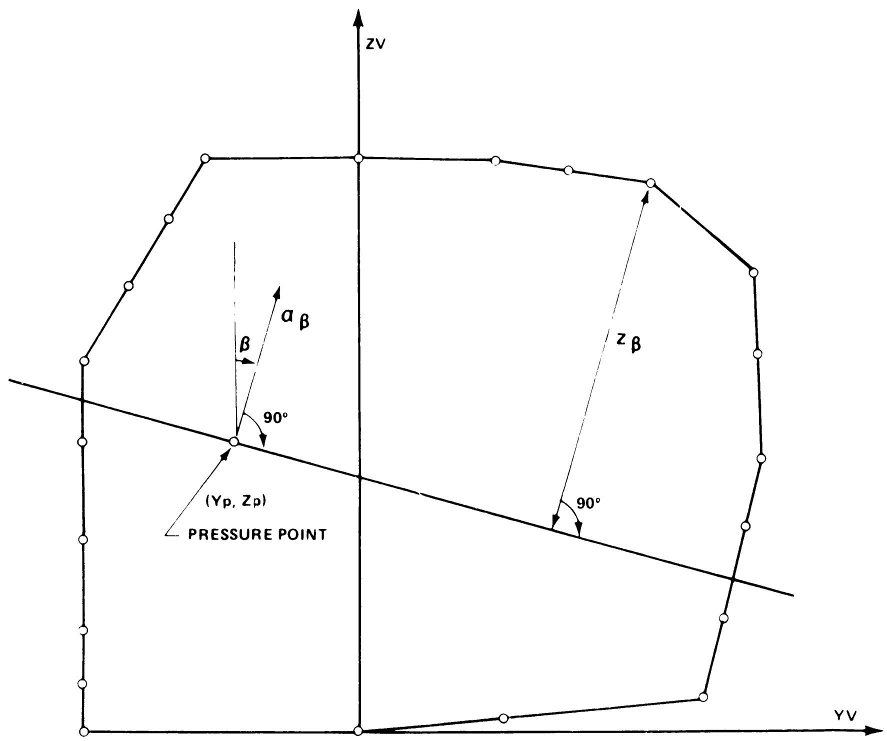


NOTE: LARGEST LIQUID HEIGHT ABOVE THE POINT WHERE THE PRESSURE IS DETERMINED = Z_β

Figure 2. Determination of Internal Pressure Heads

(b) The $(h_{gd})_{max}$ is determined for the β direction, on the ellipse in Figure 1, which gives the maximum value for h_{gd}.

(c) When the longitudinal acceleration is considered in addition to the vertical transverse acceleration, an ellipsoid must be used in the calculations instead of the ellipse contained in Figure 1.

§ 154.408 Cargo tank external pressure load.

For the calculation required under § 154.406 (a)(2) and (b), the external pressure load must be the difference between the minimum internal pressure (maximum vacuum), and the maximum external pressure to which any portion of the cargo tank may be simultaneously subjected.

§ 154.409 Dynamic loads from vessel motion.

(a) For the calculation required under § 154.406 (a)(3) and (b), the dynamic loads must be determined from the long term distribution of vessel motions, including the effects of surge, sway, heave, roll, pitch, and yaw on irregular seas that the vessel may experience during 10^8 wave encounters. The speed used for this calculation may be reduced from the ship service speed if specially approved by the Commandant

(CG–522) and if that reduced speed is used in the hull strength calculation under § 31.10–5(c) of this chapter.

(b) If the loads determined under paragraphs (c), (d), or (e) of this section result in a design stress that is lower than the allowable stress of the material under §§ 154.610, 154.615, or 154.620, the allowable stress must be reduced to that stress determined in paragraphs (c), (d), or (e).

(c) If a tank is designed to avoid plastic deformation and buckling, then acceleration components of the dynamic loads must be determined for the largest loads the vessel may experience during an operating life corresponding to the probability level of 10^{-8}, by using one of the following methods:

(1) Method 1 is a detailed analysis of the vessel's acceleration components.

(2) Method 2 applies to vessels of 50 m (164 ft) or more in length and is an analysis by the following formulae that corresponds to a 10^{-8} probability level in the North Atlantic:

(i) Vertical acceleration under paragraph (f)(1) of this section:

$$a_z = \pm a_o \sqrt{1 + \left(5.3 - \frac{45}{L_o}\right)^2 \left(\frac{x}{L_o} + 0.05\right)^2 \left(\frac{0.6}{C_B}\right)^{3/2}}$$

(ii) Transverse acceleration under § 154.409(f)(2):

$$a_y = \pm a_o \sqrt{0.6 + 2.5\left(\frac{x}{L_o} + 0.05\right)^2 + K\left(1 + 0.6K\frac{z}{B}\right)^2}$$

(iii) Longitudinal acceleration under § 154.409(f)(3):

$$a_x = \pm a_o \sqrt{0.06 + A^2 - 0.25A}$$

where:

$$A = \left(0.7 - \frac{L_o}{1200} + 5\frac{z}{L_o}\right)\left(\frac{0.6}{C_B}\right)$$

L_o = the distance in meters on the estimated summer loadline, from the fore side of the stem to the after side of the rudder-post or sternpost; where there is no rudderpost or sternpost, L_o is to be measured to the centerline of the rudder stock, but in any case

L_o is not to be less than 96% and need not be greater than 97% of the length on the summer loadline.

C_B = block coefficent.

B = greatest moulded breadth, in meters.

x = longitudinal distance, in meters, from amidships to the center of gravity of the tank with contents (positive - forward of amidships. negative - aft of amidships).

z = vertical distance in meters, from the vessel's waterline, to center of gravity of tank with contents (positive - above, and negative - below the waterline).

$$a_o = 0.2 \frac{V}{\sqrt{L_o}} + \frac{34-(600/L_o)}{L_o}$$

V = service speed in knots.

K = 1.0 OR $\frac{13GM}{B}$, whichever is greater.

GM = metacentric height in meters.

a_x = the maximum dimensionless acceleration in the x direction, acting separately for calculation purposes, and includes the component of the static weight in the longitudinal direction due to pitching.

a_y = maximum dimensionless acceleration in the y direction, acting separately for calculation purposes, and includes the component of static weight in the transverse direction due to rolling.

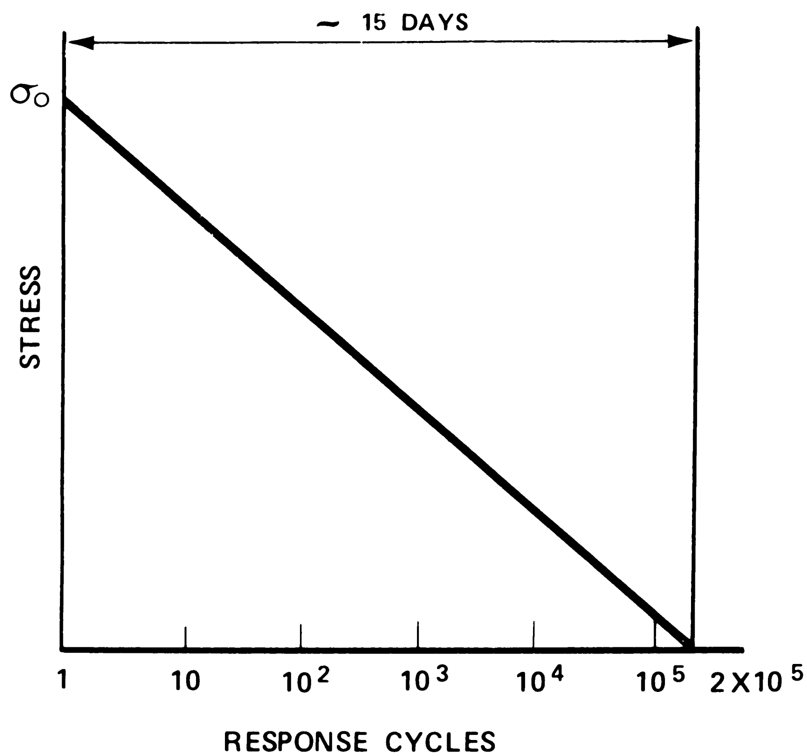
a_z = maximum dimensionless acceleration in the z direction, acting separately for calculation purposes, not including the static weight.

(d) If a cargo tank is designed to avoid fatigue, the dynamic loads determined under paragraph (a) of this section must be used to develop the dynamic spectrum.

(e) If a cargo tank is designed to avoid uncontrolled crack propagation, the dynamic loads are:

(1) Determined under paragraph (a) of this section; and

(2) For a load distribution for a period of 15 days by the method in Figure 3.



NOTE: σ_O = MOST PROBABLE MAXIMUM STRESS DURING THE LIFE OF THE VESSEL.

RESPONSE CYCLE SCALE IS LOGARITHMIC.

THE VALUE OF 2×10^5 IS GIVEN AS AN EXAMPLE OF ESTIMATE.

Figure 3. Simplified Load Distribution

(f) When determining the accelerations for dynamic loads under paragraph (a) of this section, the accelerations acting in a cargo tank must be estimated for the cargo tank's center of gravity and include the following component accelerations:

(1) Vertical accelerations, meaning the motion acceleration of heave and pitch, and of any roll normal to the vessel base that has an effect on the component acceleration.

(2) Transverse acceleration, meaning the motion acceleration of sway, yaw and roll, and gravity component of roll.

(3) Longitudinal acceleration, meaning the motion acceleration of surge and pitch and gravity component of pitch.

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

§ 154.410 Cargo tank sloshing loads.

(a) For the calculation required under § 154.406 (a)(5) and (b), the determined sloshing loads resulting from the accelerations under § 154.409(f) must be specially approved by the Commandant (CG–522).

(b) If the sloshing loads affect the cargo tank scantlings, an analysis of the effects of the sloshing loads in addition to the calculation under paragraph (a) of this section 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]

§ 154.411 Cargo tank thermal loads.

For the calculations required under § 154.406(a)(4), the following determined loads must be specially approved by the Commandant (CG–522):

(a) Transient thermal loads for the cooling down periods of cargo tanks for design temperatures lower than −55 °C (−67 °F).

(b) Stationary thermal loads for cargo tanks for design temperatures lower than −55 °C (−67 °F) that cause high thermal stress.

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

§ 154.412 Cargo tank corrosion allowance.

A cargo tank must be designed with a corrosion allowance if the cargo tank:

(a) is located in a space that does not have inert gas or dry air; or

(b) carries a cargo that corrodes the tank material.

NOTE: Corrosion allowance for independent tank type C is contained in § 54.01–35 of this chapter.

INTEGRAL TANKS

§ 154.418 General.

An integral tank must not be designed for a temperature colder than −10 °C (14 °F), unless the tank is 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]

§ 154.419 Design vapor pressure.

The P_o of an integral 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]

§ 154.420 Tank design.

(a) The structure of an integral tank must meet the deep tank scantling standards of the American Bureau of Shipping published in ''Rules for Building and Classing Steel Vessels'', 1981.

(b) The structure of an integral tank must be designed and shown by calculation to withstand the internal pressure determined under § 154.407.

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

§ 154.421 Allowable stress.

The allowable stress for the integral tank structure must meet the American Bureau of Shipping's allowable stress for the vessel's hull published in