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as required under § 154.1854 if the gas fuel supply is cut-off.

### § 154.706 Cargo boil-off as fuel: Fuel lines.

(a) Gas fuel lines must not pass through accommodation, service, or control spaces. Each gas fuel line passing through other spaces must have a master gas fuel valve and meet one of the following:

(1) The fuel line must be a double-walled piping system with the annular space containing an inert gas at a pressure greater than the fuel pressure. Visual and audible alarms must be installed at the machinery control station to indicate loss of inert gas pressure.

(2) The fuel line must be installed in a mechanically exhaust-ventilated pipe or duct, having a rate of air change of at least 30 changes per hour. The pressure in the space between the inner pipe and outer pipe or duct must be maintained at less than atmospheric pressure. Continuous gas detection must be installed to detect leaks in the ventilated space. The ventilation system must meet § 154.1205.

(b) Each double wall pipe or vent duct must terminate in the ventilation hood or casing under § 154.707(a). Continuous gas detection must be installed to indicate leaks in the hood or casing.

### § 154.707 Cargo boil-off as fuel: Ventilation.

(a) A ventilation hood or casing must be installed in areas occupied by flanges, valves, and piping at the fuel burner to cause air to sweep across them and be exhausted at the top of the hood or casing.

(b) The hood or casing must be mechanically exhaust-ventilated and meet § 154.1205.

(c) The ventilated hood or casing must have an airflow rate specially approved by the Commandant.

### § 154.708 Cargo boil-off as fuel: Valves.

(a) Gas fuel lines to the gas consuming equipment must have two fail-closed automatic valves in series. A third valve, designed to fail-open, must vent that portion of pipe between the two series valves to the open atmosphere.

(b) The valves under paragraph (a) of this section must be arranged so that loss of boiler forced draft, flame failure, or abnormal gas fuel supply pressure automatically causes the two series valves to close and the vent valve to open. The function of one of the series valves and the vent valve may be performed by a single three-way valve.

(c) A master gas fuel valve must be located outside the machinery space, but be operable from inside the machinery space and at the valve. The valve must automatically close when there is:

(1) A gas leak detected under § 154.706(a)(2) or § 154.706(b);

(2) Loss of the ventilation under § 154.706(a)(2) or § 154.707(c); or

(3) Loss of inert gas pressure within the double-walled piping system under § 154.706(a)(1).

### § 154.709 Cargo boil-off as fuel: Gas detection equipment.

(a) The continuous gas detection system required under § 154.706(a)(2) and (b) must:

(1) Meet § 154.1350(c), (d), and (j) through (s); and

(2) Have a device that:

(i) Activates an audible and visual alarm at the machinery control station and in the wheelhouse if the methane concentration reaches 1.5 percent by volume; and

(ii) Closes the master gas fuel valve required under § 154.708(c) before the methane concentration reaches 3 percent by volume.

(b) The number and arrangement of gas sampling points 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]

## CARGO VENT SYSTEMS

### § 154.801 Pressure relief systems.

(a) Each cargo tank that has a volume of 20$m^3$ (706 $ft.^3$) or less must have at least one pressure relief valve.

(b) Each cargo tank that has a volume of more than 20$m^3$ (706 $ft.^3$) must have at least two pressure relief valves of the same nominal relieving capacity.

(c) Each pressure relief valve must:

(1) Meet Subpart 162.018 of this chapter or, if the valve is also capable of vacuum relief and the MARVS is 69 kPa gauge (10 psig) or less, Subpart 162.017 of this chapter, and have at least the capacity required under § 154.806;

(2) Not be set for a higher pressure than the MARVS;

(3) Have a fitting for sealing wire that prevents the set pressure from being changed without breaking the sealing wire;

(4) Be fitted on the cargo tank to remain in the vapor phase under conditions of 15° list and of 0.015 L trim by both the bow and stern;

(5) Vent to a vent mast under § 154.805, except a relief valve may vent to a common tank relief valve header if the back pressure is included in determining the required capacity under § 154.806;

(6) Not vent to a common header or common vent mast if the relief valves are connected to cargo tanks carrying chemically incompatible cargoes;

(7) Not have any stop valves or other means of isolating the cargo tank from its relief valve unless:

(i) The stop valves are interlocked or arranged so that only one pressure relief valve is out of service at any one time;

(ii) The interlock arrangement automatically shows the relief valve that is out of service; and

(iii) The other valves have the relieving capacity required under § 154.806, or all relief valves on the cargo tank are the same size and there is a spare of the same size, or there is a spare for each relief valve on a cargo tank.

(d) The pressure relief system must:

(1) If the design temperature is below 0°C (32°F), be designed to prevent the relief valve from becoming inoperative due to ice formation; and

(2) Be designed to prevent chattering of the relief valve.

[CGD 74–289, 44 FR 26009, May 3, 1979; 44 FR 59234, Oct. 15, 1979]

### § 154.802 Alternate pressure relief settings.

Cargo tanks with more than one relief valve setting must have one of the following arrangements:

(a) Relief valves that:

(1) Are set and sealed under § 154.801(c);

(2) Have the capacity under § 154.806; and

(3) Are interlocked so that cargo tank venting can occur at any time.

(b) Relief valves that have spacer pieces or springs that:

(1) Change the set pressure without pressure testing to verify the new setting; and

(2) Can be installed without breaking the sealing wire required under § 154.801(c)(3).

### § 154.804 Vacuum protection.

(a) Except as allowed under paragraph (b) of this section, each cargo tank must have a vacuum protection system meeting paragraph (a)(1) of this section and either paragraph (a)(2) or (a)(3) of this section.

(1) There must be a means of testing the operation of the system.

(2) There must be a pressure switch that operates an audible and visual alarm in the cargo control station identifying the tank and the alarm condition and a remote group audible and visual alarm in the wheelhouse. Both alarms must be set at or below 80% of the maximum external design pressure differential of the cargo tanks. There must be a second, independent pressure switch that automatically shuts off all suction of cargo liquid or vapor from the cargo tank and secures any refrigeration of that tank at or below the maximum external design pressure differential.

(3) There must be a vacuum relief valve that:

(i) Has a gas flow capacity at least equal to the maximum cargo discharge rate per tank;

(ii) Is set to open at or below the maximum external design pressure differential; and

(iii) Admits inert gas, cargo vapor from a source other than a cargo vapor header, or air except as prohibited under § 154.1710.

(b) A vacuum protection system does not have to be installed if the cargo tank is designed to withstand:

(1) A maximum external pressure differential exceeding 24.5 kPa gauge (3.55 psig); and

(2) The maximum external pressure differential that can be obtained:

(i) At maximum discharge rates with no vapor return to the cargo tanks;

(ii) By operation of the cargo refrigeration system; or

(iii) By drawing off vapor for use in accordance with § 154.703(c)

[CGD 74–289, 44 FR 26009, May 3, 1979; 44 FR 59234, Oct. 15, 1979]

### § 154.805 Vent masts.

Relief valves or common vent headers from relief valves must discharge to a vent mast that:

(a) Discharges vertically upward;

(b) Has a rain cap or other means of preventing the entrance of rain or snow;

(c) Has a screen with 25mm (1 inch) wire mesh or bars not more than 25mm (1 in.) apart on the discharge port;

(d) Extends at least to a height of B/3 or 6m (19.7 ft.), whichever is greater, above the weather deck and 6m (19.7 ft.) above the working level;

(e) For a cargo tank, does not exhaust cargo vapors within a radius of B or 25m (82 ft.), whichever is less, from any forced or natural ventilation intake or other opening to an accommodation, service, control station, or other gas-safe space, except that for vessels less than 90m (295 ft.) in length, shorter distances may be specially approved by the Commandant (G–MSO);

(f) For a containment system, except a cargo tank, does not exhaust vapor within a radius of 10m (32.8 ft.) or less from any forced or natural ventilation intake or other opening to an accommodation, service, control station, or other gas-safe space;

(g) Has drains to remove any liquid that may accumulate; and

(h) Prevents accumulations of liquid at the relief valves.

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

### § 154.806 Capacity of pressure relief valves.

Pressure relief valves for each cargo tank must have a combined relief capacity, including the effects of back pressure from vent piping, headers, and masts, to discharge the greater of the following with not more than a 20% rise in cargo tank pressure above the set pressure of the relief valves:

(a) The maximum capacity of an installed cargo tank inerting system if the maximum attainable working pressure of the cargo tank inerting system exceeds the set pressure of the relief valves.

(b) The quantity of vapors generated from fire exposure that is calculated under § 54.15–25 of this chapter.

## ATMOSPHERIC CONTROL IN CARGO CONTAINMENT SYSTEMS

### § 154.901 Atmospheric control within cargo tanks and cargo piping systems.

(a) Each vessel must have a piping system for purging each cargo tank and all cargo piping.

(b) The piping system must minimize the pocketing of gas or air remaining after purging.

(c) For cargo tanks certificated to carry flammable gases, the piping system must allow purging the tank of flammable vapors before air is introduced and purging the tank of air before the tank is filled with cargo.

(d) Each cargo tank must have:

(1) Gas sampling points at its top and bottom; and

(2) Gas sampling line connections that are valved and capped above the deck.

### § 154.902 Atmospheric control within hold and interbarrier spaces.

(a) Vessels certificated to carry flammable cargo in cargo containment systems with full secondary barriers must have an inert gas system or onboard storage of inert gas that provides enough inert gas to meet the requirements of § 154.1848 for 30 days consumption.

(b) Vessels certificated to carry flammable cargo in cargo containment systems with partial secondary barriers must:

(1) Have an inert gas system or onboard inert gas storage that can inert the largest hold and interbarrier space so that the oxygen concentration is 8 percent or less by volume; and

(2) Meet paragraph (a) or (c)(2) of this section.