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(c) An independent tank must have supports with an antiflotation system that withstands the upward force of the tank without causing plastic deformation that endangers the hull structure when the tank is:
(1) Empty; and
(2) In a hold space flooded to the summer load draft of the vessel.

§ 154.471 Design criteria.

(a) The cargo tank support system must be designed:
(1) For the loads in § 154.406(a);
(2) To not exceed the allowable stress under this part at a static angle of heel of 30°;
(3) To withstand a collision force equal to at least one-half the weight of the cargo tank and cargo from forward and one-quarter the weight of the cargo tank and cargo from aft; and
(4) For the largest resulting acceleration in Figure 1, including rotational and translation effects.
(b) The cargo tank support design loads in paragraph (a) of this section may be analyzed separately.

§ 154.476 Cargo transfer devices and means.

(a) If a cargo pump in a cargo tank is not accessible for repair when the cargo tank is in use, the cargo tank must have an additional means of cargo transfer, such as another pump or gas pressurization.
(b) If cargo is transferred by gas pressurization, the pressurizing line must have a safety relief valve that is set at less than 90 percent of the tank relief valve setting.

CARGO AND PROCESS PIPING SYSTEMS

§ 154.500 Cargo and process piping standards.

The cargo liquid and vapor piping and process piping systems must meet the requirements in §§ 154.503 through 154.562, Subparts 56.01 through 56.35, §§ 56.50–20 and 56.50–105, and Subparts 56.60 through 56.97 of this chapter.

§ 154.503 Piping and piping system components: Protection from movement.

Where thermal movement and movements of the cargo tank and the hull structure may cause stresses that exceed the design stresses, the piping and piping system components and cargo tanks must be protected from movement by:
(a) Offsets;
(b) Loops;
(c) Bends;
(d) Mechanical expansion joints including:
(1) Bellows;
(2) Slip joints;
(3) Ball joints; or
(e) Other means 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]

§ 154.506 Mechanical expansion joint: Limits in a piping system.

Mechanical expansion joints in a piping system outside of a cargo tank:
(a) May be installed only if offsets, loops or bends cannot be installed due to limited space or piping arrangement;
(b) Must be a bellows type; and
(c) Must not have insulation or a cover unless necessary to prevent damage.

§ 154.512 Piping: Thermal isolation.

Low temperature piping must be thermally isolated from any adjacent hull structure to prevent the temperature of that structure from dropping below the minimum temperature for the hull material under § 154.170.

§ 154.514 Piping: Electrical bonding.

(a) Cargo tanks or piping that are separated from the hull structure by thermal isolation must be electrically bonded to the hull structure by a method under paragraph (c) of this section.
(b) A pipe joint or a hose connection fitting that has a gasket must be electrically bonded by a method under paragraph (c) of this section that bonds:
(1) Both sides of the connection to the hull structure; or
(2) Each side of the connection to the other side.
(c) An electrical bond must be made by at least one of the following methods:
(1) A metal bonding strap attached by welding or bolting.

(2) Two or more bolts that give metal to metal contact between the bolts and the parts to be bonded.

(3) Metal to metal contact between adjacent parts under designed operating conditions.

§ 154.516 Piping: Hull protection.

A vessel's hull must be protected from low temperature liquid leakage by a drip pan, or other means specially approved by the Commandant (G–MSO), at:

(a) Each piping connection dismantled on a routine basis;

(b) Cargo discharge and loading manifolds; and

(c) Pump seals.

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

§ 154.517 Piping: Liquid pressure relief.

The cargo loading and discharge crossover headers, cargo hoses, and cargo loading arms must have means to relieve cargo pressure and to remove liquid cargo.

§ 154.519 Piping relief valves.

(a) The liquid relief valve that protects the cargo piping system from liquid pressure exceeding the design pressure must discharge into:

(1) A cargo tank; or

(2) A cargo vent mast if that vent mast has a means for the detection and removal of the liquid cargo that is specially approved by the Commandant (G–MSO).

(b) A relief valve on a cargo pump that protects the cargo piping system must discharge into the pump suction.

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

§ 154.520 Piping calculations.

A piping system must be designed to meet the allowable stress values under § 56.07–10 of this chapter and, if the design temperature is −110° C (−166° F) or lower, the stress analysis must be specially approved by the Commandant (G–MSO) and must include:

(a) Pipe weight loads;

(b) Acceleration loads;

(c) Internal pressure loads;

(d) Thermal loads; and

(e) Loads from the hull.

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

§ 154.522 Materials for piping.

(a) The materials for piping systems must meet § 154.625 for the minimum design temperature of the piping, except the material for open ended vent piping may be specially approved by the Commandant (G–MSO) if:

(1) The temperature of the cargo at the pressure relief valve setting is −55° C (−67° F) or warmer; and

(2) Liquid can not discharge to the vent piping.

(b) Materials for piping outside the cargo tanks must have a melting point of at least 925° C (1697° F), except for short lengths of pipes with fire resisting insulation that are attached to the cargo tanks.

§ 154.524 Piping joints: Welded and screwed couplings.

Pipe lengths without flanges must be joined by one of the following:

(a) A butt welded joint with complete penetration at the weld root except that for design temperatures colder than −10° C (14° F) the butt weld must be double welded or must be welded using:

(1) A backing ring that for design pressures greater than 979 kPa gauge (142 psig) must be removed after the weld is completed;

(2) A consumable insert; or

(3) An inert gas back-up on the first weld pass.

(b) A slip-on welded joint with sleeves and attachment welds is allowed for an open ended pipe with an external diameter of 50 mm (2 in.) or less and a design temperature of −55° C (−67° F), or warmer.

(c) A socket weld fitting with attachment welds is allowed for pipe with an external diameter of 50 mm (2 in.) or less and a design temperature of −55° C (−67° F) or warmer.

(d) Screwed couplings are allowed for instrumentation and control piping that meets § 56.30–20 and § 56.50–105 (a)(4) and (b)(4) of this chapter.

(e) A method or fitting 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]

§ 154.526 Piping joints: Flange connection.

Flange connections for pipe joints must meet § 56.30–10 and § 56.50–105 (a)(4) and (b)(4) of this chapter.

§ 154.528 Piping joints: Flange type.

(a) A flange must be one of the following types:

(1) Welding neck.

(2) Slip-on.

(3) Socket weld.

(b) If the piping is designed for a temperature between −10°C (14°F) and −55°C (−67°F), the pipe flange may be a:

(1) Slip-on type, if the nominal pipe size is 100 mm (4 in.) or less;

(2) Socket weld, if the nominal pipe size is 50 mm (2 in.) or less; or

(3) Welding neck.

(c) If the piping is designed for a temperature lower than −55°C (−67°F), the pipe flange must be a welding neck type.

§ 154.530 Valves: Cargo tank MARVS 69 kPa gauge (10 psig) or lower.

(a) Except those connections for tank safety relief valves and for liquid level gauging devices other than those under §§ 154.536 and 154.1310, liquid and vapor connections on a cargo tank with a MARVS of 69 kPa gauge (10 psig) or lower must have shut-off valves that—

(1) Are located as close to the tank as practical;

(2) Are capable of local manual operation; and

(3) May be remotely controlled.

(b) The cargo piping system for a cargo tank with a MARVS of 69 kPa gauge (10 psig) or lower must have at least one remotely controlled quick-closing shut-off valve for closing liquid and vapor piping between vessel and shore that meets §§ 154.540 and 154.544.

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

§ 154.532 Valves: Cargo tank MARVS greater than 69 kPa gauge (10 psig).

(a) Except connections for tank safety relief valves and except for liquid level gauging devices other than those under §§ 154.536 and 154.1310, liquid and vapor connections on a cargo tank with a MARVS greater than 69 kPa gauge (10 psig) must have, as close to the tank as practical, a:

(1) Stop valve capable of local manual operation; and

(2) A remotely controlled quick-closing shut-off valve.

(b) If the nominal pipe size of a liquid or vapor connection is less than 50 mm (2 in.), an excess flow valve may be substituted for the quick-closing valve under paragraph (a) of this section.

(c) One valve may be substituted for the manual controlled stop valve and the remotely controlled quick-closing shut-off valve required under paragraph (a) of this section if that valve:

(1) Meets §§ 154.540 and 154.544; and

(2) Is capable of local manual operation.

§ 154.534 Cargo pumps and cargo compressors.

Cargo pumps and cargo compressors must shut-down automatically when the quick-closing shut-off valves under §§ 154.530 and 154.532 are closed by the emergency shut-down system required under § 154.540.

§ 154.536 Cargo tank gauging and measuring connections.

Unless the outward flow from a cargo tank is less than the flow through a circular hole of 1.4 mm (0.055 in.) in diameter, cargo tank connections for gauging or measuring devices must have the excess flow, shut-off, or quick-closing shut-off valves under § 154.530 or § 154.532.

§ 154.538 Cargo transfer connection.

A cargo transfer connection must have a:

(a) Remotely controlled quick-closing shut-off valve that meets §§ 154.540 and 154.544; or

(b) Blank flange.

§ 154.540 Quick-closing shut-off valves: Emergency shut-down system.

The quick-closing shut-off valves under §§ 154.530, 154.532, and 154.538 must have an emergency shut-down system that:

(a) Closes all the valves;

(b) Is actuated by a single control in at least two locations remote from the quick-closing valves;

(c) Is actuated by a single control in each cargo control station under § 154.320; and

(d) Has fusible elements at each tank dome and cargo loading and discharge manifold that melt between 98°C (208° F) and 104°C (220° F) and actuate the emergency shut-down system.

§ 154.544 Quick-closing shut-off valves.

The quick-closing shut-off valve under §§ 154.530, 154.532 and 154.538 must:

(a) Be a shut-off valve;

(b) Close from the time of actuation in 30 seconds or less;

(c) Be the fail-closed type; and

(d) Be capable of local manual closing.

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

§ 154.546 Excess flow valve: Closing flow.

(a) The rated closing flow of vapor or liquid cargo for an excess flow valve must be specially approved by the Commandant (G–MSO).

(b) An excess flow valve allowed under § 154.532(b) must close automatically at the rated closing flow.

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

§ 154.548 Cargo piping: Flow capacity.

Piping with an excess flow valve must have a vapor or liquid flow capacity that is greater than the rated closing flow under § 154.546.

§ 154.550 Excess flow valve: Bypass.

If the excess flow valve allowed under § 154.532(b) has a bypass, the bypass must be of 1.0 mm (0.0394 in.) or less in diameter.

CARGO HOSE

§ 154.551 Cargo hose: General.

Each of the vessel's liquid and vapor cargo hose for loading or discharging cargo must meet §§ 154.552 through 154.562.

§ 154.552 Cargo hose: Compatibility.

Liquid and vapor cargo hoses must:

(a) Not chemically react with the cargo; and

(b) Withstand design temperature.

§ 154.554 Cargo hose: Bursting pressure.

Cargo hose that may be exposed to the pressure in the cargo tank, the cargo pump discharge, or the vapor compressor discharge must have a bursting pressure of at least five times the maximum working pressure on the hose during cargo transfer.

§ 154.556 Cargo hose: Maximum working pressure.

A cargo hose must have a maximum working pressure not less than the maximum pressure to which it may be subjected and at least 1034 kPa gauge (150 psig).

§ 154.558 Cargo hose: Marking.

Each cargo hose must be marked with the:

(a) Maximum working pressure; and

(b) Minimum service temperature for service at other than ambient temperature.

§ 154.560 Cargo hose: Prototype test.

(a) Each cargo hose must be of a type that passes a prototype test at a pressure of at least five times its maximum working pressure at or below the minimum service temperature.

(b) Each cargo hose must not be the hose used in the prototype test.

§ 154.562 Cargo hose: Hydrostatic test.

Each cargo hose must pass a hydrostatic pressure test at ambient temperature of at least one and a half times its specified maximum working pressure but not more than two-fifths its bursting pressure.