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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]

§ 154.426 Design vapor pressure.

The P_o of a membrane tank must not exceed 24.5 kPa gauge (3.55 psig) unless special approval by the Commandant (G–MSO) 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]

§ 154.427 Membrane tank system design.

A membrane tank system must be designed for:

(a) Any static and dynamic loads with respect to plastic deformation and fatigue;

(b) Combined strains from static, dynamic, and thermal loads;

(c) Preventing collapse of the membrane from:

(1) Over-pressure in the interbarrier space;

(2) Vacuum in the cargo tank;

(3) Sloshing in a partially filled cargo tank; and

(4) Hull vibrations; and

(d) The deflections of the vessel's hull.

§ 154.428 Allowable stress.

The membrane tank and the supporting insulation must have allowable stresses that are 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]

§ 154.429 Calculations.

The tank design load calculations for a membrane tank must include the following:

(a) Plastic deformation and fatigue life resulting from static and dynamic loads in the membrane and the supporting insulation.

(b) The response of the membrane and its supporting insulation to vessel motion and acceleration under the worst weather conditions. Calculations from a similar vessel may be submitted to meet this paragraph.

(c) The combined strains from static, dynamic, and thermal loads.

§ 154.430 Material test.

(a) The membrane and the membrane supporting insulation must be made of materials that withstand the combined strains calculated under § 154.429(c).

(b) Analyzed data of a material test for the membrane and the membrane supporting insulation must be submitted to 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]

§ 154.431 Model test.

(a) The primary and secondary barrier of a membrane tank, including the corners and joints, must withstand the combined strains from static, dynamic, and thermal loads calculated under § 154.429(c).

(b) Analyzed data of a model test for the primary and secondary barrier of the membrane tank must be submitted to 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]

§ 154.432 Expansion and contraction.

The support system of a membrane tank must allow for thermal and physical expansion and contraction of the tank.

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 (G–MSO).

(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 (G–MSO) 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 (G–MSO).

[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 $\sigma\mathbf{B}/2.66$ or $\sigma\mathbf{Y}$ 1.33, whichever is less; and

(2) For other materials, be specially approved by the Commandant (G–MSO).

(b) A greater allowable stress than required in paragraph (a)(1) of this section may be specially approved by the Commandant (G–MSO) if the equivalent stress ($\sigma\mathbf{c}$) 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:

$\sigma_m \leq f$
$\sigma_L \leq 1.5\ f$
$\sigma_b \leq 1.5\ F$
$\sigma_L + \sigma\mathbf{b} \leq 1.5\ F$
$\sigma_m + \sigma\mathbf{b} \leq 1.5\ F$

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.

[3] See Appendix B for stress analyses definitions.

[4] See Appendix A for equivalent stress.