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described in paragraph (e) of the definition for ''gas-dangerous space'' in §154.7, must—

(1) Have a clear opening of at least 600 mm by 600 mm (23.6 in. by 23.6 in.) through horizontal openings, hatches, or manholes;

(2) Have a clear opening of at least 600 mm by 800 mm (23.6 in. by 31.5 in.) through bulkheads, frames or other vertical structural members; and

(3) Have a fixed ladder if the lower edge of a vertical opening is more than 600 mm (23.6 in.) above the deck or bottom plating.

(c) Each access trunk in the cargo area must be at least 760 mm (30 in.) in diameter.

(d) The lower edge of each access from the weather deck to gas-safe spaces in the cargo area must be at least 2.4 m (7.9 ft.) above the weather deck or the access must be through an air lock that meets §154.345.

(e) The inner hull in the cargo area must be accessible for inspection from at least one side without the removal of any fixed structure or fitting.

(f) The hold space insulation in the cargo area must be accessible for inspection from at least one side from within the hold space or there must be a means, that is specially approved by the Commandant, of determining from outside the hold space whether or not the hold space insulation meets this part.

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

### §154.345 Air locks.

(a) An air lock may be used for access from a gas-dangerous zone on the weather deck to a gas-safe space.

(b) Each air lock must:

(1) Consist of two steel doors, at least 1.5 m (4.9 ft.) but not more than 2.5 m (8.2 ft.) apart, each gasketed and tight when tested with a fire hose at not less 207 kPa gauge (30 psig);

(2) Have self-closing doors with no latches or other devices for holding them open;

(3) Have an audible and visual alarm on both sides which are actuated when both door securing devices are in other than the fully closed position at the same time;

(4) Have mechanical ventilation in the space between the doors from a gas-safe area;

(5) Have a pressure greater than that of the gas-dangerous area on the weather deck;

(6) Have the rate of air change in the space between the doors of at least 8 changes per hour; and

(7) Have the space between the doors monitored for cargo vapor leaks under §154.1350.

(c) In addition to the requirements of paragraphs (a) and (b) of this section, no gas-safe space on a liquefied flammable gas carrier may have an air lock unless the space:

(1) Is mechanically ventilated to make the pressure in the space greater than that in the air lock; and

(2) Has a means of automatically de-energizing all electrical equipment that is not explosion-proof in the space when the pressure in the space falls to or below the pressure in the air lock.

### §154.350 Bilge and ballast systems in the cargo area.

(a) Hold, interbarrier, and insulation spaces must have a means of sounding the space or other means of detecting liquid leakage specially approved by the Commandant (G–MSO).

(b) Each hold and insulation space must have a bilge drainage system.

(c) Interbarrier spaces must have an eductor or pump for removing liquid cargo and returning it to the cargo tanks or to an emergency jettisoning system meeting §154.356.

(d) Spaces in the cargo containment portion of the vessel, except ballast spaces and gas-safe spaces, must not connect to pumps in the main machinery space.

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

### §154.355 Bow and stern loading piping.

(a) Bow and stern loading piping must:

(1) Meet §154.310;

(2) Be installed in an area away from the accommodation, service, or control space on type IG hulls;

(3) Be clearly marked;

(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:

''$\sigma$**Y**'' means the minimum yield strength of the tank material, including weld metal, at room temperature.

''$\sigma$**B**'' 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: