SEMI-MEMBRANE TANKS

§ 154.435 General.

(a) The design of a semi-membrane tank, the supporting insulation for the tank, and the supporting hull structure for the tank must be specially approved by the Commandant (CG–522).

(b) A semi-membrane tank must be designed to meet:

(1) § 154.425 through § 154.432;

(2) § 154.437 through § 154.440; or

(3) § 154.444 through § 154.449.

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

§ 154.436 Design vapor pressure.

The P_o of a semi-membrane tank must not exceed 24.5 kPa gauge (3.55 psig) unless special approval by the Commandant (CG–522) allows a P_o between 24.5 kPa gauge (3.55 psig) and 69 kPa gauge (10 psig).

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

INDEPENDENT TANK TYPE A

§ 154.437 General.

An independent tank type A must meet § 154.438 through § 154.440.

§ 154.438 Design vapor pressure.

(a) If the surface of an independent tank type A are mostly flat surfaces,the P_o must not exceed 69 kPa gauge (10 psig).

(b) If the surfaces of an independent tank type A are formed by bodies of revolution, the design calculation of the P_o must be specially approved by the Commandant (CG–522).

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

§ 154.439 Tank design.

An independent tank type A must meet the deep tank standard of the American Bureau of Shipping published in ''Rules for Building and Classing Steel Vessels'', 1981, and must:

(a) Withstand the internal pressure determined under § 154.407;

(b) Withstand loads from tank supports calculated under §§ 154.470 and 154.471; and

(c) Have a corrosion allowance that meets § 154.412.

[CGD 74–289, 44 FR 26009, May 3, 1979, as amended by CGD 77–069, 52 FR 31630, Aug. 21, 1987]

§ 154.440 Allowable stress.

(a) The allowable stresses for an independent tank type A must:

(1) For tank web frames, stringers, or girders of carbon manganese steel or aluminum alloys, meet $\sigma_B/2.66$ or $\sigma_Y/1.33$, whichever is less; and

(2) For other materials, be specially approved by the Commandant (CG–522).

(b) A greater allowable stress than required in paragraph (a)(1) of this section may be specially approved by the Commandant (CG–522) if the equivalent stress (σ_c) is calculated from the formula in Appendix A of this part.

(c) Tank plating must meet the American Bureau of Shipping's deep tank standards, for an internal pressure head that meets § 154.439(a), published in ''Rules for Building and Classing Steel Vessels'', 1981.

[CGD 74–289, 44 FR 26009, May 3, 1979, as amended by CGD 82–063b, 48 FR 4782, Feb. 3, 1983; CGD 77–069, 52 FR 31630, Aug. 21, 1987]

INDEPENDENT TANK TYPE B

§ 154.444 General.

An independent tank type B must be designed to meet §§ 154.445 through 154.449.

§ 154.445 Design vapor pressure.

If the surfaces of an independent tank type B are mostly flat surfaces, the P_o must not exceed 69 kPa gauge (10 psig).

§ 154.446 Tank design.

An independent tank type B must meet the calculations under § 154.448.

§ 154.447 Allowable stress.

(a) An independent tank type B designed from bodies of revolution must have allowable stresses[3] determined by the following formulae:

[3] See Appendix B for stress analyses definitions.

$\sigma_m \leq f$

$\sigma_L \leq 1.5\ f$

$\sigma_b \leq 1.5\ F$

$\sigma_L + \sigma_b \leq 1.5\ F$

$\sigma_m + \sigma_b \leq 1.5\ F$

where:

σ_m=equivalent primary general membrane stress [4]

σ_L=equivalent primary local membrane stress [4]

σ_b=equivalent primary bending stress [4]

f=the lesser of (σ_B/A) or (σ_Y/B)

F=the lesser of (σ_B/C) or (σ_Y/D)

A, B, C, and D=stress factors in Table 2.

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 (CG–522).

[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 (CG–522):

(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 (CG–522) 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.

[4] See Appendix A for equivalent stress.