§ 151.13–5 Cargo segregation—tanks.

(a) The configurations listed in this paragraph refer to the separation of the cargo from its surroundings and list the various degrees of segregation required. Paragraphs and (2) of this section explain the symbols used in lines 1 and 2, in order, under the tank segregation column of Table 151.05.

(1) Segregation of cargo from surrounding waters (Line 1 of Table 151.05).

i=Skin of vessel (single skin) only required. Cargo tank wall can be vessel's hull.
ii=Double skin required. Cargo tank wall cannot be vessel's hull.
NA=Nonapplicable for this case. Independent tanks already have such segregation built in through design.

(2) Segregation of cargo space from machinery spaces and other spaces which have or could have a source of ignition (Line 2 of Table 151.05).

i=Single bulkhead only required. Tank wall can be sole separating medium.
ii=Double bulkhead, required. Cofferdam, empty tank, pumproom, tank with Grade E Liquid (if compatible with cargo) is satisfactory.

(b) [Reserved]

(c) If a cofferdam is required for segregation purposes and a secondary barrier is required for low temperature protection by §151.15–3(d)(4), the void space between the primary and secondary barriers shall not be acceptable in lieu of the required cofferdam.

[CGFR 70–10, 35 FR 3714, Feb. 25, 1970, as amended by CGD 75–59, 45 FR 70273, Oct. 23, 19805; CGD 96–041, 61 FR 50731, Sept. 27, 1996]

Subpart 151.15—Tanks

§ 151.15–1 Tank types.

This section lists the definitions of the various tank types required for cargo containment by Table 151.05.

(a) *Integral.* A cargo containment envelope which forms a part of the vessel's hull in which it is built, and may be stressed in the same manner and by the same loads which stress the contiguous hull structure. An integral tank is essential to the structural completeness of its vessel's hull.

(b) *Independent.* A cargo containment envelope which is not a contiguous part of the hull structure. An independent tank is built and installed so as to eliminate, wherever possible (or, in any event, to minimize) its stressing as a result of stressing or motion of the adjacent hull structure. In general, therefore, motion of parts of the tank relative to the adjacent hull structure is possible. An independent tank is not essential to the structural completeness of its carrying vessel's hull.

(c) *Gravity.* Tanks having a design pressure (as described in Part 54 of this chapter) not greater than 10 pounds per square inch gauge and of prismatic shape or other geometry where stress analysis is neither readily nor completely determinate. (Integral tanks are of the gravity type.)

(d) *Pressure.* Independent tanks whose design pressure (as described in Part 54 of this chapter) is above 10 pounds per square inch gauge and fabricated in accordance with part 54, of this chapter. Independent gravity tanks which are of normal pressure vessel configuration (i.e., bodies of revolution, in which the stresses are readily determinate) shall be classed as pressure vessel type tanks even though their maximum allowable working pressure is less than 10 pounds per square inch gauge. Pressure vessel tanks shall be of Classes I, I-L, II, II-L, or III, as defined in subchapter F of this chapter.

§ 151.15–3 Construction.

This section lists the requirements for construction of the types of cargo tanks defined in §151.15–1.

(a) *Gravity type tanks.* Gravity type cargo tanks vented at a pressure of 4 pounds per square inch gauge or less shall be constructed and tested as required by standards established by the American Bureau of Shipping or other recognized classification society. Gravity type tanks vented at a pressure exceeding 4 but not exceeding 10 pounds per square inch gauge will be given special consideration by the Commandant.

(b) *Pressure vessel type tanks.* Pressure vessel type tanks shall be designed and tested in accordance with the requirements of Part 54 of this chapter.

(1) Uninsulated cargo tanks, where the cargo is transported, at or near ambient temperatures, shall be designed for a pressure not less than the vapor pressure of the cargo at 115 °F. The design shall also be based on the minimum internal pressure (maximum vacuum), plus the maximum external static head to which the tank may be subjected.

(2) When cargo tanks, in which the cargo is transported at or near ambient temperature, are insulated with an insulation material of a thickness to provide a thermal conductance of not more than 0.075 B.t.u. per square foot per degree Fahrenheit differential in temperature per hour, the tanks shall be designed for a pressure of not less than the vapor pressure of the cargo at 105 °F. The insulation shall also meet the requirements of paragraph (f) of this section.

(3) Cargo tanks in which the temperature is maintained below the normal atmospheric temperature by refrigeration or other acceptable means shall be designed for a pressure of not less than 110 percent of the vapor pressure corresponding to the temperature of the liquid at which the system is maintained, or the pressure corresponding to the greatest dynamic and static loads expected to be encountered in service. For mechanically stressed relieved cargo tanks, additional factors relating design pressure and maximum allowable pressure shall be as specified by the Commandant. The material of the tank shall meet the material requirements specified in part 54 of this chapter for the service temperature, and this temperature shall be permanently marked on the tank as prescribed in §54.10–20 of this chapter.

(4) The maximum allowable temperature of the cargo is defined as the boiling temperature of the liquid at a pressure equal to the setting of the relief valve.

(5) The service temperature is the minimum temperature of a product at which it may be contained, loaded and/or transported. However, the service temperature shall in no case be taken higher than given by the following formula.

$$t_z = t_w - 0.25(t_w - t_B)$$

where:

t_z=Service temperature.

t_w=Boiling temperature of gas at normal working pressure of container but not higher than +32 °F.

t_B=Boiling temperature of gas at atmospheric pressure.

Under normal circumstances, only temperatures due to refrigerated service will be considered in determining the service temperature. Refrigerated service for purposes of this paragraph is defined as service where the temperature is controlled in the process rather than being caused by atmospheric conditions.

(6) Heat transmission studies, where required, shall assume the minimum ambient temperatures of 0 °F still air and 32 °F still water, and maximum ambient temperatures of 115 °F still air and 90 °F still water.

(7) Where applicable, the design of the cargo tanks shall investigate the thermal stresses induced in the tanks at the service temperature.

(8) Calculations showing the stress level in the tanks under dynamic loading conditions for ocean service barges (see §151.10–20(b)(4)) and grounding conditions for inland service barges (see §151.10–20–(b)(2)) shall be submitted to the Commandant for approval. These calculations shall take into account the local stresses due to the interaction between the barge hull and the tanks.

(c) *High density cargo.* Cargoes with a specific gravity greater than that for which the scantlings of the tank are designed may be carried provided that:

(1) The maximum cargo weight (tons) in a specific tank does not exceed the maximum cargo weight (tons) endorsed on the certificate of inspection.

(2) The scantlings of the tank are sufficient to prevent rupture under a full head of the higher density cargo. Scantlings meeting ordinary bulkhead requirements for the full head will satisfy this requirement.

(d) *Arrangements*—(1) *Collision protection.* (i) Tanks containing cargoes which are required to be carried in Type I hulls by Table 151.05 shall be located a minimum of 4 feet inboard from the side shell and box end of the vessel. Tanks containing cargoes which are required to be carried in Type II

hulls by Table 151.05 shall be located a minimum of 3 feet inboard from the side shell and box end of the vessel.

(ii) All independent cargo tanks installed on Type I or Type II barge hulls shall be protected with suitable collision chocks or collision straps. A longitudinal collision load of one and one half times the combined weight of the tank and the cargo shall be assumed. All other independent cargo tanks shall be provided with suitable collision chocks or collision straps assuming a longitudinal collision load equal to the combined weight of the tank and the cargo. The design bearing stress shall not exceed 2 times the yield strength or 1.5 times the minimum ultimate strength, whichever is less.

(iii) Tanks containing cargoes, which are required to be carried in Type I or Type II hulls by Table 151.05, shall be located a minimum of 25 feet from the head log at the bow. Box barges and trail barges need not comply with this requirement.

(2) *Inspection clearances.* The distance between tanks or between a tank and the vessel's structure shall be such as to provide adequate access for inspection and maintenance of all tank surfaces and hull structure; but shall not normally be less than 15 inches except in way of web frames or similar major structural members where the minimum clearance shall be equal to the flange or faceplate width.

(3) *Access openings.* Each tank shall be provided with at least a 15″×18″ diameter manhole, fitted with a cover located above the maximum liquid level as close as possible to the top of the tank. Where access trunks are fitted to tanks, the diameter of the trunks shall be at least 30 inches.

(4) *Low temperature protection.* (i) When low temperature cargoes are to be carried in gravity type tanks at a temperature lower than that for which the hull steel is adequate, a secondary barrier designed to contain leaked cargo temporarily shall be provided. The design of the cargo containment system shall be such that under normal service conditions, or upon failure of the primary tank, the hull structure shall not be cooled down to a temperature which is unsafe for the materials involved. The secondary barrier and structural components of the hull which may be exposed to low temperatures shall meet the material requirements (i.e., chemistry and physical properties) specified in part 54 of this chapter for the service temperature involved. Heat transmission studies and tests may be required to demonstrate that the structural material temperatures in the hull are acceptable.

(ii) The design shall take into consideration the thermal stresses induced in the cargo tank at the service temperature during loading.

(iii) Where necessary, devices for spray loading or other methods of precooling or cooling during loading shall be included in the design.

(iv) Pressure-vessel type tanks shall be radiographed in accordance with the requirements of part 54 of this chapter. For gravity type tanks, all weld intersections or crossings in joints of primary tank shells shall be radiographed for a distance of 10 thicknesses from the intersection. All other welding in the primary tank and in the secondary barrier, shall be spot radiographed in accordance with the requirements specified in part 54 of this chapter for Class II-L pressure vessels.

(v) For nonpressure vessel type containment systems, access shall be arranged to permit inspection one side each of the primary tank and secondary barrier, under normal shipyard conditions. Containment systems which, because of their peculiar design, cannot be visually inspected to this degree, may be specially considered provided an equivalent degree of safety is attained.

(e) *Installation of cargo tanks.* (1) Cargo tanks shall be supported on foundations of steel or other suitable material and securely anchored in place to prevent the tanks from shifting when subjected to external forces. Each tank shall be supported so as to prevent the concentration of excessive loads on the supporting portions of the shell or head.

(2) Foundations, and stays where required, shall be designed for support and constraint of the weight of the full tank, and the dynamic loads imposed thereon. Thermal movement shall also be considered.

(3) Foundations and stays shall be suitable for the temperatures they will experience at design conditions.

(4) Cargo tanks may be installed ''on deck,'' ''under deck,'' or with the tanks protruding through the deck. All tanks shall be installed with the manhole openings located in the open above the weather deck. Provided an equivalent degree of safety is attained, the Commandant may approve cargo tanks installed with manhole openings located below the weather deck. Where a portion of the tank extends above the weather deck, provision shall be made to maintain the weathertightness of the deck, except that the weathertightness of the upper deck need not be maintained on:

(i) Vessels operating on restricted routes which are sufficiently protected; or,

(ii) Open hopper type barges of acceptable design.

(5) No welding shall be performed on tanks which require and have been stress relieved unless authorized by the Commandant.

(f) *Materials.* (1) Materials used in the construction of cargo tanks shall be suitable for the intended application and shall be in accordance with the applicable requirements of part 54 of this chapter. For cargoes carried at low temperatures, the tank supports and foundations, and portions of the hull which may be exposed to low temperature, shall also meet the applicable requirements of that part.

(2) When required, cargo tanks shall be lined with rubber or other material acceptable to the Commandant. The interior surfaces of the cargo tanks shall be made smooth, welds chipped or ground smooth, and the surfaces thoroughly cleaned before the lining is applied. The lining material shall be resistive to attack by the cargo, not less elastic than the metal of the tank proper, and nonporous when tested after application. It shall be of substantially uniform thickness. The lining shall be directly bonded to the tank plating, or attached by other satisfactory means acceptable to the Commandant.

(g) *Insulation.* (1) Insulation, when provided, shall be compatible with the cargo and the tank materials.

(2) Insulation in a location exposed to possible high temperature or source of ignition shall be one of the following:

(i) Incombustible, complying with the requirements of Subpart 164.009 of Part 164 of this chapter; or

(ii) Fire retardant, having a flame spread rating of 50 or less as determined by ASTM Specification E 84 (incorporated by reference, see §151.01–2) (Tunnel Test); or,

(iii) Nonburning or ''self-extinguishing'' as determined by ASTM Specification D 4986, ''Horizontal Burning Characteristics of Cellular Polymeric Materials'' (incorporated by reference, see §151.01–2) and covered by a steel jacket having a minimum thickness of 18 gauge (0.0428 inches) (U.S. Standard Gauge) or an equivalent means of protection acceptable to the Commandant.

(3) Insulation in a location protected against high temperature or source of ignition need satisfy no requirement for combustibility.

(4) Insulation shall be impervious to water vapor, or have a vapor-proof coating of a fire-retardant material acceptable to the Commandant. Unless the vapor barrier is inherently weather resistant, tanks exposed to the weather shall be fitted with a removable sheet metal jacket of not less than 18 gauge over the vapor-proof coating and flashed around all openings so as to be weathertight. Insulation which is not exposed to the weather when installed on tanks carrying cargoes above ambient temperatures need not be impervious to water vapor nor be covered with a vapor-proof coating.

(5) Insulation shall be adequately protected in areas of possible mechanical damage.

(h) *Fire exposure protection.* Tanks which are provided with fire exposure protection of one of the following categories may be allowed a reduction in the size of relief valves.

(1) Approved incombustible insulation meeting the requirements of subpart 164.007 of part 164 of this chapter which is secured to the tank with steel bands.

(2) Located in a hold or protected by a self-supporting steel jacket or cover (such as a hopper cover) of at least 10 gauge (0.1345) for insulation.

(i) Tanks not protected against fire exposure as described in this paragraph shall not be permitted a reduction in size of relief valves.

[CFGR 70–10, 35 FR 3714, Feb. 25, 1970, as amended by CGD 88–100, 54 FR 40040, Sept. 29, 1989; USCG–1999–5151, 64 FR 67183, Dec. 1, 1999; USCG–2000–7790, 65 FR 58463, Sept. 29, 2000]

§ 151.15–5 Venting.

This section contains definitions and requirements for the various methods of venting specified in Table 151.05. In addition to the requirement that all vents must penetrate into tanks at the top of the vapor space, the following methods of venting and the applicable restrictions are listed:

(a) *Open venting.* A venting system which offers no restriction (except pipe losses and flame screen, where used) to the movement of liquid or vapor to or from the cargo tank (via the vent) under normal operating conditions. The total cross-sectional area of the vents shall not be less than the total cross-sectional area of the filling pipe or pipes. Ullage openings may be counted as part of the required cross-sectional area: *Provided,* That each cargo tank has at least one permanent vent. The minimum size of a cargo tank vent shall be not less than 2½ inches. The outlet end of the vent shall terminate in a gooseneck bend and shall be located at a reasonable height above the weather deck, clear of all obstructions. No shut-off valve or frangible disk shall be fitted in the vent lines except that a float check valve may be installed so as to exclude the entry of water into the tank (i.e., to prevent downflooding). An open venting system may be fitted with a flame screen.

(b) *Pressure-vacuum venting.* A normally closed venting system fitted with a device to automatically limit the pressure or vacuum in the tank to design limits. Pressure-vacuum relief valves shall comply with the requirements of subpart 162.017 of this chapter. The required capacity of the venting system shall be in accordance with part 54 of this chapter.

(c) *Safety relief venting.* A closed venting system fitted with a device to automatically limit the pressure in the tank to below its maximum allowable working pressure. The maximum safety relief valve setting shall not exceed the maximum allowable working pressure of the tank. For cargoes carried at ambient temperatures, the minimum safety relief valve setting shall correspond to the saturated vapor pressure of the cargo at 105 °F if carried in an insulated tank, or 115 °F if carried in an uninsulated tank. For cargoes carried below ambient temperature, the safety relief valve setting shall be selected to provide a suitable margin between normal operating pressure of the tank and the opening pressure of the valve but in no case shall it exceed the maximum allowable working pressure of the tank. The safety relief valves shall be of a type approved under subparts 162.001 or 162.018 of subchapter Q of this chapter. The required capacity of the safety relief valves shall be in accordance with the requirements of part 54 of this chapter.

(d) *Rupture disks.* (1) When required by the nature of the cargo, rupture disks may be installed in lieu of or in addition to other pressure limiting devices in accordance with the requirements of § 54.15–13 of this chapter.

(2) When a pressure-vacuum relief valve or safety relief valve normally protected by a rupture disk or breaking pin device is exposed to the cargo due to breakage of the disk, the valve shall be reinspected before being returned to service.

§ 151.15–6 Venting piping.

(a) The back pressure in the relief valve discharge lines shall be taken into account when determining the flow capacity of the relief valve to be used. The back pressure in the discharge line shall be limited to 10 percent of the valve operating pressure or a compensating-type valve shall be used. Suitable provision shall be made for draining condensate which may accumulate in the vent piping.

(b) [Reserved]

§ 151.15–10 Cargo gauging devices.

This section contains definitions and requirements for types of gauging devices specified in Table 151.05.

(a) *Open gauging.* A gauging method which uses an opening in the cargo tank and which may expose the gauge