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TABLE 2—VALUES FOR STRESS FACTORS

	Nickel steel and carbon manganese steel values	Austenitic steel values	Aluminum alloy values
Stress factors:			
A	4.0	4.0	4.0
B	2.0	1.6	1.5
C	3.0	3.0	3.0
D	1.5	1.5	1.5

(b) An independent tank type B designed from plane surfaces must have allowable stresses specially approved by the Commandant (G–MSO).

[CGD 74–289, 44 FR 26009, May 3, 1979, as amended by CGD 82–063b, 48 FR 4782, Feb. 3, 1983]

§ 154.448 Calculations.

The following calculations for an independent tank type B must be specially approved by the Commandant (G–MSO):

(a) Plastic deformation, fatigue life, buckling, and crack propagation resulting from static and dynamic loads on the tank and its support.

(b) A three-dimensional analysis of the stress exerted by the hull on the tank, its support, and its keys.

(c) The response of the tank and its support to the vessel's motion and acceleration in irregular waves or calculations from a similar vessel.

(d) A tank buckling analysis considering the maximum construction tolerance.

(e) A finite element analysis using the loads determined under § 154.406.

(f) A fracture mechanics analysis using the loads determined under § 154.406.

(g) The cumulative effects of the fatigue load from the following formula:

$$\sum \frac{n_1}{N_1} + \frac{10^3}{N_j} \leq C_w$$

where:

n_i=the number of stress cycles at each stress level during the life of the vessel;
N_i=the number of cycles to failure for corresponding stress levels from the Wohler (S–N) curve;
N_j=the number of cycles to failure from the fatigue load by loading and unloading the tank; and
C_w=0.5 or less. A C_w of greater than 0.5 but not exceeding 1.0 may be specially approved by the Commandant (G–MTH).

[CGD 74–289, 44 FR 26009, May 3, 1979, as amended by CGD 82–063b, 48 FR 4782, Feb. 3, 1983]

§ 154.449 Model test.

The following analyzed data of a model test of structural elements for independent tank type B must be submitted to the Commandant (G–MSO) for special approval:

(a) Stress concentration factors.

(b) Fatigue life.

[CGD 74–289, 44 FR 26009, May 3, 1979, as amended by CGD 82–063b, 48 FR 4782, Feb. 3, 1983]

INDEPENDENT TANK TYPE C AND PROCESS PRESSURE VESSELS

§ 154.450 General.

Independent tanks type C and process pressure vessels must be designed to meet the requirements under Part 54 of this chapter, except § 54.01–40(b), and:

(a) The calculation under § 54.01–18 (b)(1) must also include the design loads determined under § 154.406;

(b) The calculated tank plating thickness, including any corrosion allowance, must be the minimum thickness without a negative plate tolerance; and

(c) The minimum tank plating thickness must not be less than:

(1) 5mm (3/16 in.) for carbon-manganese steel and nickel steel;

(2) 3mm (1/8 in.) for austenitic steels; or

(3) 7mm (9/32 in.) for aluminum alloys.

§ 154.451 Design vapor pressure.

The P_o (kPa) of an independent tank type C must be calculated by the following formula:

$$P_o = 196 + AC(\rho)^{3/2}$$

where:

$A = 1.813\ (\sigma_m/\Delta\sigma_A)^2$;
σ_m=design primary membrane stress;
$\Delta\sigma_A$=(allowable dynamic membrane stress for double amplitude at probability level $Q = 10^{-8}$) 53.9 MPa (7821 psi) for ferritic and martensitic steels and 24.5 MPa (3555 psi) for 5083–0 aluminum;
C=a characteristic tank dimension that is the greatest of h, 0.75b, or 0.45 l;

where:

h=the height of the tank or the dimension in the vessel's vertical direction, in meters;
b=the width of the tank or the dimension in the vessel's transverse direction; in meters; and
l=the length of the tank or the dimension in the vessel's longitudinal direction, in meters; and
ρ=the specific gravity of the cargo.

§ 154.452 External pressure.

The design external pressure, P_e, for an independent tank type C must be calculated by the following formula:

$$P_e = P_1 + P_2 + P_3 + P_4$$

where:

P_1=the vacuum relief valve setting for tanks with a vacuum relief valve, or 24.5 kPa gauge (3.55 psig) for tanks without a vacuum relief valve.
P_2=0, or the pressure relief valve setting for an enclosed space containing any portion of a pressure vessel.
P_3=total compressive load in the tank shell from the weight of the tank, including corrosion allowance, weight of insulation, weight of dome, weight of pipe tower and piping, the effect of the partially filled tank, the effect of acceleration and hull deflection, and the local effect of external and internal pressure.
P_4=0, or the external pressure from the head of water from any portion of the pressure vessel on exposed decks.

§ 154.453 Failure to meet independent tank type C standards.

If the Commandant (G–MSO) determines during plan review, that a tank designed as an independent tank type C fails to meet the standards under § 154.450, § 154.451, and 154.452 and can not be redesigned to meet those standards, the tank may be redesigned as an independent tank type A or B.

[CGD 74–289, 44 FR 26009, May 3, 1979, as amended by CGD 82–063b, 48 FR 4782, Feb. 3, 1983]

SECONDARY BARRIER

§ 154.459 General.

(a) Each cargo tank must have a secondary barrier that meets Table 3 and except as allowed in Table 3, the hull must not be the secondary barrier.

(b) If the Commandant (G–MSO) specially approves an integral tank for a design temperature at atmospheric pressure lower than −10° C (14°F), the integral tank must have a complete secondary barrier that meets § 154.460.

(c) If the Commandant (G–MSO) specially approves a semi-membrane tank under the requirements of an independent tank type B, the semi-membrane tank may have a partial secondary barrier specially approved by the Commandant (G–MSO).

(d) If Table 3 allows the hull to be a secondary barrier, the vessel's hull must:

(1) Meet §§ 154.605 through 154.630; and

(2) Be designed for the stresses resulting from the design temperature.

TABLE 3—SECONDARY BARRIERS FOR TANKS

Tank type	Cargo temperature (T) at atmospheric pressure		
	T≥ −10°C (14°F)	T<–10°C (14°F)≥55°C (−67°F)	T< −55°C (−67°F)
Integral	No secondary barrier required	Tank type not usually allowed[1]	Tank type not allowed.
Membrane	...do	Complete secondary barrier[1]	Complete secondary barrier.
Semi-membrane	...do	...do	Do.
Independent:			
Type A	...do	...do	Do.
Type B	...do	Partial secondary barrier[1]	Partial secondary barrier.
Type C	...do	No secondary barrier required	No secondary barrier required.

[1] The hull may be a secondary barrier.

(14 U.S.C. 632; 46 U.S.C. 369, 375, and 416; 49 U.S.C. 1655(b); 49 CFR 1.46(b))
[CGD 74–289, 44 FR 26009, May 3, 1979, as amended by CGD 82–063b, 48 FR 4782, Feb. 3, 1983]