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(4) Be segregated from the cargo piping by a removable spool piece in the cargo area or by at least two shut-off valves in the cargo area that have means of locking to meet § 154.1870(a);

(5) Have a means for checking for cargo vapor between the two valves under paragraph (a)(4) of this section;

(6) Have fixed inert gas purging lines; and

(7) Have fixed vent lines for purging with inert gas to meet § 154.1870(b).

(b) Entrances, forced or natural ventilation intakes, exhausts, and other openings to accommodation, service, or control spaces that face the bow or stern loading area must meet § 154.330.

### § 154.356 Cargo emergency jettisoning piping.

Emergency jettisoning piping must:

(a) Meet § 154.355(a);

(b) Be designed to allow cargo discharge without the outer hull steel temperature falling below the minimum temperatures under §§ 154.170 and 154.172; and

(c) 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]

## CARGO CONTAINMENT SYSTEMS

### § 154.401 Definitions.

As used in §§154.440 and 154.447:

''**σY**'' means the minimum yield strength of the tank material, including weld metal, at room temperature.

''**σB**'' means minimum tensile strength of the tank material, including weld metals, at room temperature.

### § 154.405 Design vapor pressure ($P_o$) of a cargo tank.

(a) The design vapor pressure ($P_o$) of a cargo tank must be equal to or greater than the MARVS.

(b) The $P_o$ of a cargo tank must be equal to or greater than the vapor pressure of the cargo at 45° C (113°F) if:

(1) The cargo tank has no temperature control for the cargo; and

(2) The vapor pressure of the cargo results solely from ambient temperature.

(c) The $P_o$ of a cargo tank may be exceeded under harbor conditions if 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]

### § 154.406 Design loads for cargo tanks and fixtures: General.

(a) Calculations must show that a cargo tank and its fixtures are designed for the following loads:

(1) Internal pressure head.

(2) External pressure load.

(3) Dynamic loads resulting from the motion of the vessel.

(4) Transient or stationary thermal loads if the design temperature is colder that −55°C (−67°F) or causes thermal stresses in cargo tank supports.

(5) Sloshing loads, if the cargo tank is designed for partial loads.

(6) Loads resulting from vessel's deflection.

(7) Tank weight, cargo weight, and corresponding support reaction.

(8) Insulation weight.

(9) Loads of a pipe tower and any other attachments to the cargo tank.

(10) Vapor pressure loads in harbor conditions allowed under § 154.405.

(11) Gas pressurization if the cargo tank is designed for gas pressurization as a means of cargo transfer.

(b) A cargo tank must be designed for the most unfavorable static heel angle within a 0° to 30° range without exceeding the allowable stress of the material.

(c) A hydrostatic or hydropneumatic test design load 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]

### § 154.407 Cargo tank internal pressure head.

(a) For the calculation required under § 154.406(a)(1) and (b), the internal pressure head ($h_{eq}$), must be determined from the following formula:

$h_{eq}=10\ P_o+(h_{gd})_{max}$

where:

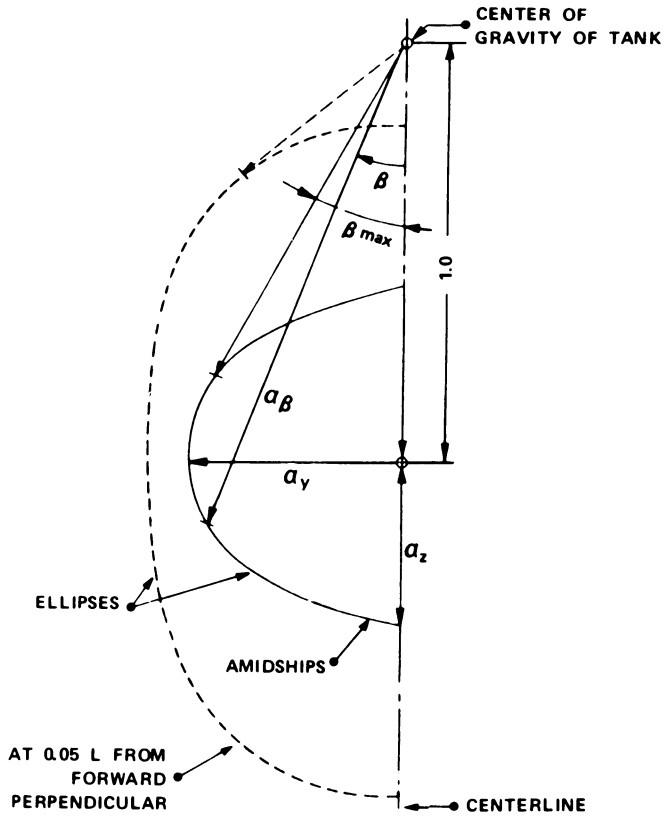
$h_{gd}$ (the value of internal pressure, in meters of fresh water, resulting from the combined effects of gravity and dynamic accelerations of a full tank)$=a_\beta\ Z_\beta\ Y$;

where:

$a_\beta$=dimensionless acceleration relative to the acceleration of gravity resulting from gravitational and dynamic loads in the $\beta$ direction (see figure 1);

$Z_\beta$=largest liquid height (m) above the point where the pressure is to be determined in the $\beta$ direction (see figure 2);

Y=maximum specific weight of the cargo (t/$m^3$) at the design temperature.

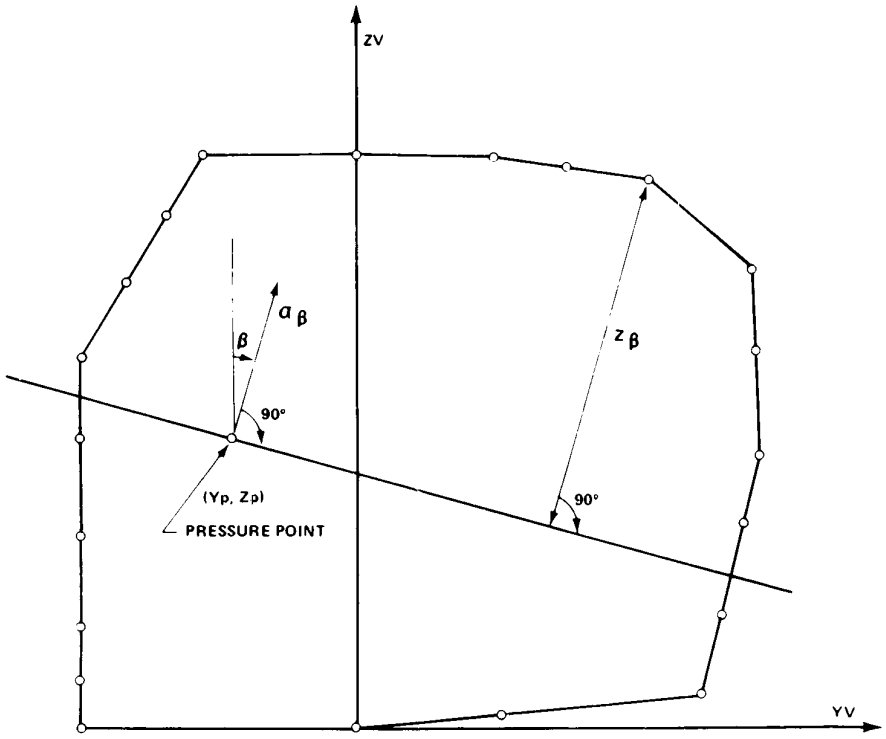



NOTE: RESULTING ACCELERATION (STATIC + DYNAMIC) = $a_\beta$ IN ARBITRARY DIRECTION $\beta$.

$a_y$ = TRANSVERSE COMPONENT OF ACCELERATION.

$a_z$ = VERTICAL COMPONENT OF ACCELERATION.

Figure 1. Acceleration Ellipse




NOTE: LARGEST LIQUID HEIGHT ABOVE THE POINT WHERE THE PRESSURE IS DETERMINED = $Z_\beta$

Figure 2. Determination of Internal Pressure Heads

(b) The $(h_{gd})_{max}$ is determined for the $\beta$ 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