 bar (14.5 psig), in combination with the dynamic pressure resulting from a longitudinal deceleration of 2 ''g'', and the requirements of paragraphs (b) (4), (5) and (6) of this section;

(4) Loads resulting from any discontinuities between tank shell and heads;

(5) Superimposed loads such as operating equipment, insulation, linings and piping; and

(6) Reactions of supporting lugs and saddles or other supports.

(c) The shell thickness used in calculating the resulting stress levels in a tank shall be exclusive of any corrosion allowance.

[Amdt. 178–65, 46 FR 9895, Jan. 29, 1981, as amended at 66 FR 45387, Aug. 28, 2001]

§ 178.270–5 Minimum thickness of shells and heads.

(a) For the purposes of this section, mild steel is steel with a guaranteed minimum tensile strength of 37 decanewtons per square millimeter (53,650 p.s.i.) and a guaranteed elongation of 27 percent or greater.

(b) Except as otherwise provided in this subchapter, the shell and heads of each portable tank constructed of reference mild steel:

(1) With a maximum cross-sectional dimension of 1.8 m (5.9 feet) or less, shall be at least 5 mm (0.197 inches) thick; or,

(2) With a maximum cross-sectional dimension exceeding 1.8 m (5.9 feet), shall be at least 6.35 mm (0.250 inches) thick.

(c) The minimum thickness of the shell and heads of each portable tank constructed of a steel other than the reference mild steel, shall be obtained from the following formula:

Formula for metric units

$$e_1 = (10e_0) / (Rm_1\ A_1)^{1/3}$$

Formula for nonmetric units

$$e_1 = (112.3e_0) / (Rm_1\ A_1)^{1/3}$$

where:

e_0 = Required thickness of the reference steel from § 178.270–5(b)—millimeters (inches);

e_1 = Equivalent thickness of the steel used—millimeters (inches);

Rm_1 = Specified minimum tensile strength of the steel used—decanewtons per square millimeter (p.s.i.); and

A_1 = Specified minimum percentage elongation of the steel used—percent times 100 (i.e., if 20% use 20.0).

(d) When other than the standard minimum thickness for the reference mild steel is specified for a tank in this subchapter, the specified minimum shell and head thickness must be at least equal to the larger of the thicknesses calculated from the formula given in § 178.270–5(c) and the following formula:

Formula for metric units

$$e_1 = (10e_0\ d_1) / 1.8(Rm_1\ A_1)^{1/3}$$

Formula for nonmetric units

$$e_1 = (112.3e_0\ d_1) / 5.9(Rm_1\ A_1)^{1/3}$$

where:

e_1 = Equivalent thickness of the steel used—millimeters (inches);

e_0 = The specified minimum shell and head thickness of the reference mild steel specified in the IM Tank Table—millimeters (inches);

d_1 = Actual outside diameter of the tank—m (feet);

Rm_1 = Specified minimum tensile strength of the steel used—decanewtons per square millimeter (p.s.i.); and