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Cargoes	Pollution Category
Sodium carbonate solution	D
Sodium lignosulfonate solution, *see also* Lignin liquor.	III
Sodium naphthenate solution (free alkali content, 3% or less), *see* Naphthenic acid, sodium salt solution.	**[A]**
•Sodium **poly(4+)acrylate** solution	**III**
•Sodium silicate solution	**C**
•Sodium sulfate solution	**III**
Sorbitol solution	III
Tetrasodium salt of Ethylenediaminetetraacetic acid solution, *see* Ethylenediaminetetraacetic acid, tetrasodium salt solution.	D
1,1,1-Trichloroethane	**C**
1,1,2-Trichloro-1,2,2-trifluoroethane	C
Trisodium salt of N-(Hydroxyethyl)-ethylenediaminetriacetic acid solution, *see* N-(Hydroxyethyl)ethylenediamine triacetic acid, trisodium salt solution.	D
Urea, Ammonium mono- and di-hydrogen phosphate, Potassium chloride solution.	D
•Urea, Ammonium nitrate solution (2% or less NH_3), *see also* Ammonium nitrate, Urea solution (2% or less).	D
•Urea, Ammonium phosphate solution, *see also* Ammonium phosphate, Urea solution.	D
Urea solution	III
Vanillan black liquor (free alkali content, 1% or less).	#
Vegetable protein solution *(hydrolysed)*	III
Water	III
•*Zinc bromide, Calcium bromide solution, see* Drilling brine (containing Zinc salts).	

Items with a bullet (•) or in **boldface** are changes since October 1, 1993.

Explanation of Symbols: As used in this table, the following stand for:

A, B, C, D—NLS Category of Annex II of MARPOL 73/78.

I—Considered an ''oil'' under Annex I of MARPOL 73/78.

III—Appendix III of Annex II (non-NLS cargoes) of MARPOL 73/78.

LFG—Liquefied flammable gas.

#—No determination of NLS status. For shipping on an oceangoing vessel, see 46 CFR 153.900(c).

[ ]—A NLS category in brackets indicates that the product is provisionally categorized and that further data are necessary to complete the evaluation of its pollution hazards. Until the hazard evaluation is completed, the pollution category assigned is used.

@The NLS category has been assigned by the U.S. Coast Guard, in absence of one assigned by the IMO. The category is based upon a GESAMP Hazard Profile or by analogy to a closely related product having an NLS assigned.

Abbreviations for Noxious liquid Cargoes:

N.F.—non-flammable (flash point greater than 60 degrees C (140 degrees F) cc).
n.o.s.—not otherwise specified.
ST—Ship type.
Cat—Pollution category.

[CGD 88–100, 54 FR 43584, Oct. 26, 1989; CGD 92–100, 59 FR 17044, Apr. 11, 1994, as amended by CGD 94–900, 59 FR 45142, Aug. 31, 1994; CGD 94–902, 60 FR 34043, June 29, 1995; CGD 95–900, 60 FR 34052, June 29, 1995]

APPENDIX I [RESERVED]

APPENDIX II—METRIC UNITS USED IN PART 153

Parameter	Metric (SI unit)	Abbreviation	Equivalent to English or common metric
Force	Newton	N	0.225 lbs.
Length	Meter	m	39.37 in.
	Centimeter	cm	.3937 in.
Pressure	Pascal	Pa	1.450×10^{-4} lbs/in^2.
	Kilo-Pascal (1,000 Pascals).	kPa	0.145 lbs/in^2.
	Kilo-Pascal	kPa	1.02×10^{-2} kg/cm^2.
	....do	kPa	1×10^3 N/m^2.
Temperature	Degree Celsius	° C	5/9 (°F–32).
Viscosity	milli-Pascal second.	mPa. sec.	1.0 centipoise.
Volume	Cubic meter	m^3	264 gallons (gal).
	....do	m^3	35.3 ft^3.

[CGD 73–96, 42 FR 49027, Sept. 26, 1977, as amended by CGD 78–128, 47 FR 21212, May 17, 1982; CGD 81–101, 52 FR 7799, Mar. 12, 1987. Redesignated by CGD 92–100, 59 FR 17045, Apr. 11, 1994]

PART 154—SAFETY STANDARDS FOR SELF-PROPELLED VESSELS CARRYING BULK LIQUEFIED GASES

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TABLE 4—SUMMARY OF MINIMUM REQUIREMENT

APPENDIX A—EQUIVALENT STRESS
APPENDIX B—STRESS ANALYSES DEFINITIONS

AUTHORITY: 46 U.S.C. 3703, 9101; 49 CFR 1.46.

SOURCE: CGD 74–289, 44 FR 26009, May 3, 1979, unless otherwise noted.

EDITORIAL NOTE: Nomenclature changes affecting Part 154 appear at CGD 95–072, 60 FR 50466, Sept. 29, 1995 and at CGD 96–041, 61 FR 50732, Sept. 27, 1996.

Subpart A—General

SOURCE: CGD 77–069, 52 FR 31626, Aug. 21, 1987, unless otherwise noted.

§ 154.1 Incorporation by reference.

(a) Certain materials are incorporated by reference into this part with approval of the Director of the Federal Register in accordance with 5 U.S.C. 552(a). The Office of the Federal Register publishes a list ''Material Approved for Incorporation by Reference,'' which appears in the Finding Aids section of this volume. To enforce any edition other than the one listed in paragraph (b) of this section, notice of change must be published in the FEDERAL REGISTER and the material made available. All approved material is on file at the Office of the Federal Register, Washington, DC 20408, and at the Commandant (G–MSO), U.S. Coast Guard, 2100 Second Street SW. Washington, DC 20593–0001.

(b) The materials approved for incorporation by reference in this part are:

AMERICAN BUREAU OF SHIPPING

Two World Trade Center, 106th Floor, New York, NY 10048

Rules for Building and Classing Steel Vessels, 1981

AMERICAN NATIONAL STANDARDS INSTITUTE

11 West 42nd Street, New York, NY 10036

ANSI Z89.1–69 Safety Requirements for Industrial Head Protection, 1969

ANSI Z87.1–79 Practice for Occupational and Educational Eye and Face Protection, 1979

AMERICAN SOCIETY FOR TESTING AND MATERIALS

100 Barr Harbor Drive, West Conshohocken, PA 19428–2959

ASTM A20–1978 Steel Plates for Pressure Vessels.

ASTM F1014–1986 Standard Specification for Flashlights on Vessels.

Sections effected—154.1400(a)(4), 154.1400(b)(4), 154.1400(c)(4).

NOTE: All other documents referenced in this part are still in effect.

INTERNATIONAL MARITIME ORGANIZATION

Publications Section, 4 Albert Embankment, London SE1 7SR, United Kingdom

Resolution A.328(IX), Code for the Construction and Equipment of Ships Carrying Liquefied Gases in Bulk, 1976

Code For Existing Ships Carrying Liquefied Gases in Bulk, 1976

Medical First Aid Guide for Use in Accidents Involving Dangerous Goods

UNDERWRITERS LABORATORIES, INC.

12 Laboratory Drive, Research Triangle Park, NC 27709–3995

UL No. 783–79 Standard for Safety, Electric Flashlights for Use in Hazardous Locations, Class 1, Groups C and D, 1979.

[CGD 77–069, 52 FR 31626, Aug. 21, 1987, as amended by CGD 82–042, 53 FR 17705, May 18, 1988; CGD 82–042, 53 FR 18949, May 25, 1988; CGD 88–070, 53 FR 34535, Sept. 7, 1988; CGD 96–041, 61 FR 50732, Sept. 27, 1996; CGD 97–057, 62 FR 51048, Sept. 30, 1997]

§ 154.3 Purpose.

The purpose of this part is to prescribe rules for new and existing gas vessels.

§ 154.5 Applicability.

This part applies to each self-propelled vessel that has on board bulk liquefied gases as cargo, cargo residue or vapor, except subpart C does not apply if the vessel meets § 154.12 (b), (c), or (d).

§ 154.7 Definitions, acronyms, and terms.

As used in this part:

''A'' Class Division means a division as defined in Regulation 3 of Chapter II–2 of the 1974 Safety Convention.

Accommodation spaces means public spaces, corridors, lavatories, cabins, offices, hospitals, cinemas, game and hobby rooms, pantries containing no cooking appliances, and spaces used in a similar fashion.

Boiling point means the temperature at which a substance's vapor pressure is equal to the atmospheric barometric pressure.

Breadth (B) means the maximum width of the vessel in meters measured amidships to the molded line of the frame in a ship with a metal shell and to the outer surface of the hull in a ship with a shell of any other material.

Cargo area means that part of the vessel that contains the cargo containment system, cargo pump rooms, cargo compressor rooms, and the deck areas over the full beam and the length of the vessel above them, but does not include the cofferdams, ballast spaces, or

void spaces at the after end of the aftermost hold space or the forward end of the forwardmost hold space.

Cargo containment system means the arrangement for containment of the cargo including a primary and secondary barrier, associated insulation and any intervening spaces, and adjacent structure that is necessary for the support of these elements.

Cargo service space means space within the cargo area that is more than 2 m^2 (21.5 $ft.^2$) in deck area and used for work shops, lockers, or store rooms.

Cargo tank means the liquid tight shell that is the primary container of the cargo.

Certificate of Compliance means a certificate issued by the Coast Guard to a foreign flag vessel after it is examined and found to comply with regulations in this chapter.

Cofferdam means the isolating space between two adjacent steel bulkheads or decks, which could be a void space or a ballast space.

Contiguous hull structure includes the inner deck, the inner bottom plating, longitudinal bulkhead plating, transverse bulkhead plating, floors, webs, stringers, and attached stiffeners.

Control space means those spaces in which the vessel's radio, main navigating equipment, or the emergency source of power is located or in which the fire control equipment, other than firefighting control equipment under § 154.1140 to § 154.1170, is centralized.

Design temperature means the minimum cargo temperature the Coast Guard allows for loading, unloading, or carriage.

Design vapor pressure (P_o) means the maximum gauge pressure at the top of the cargo tank for the design of the cargo tank.

Document means a Certificate of Inspection for a U.S. flag vessel or a Certificate of Compliance for a foreign flag vessel.

Existing gas vessel means a self-propelled vessel that—

(a) Is delivered on or before October 31, 1976; or

(b) Is delivered between October 31, 1976 and June 30, 1980, and is not a new gas vessel.

Flammable cargoes includes the following liquefied gases from Table 4 (follows § 154.1872):

Acetaldehyde
Butadiene
Butane
Butylene
Dimethylamine
Ethane
Ethylamine
Ethyl chloride
Ethylene
Ethylene oxide
Methane (LNG)
Methyl acetylene-propadiene mixture
Methyl bromide
Methyl chloride
Propane
Propylene
Vinyl chloride

Gas-dangerous space includes the following spaces:

(a) A space in the cargo area without arrangements to provide a safe atmosphere at all times.

(b) An enclosed space outside the cargo area through which any piping that may contain liquid or gaseous cargo passes, or within which that piping terminates, without arrangements to prevent gas from escaping into the space.

(c) A cargo containment system and cargo piping.

(d) A hold space where cargo is carried in a cargo containment system:

(1) With a secondary barrier; or

(2) Without a secondary barrier.

(e) A space separated from a hold space under paragraph (d)(1) of this definition by a single gastight boundary.

(f) A cargo pumproom and a cargo compressor room.

(g) A zone on the weather deck or a semi-enclosed space on the weather deck within 3.05 m (10 ft) of any cargo tank outlet, gas or vapor outlet, cargo pipe flange, cargo valve, or of entrances and ventilation openings to a cargo pump room or a cargo compressor room.

(h) Except for existing gas vessels, the weather deck over the cargo area and 3.05 m (10 ft) forward and aft of the cargo area on the weather deck to 2.4 m (8 ft) above the weather deck.

(i) A zone within 2.4 m (8 ft) of the outer surface of a cargo containment system where the surface is exposed to the weather.

(j) An enclosed or semi-enclosed space in which there is piping containing cargo, except those—

(1) With gas sampling lines for gas detection equipment under § 154.1350(n); or

(2) In which boil-off gas is used as fuel under § 154.703.

(k) A space for storage of cargo hoses.

(l) An enclosed or semi-enclosed space having an opening into any gas-dangerous space or zone.

Gas-safe space means a space that is not a gas-dangerous space.

Hold space means the space enclosed by the vessel's structure in which there is a cargo containment system.

IMO stands for the lnternational Maritime Organization.

IMO Certificate means a Certificate of Fitness for the Carriage of Liquefied Gases in Bulk issued under the IMO—

(a) ''Code for the Construction and Equipment of Ships Carrying Liquefied Gases in Bulk'', adopted November 12, 1975 by Assembly Resolution A.328(IX), as amended;

(b) ''Code for Existing Ships Carrying Liquefied Gases in Bulk'', adopted November 12, 1975, as amended; or

(c) ''Recommendations Concerning Ships Not Covered by the Code for the Construction and Equipment of Ships Carrying Liquefied Gases in Bulk'', (Resolution A.328(IX)), adopted November 12, 1975 by Assembly Resolution A.329(IX).

Independent tank is a cargo tank that is permanently affixed to the vessel, is self-supporting, and is not part of the hull or essential to the strength or integrity of the hull.

Independent tank type A is an independent cargo tank designed primarily using classification society classical ship structural analysis procedures.

Independent tank type B is an independent cargo tank designed from model tests, refined analytical tools, and analysis methods to determine stress levels, fatigue life, and crack propagation characteristics.

Independent tank type C (pressure tank) is an independent cargo tank meeting pressure vessel criteria where the dominant stress producing load is design vapor pressure.

Insulation space means a space, that could be an interbarrier space, occupied wholly or in part by insulation.

Integral tank means a cargo tank that is a structural part of the vessel's hull and is influenced in the same manner and by the same loads that stress the adjacent hull structure.

Interbarrier space means the space between a primary and a secondary barrier, with or without insulation or other material.

Length (L) is ninety-six percent of the total length in meters on a waterline at eighty-five percent of the least molded depth measured from the top of the keel or the length from the foreside of the stem to the axis of the rudder stock on the waterline, whichever is greater. In vessels having a rake of keel, the waterline is parallel to the design waterline.

Liquefied gas means a cargo having a vapor pressure of 172 kPa (25 psia) or more at 37.8 °C (100 °F).

MARVS stands for the Maximum Allowable Relief Valve Setting.

Membrane tank is a cargo tank that is not self-supporting and consists of a thin layer (membrane) supported through insulation by the adjacent hull structure.

New gas vessel means a self-propelled vessel that—

(a) Is constructed under a building contract awarded after October 31, 1976;

(b) In the absence of a building contract, has a keel laid or is at a similar stage of construction after December 31, 1976;

(c) Is delivered after June 30, 1980; or

(d) Has undergone a major conversion for which—

(1) The building contract is awarded after October 31, 1976;

(2) In the absence of a building contract, conversion is begun after December 31, 1976; or

(3) Conversion is completed after June 30, 1980.

Primary barrier means the inner boundary that contains the cargo when the cargo containment system includes two boundaries.

Process pressure vessel means a pressure vessel that is used in a reliquefaction, cargo heating, or other system that processes cargo.

Remote group alarm means an audible and visual alarm that alerts when an alarm condition exists but does not identify that condition.

Secondary barrier means the liquid resisting outer boundary of a cargo containment system when the cargo containment system includes two boundaries.

Semi-membrane tank is a cargo tank that is not self-supporting and that can expand and contract due to thermal, hydrostatic, and pressure loadings. It consists of flat surfaces, supported through insulation by the adjacent hull structure, and shaped corners that connect the flat surfaces.

Service space means a space outside the cargo area that is used for a galley, pantry containing cooking appliances, locker or store room, workshop except those in machinery spaces, and similar spaces and trunks to those spaces.

Shut-off valve is a valve that closes a pipeline and provides nominal metal to metal contact between the valve operating parts, including the disc and gate, and the valve body.

Specific gravity (p) means the ratio of the density of the cargo at the design temperature to the density of water at 4 °C (39 °F).

Tank cover is the structure protecting those parts of the cargo containment system that protrude through the weather deck and providing continuity to the deck structure.

Tank dome means the uppermost portion of the cargo tank. For below deck cargo containment systems, it means the uppermost portion of the cargo tank that protrudes through the weather deck or through the tank cover.

Toxic cargoes includes the following liquefied gases from Table 4 (follows § 154.1872):

Acetaldehyde
Ammonia, anhydrous
Dimethylamine
Ethylamine
Ethyl chloride
Ethylene oxide
Methyl bromide
Methyl chloride
Sulfur dioxide
Vinyl chloride

Vapor pressure means the absolute equilibrium pressure of the saturated vapor above the liquid, expressed in kPa (psia), at a specific temperature.

Void space means an enclosed space in the cargo area outside of the cargo containment system, except a hold space, ballast space, fuel oil tank, cargo pump or compressor room, or any space used by personnel.

1974 Safety Convention stands for the International Convention on Safety of Life at Sea, 1974, done at London, November 1, 1974.

§ 154.9 Issuance of documents.

The Coast Guard issues an endorsed Certificate of Inspection to a U.S. flag vessel or an endorsed Certificate of Compliance to a foreign flag vessel that meets this part.

§ 154.12 Existing gas vessel: Endorsements and requirements.

(a) Except an existing gas vessel under paragraph (b), (c), or (d) of this section, an existing gas vessel must meet subpart C of this part if the owner desires a document endorsed for the carriage of a cargo listed in Table 4 (follows § 154.1872).

(b) If an existing gas vessel is issued a document by the Coast Guard before November 1, 1987 that is endorsed for the carriage of a cargo listed in Table 4 (follows § 154.1872), and the owner desires the same endorsement on a reissued document, the vessel must—

(1) Continue to meet the same design and construction standards under which the Coast Guard issued the original document; and

(2) Meet paragraph (e) of this section.

(c) If an existing gas vessel is issued a document by the Coast Guard before November 1, 1987 that is endorsed for the carriage of a cargo listed in Table 4 (follows § 154.1872), and the owner desires an endorsement for a different cargo listed in that table, the vessel must—

(1) Continue to meet the same design and construction standards under which the Coast Guard issued the original document;

(2) Meet paragraph (e) of this section;

(3) Meet subpart D for the different cargo; and

(4) Meet any additional requirements of this part that the Commandant (G–

MSO) determines to be necessary for safety.

(d) If an existing gas vessel does not meet paragraph (b) or (c) of this section and the owner desires a document endorsed for the carriage of a cargo listed in Table 4 (follows §154.1872), the vessel must—

(1) Have a letter from the Coast Guard dated before November 1, 1987 stating that—

(i) Review of the vessel's plans for the carriage of that cargo is completed; or

(ii) The vessel's IMO Certificate endorsed for the carriage of that cargo is accepted;

(2) Meet the plans that were reviewed and marked ''Examined'' or ''Approved'' by the Coast Guard, or meet the standards under which the IMO Certificate was issued;

(3) Meet paragraph (e) of this section; and

(4) Meet any additional requirements of this part that the Commandant (G–MSO) determines to be necessary for safety.

(e) If the owner of a vessel desires any document endorsement described in paragraph (b), (c), or (d) of this section, the existing gas vessel must meet the requirements in each of the following:

(1) Section 154.310 (d) and (e).

(2) Section 154.320 (b) and (c).

(3) Section 154.330 (a) through (e).

(4) Section 154.340(d).

(5) Section 154.345 (a), (b)(1) through (b)(5), (b)(7) and (c).

(6) Section 154.476(a).

(7) Section 154.519(a)(2).

(8) Section 154.534.

(9) Section 154.538.

(10) Section 154.540 (c) and (d).

(11) Section 154.556.

(12) Section 154.558.

(13) Section 154.560.

(14) Section 154.562.

(15) Section 154.703.

(16) Section 154.705.

(17) Section 154.706.

(18) Section 154.707.

(19) Section 154.708.

(20) Section 154.709.

(21) Section 154.904.

(22) Section 154.906.

(23) Section 154.908(a), unless the space is separated from the accommodation, service, or control space by a steel door that—

(i) Is watertight when tested with a firehose at not less than 207 kPa gauge (30 psig);

(ii) Has a means to self-close and does not have latches or other devices designed to hold it open; and

(iii) Has an audible and visual alarm on both sides of the door which is actuated when the door is open.

(24) Section 154.910.

(25) Section 154.912.

(26) Sections 154.1110 through 154.1130, except §§154.1115(b), 154.1120(b), and 154.1125 (c) and (f).

(27) Section 154.1145, except an existing gas vessel with a cargo carrying capacity of less than 2500 m^3 (88,200 ft^3) may have only one self-contained dry chemical storage unit if that unit—

(i) is installed before November 1, 1987; and

(ii) Has the capacity to meet §154.1145 (d) and (e), and §154.1170(e).

(28) Section 154.1150 (a) and (b).

(29) Section 154.1155.

(30) Section 154.1160.

(31) Section 154.1165 (a), (b), (d), and (f).

(32) Section 154.1170 (b) through (f).

(33) Section 154.1200 (a), (b)(1), and (b)(2).

(34) Section 154.1205(f).

(35) Section 154.1325.

(36) Section 154.1335(e).

(37) Section 154.1350 (e), (f), (i), (o), and (u).

§154.15 U.S. flag vessel: Endorsement application.

(a) A person who desires the endorsement required under §154.1801 for a U.S. flag vessel must submit an application for an endorsement of the vessel's Subchapter D Certificate of Inspection under the procedures in §91.55–15 of this chapter.

(b) The person requesting an endorsement under paragraph (a) of this section must submit to the Coast Guard, if requested—

(1) Calculations for hull design required by §172.175 of this chapter;

(2) The plans and information listed in §§54.01–18, 56.01–10, 91.55–5 (a), (b), (d), (g), and (h), and 110.25–1 of this chapter;

(3) Plans for the dry chemical supply and distribution systems, including the controls; and

(4) Any other vessel information, including, but not limited to plans, design calculations, test results, certificates, and manufacturer's data, needed to determine whether or not the vessel meets the standards of this part.

§ 154.17 U.S. flag vessel: Certificate of Inspection endorsement.

The Certificate of Inspection for a U.S. flag vessel allowed to carry a liquefied gas listed in Table 4 has the following endorsement for each cargo, with the corresponding carriage requirement data inserted:

Inspected and approved for the carriage of _____ at a maximum allowable relief valve setting of _____ kPa gauge (_____ psig) with an F factor of _____, a maximum external pressure of _____ kPa gauge (_____ psig), a minimum service temperature of _____ °C (_____ °F), and a maximum specific gravity of _____. Hull type _____.

§ 154.19 U.S. flag vessel: IMO certificate issuance.

(a) The Coast Guard Officer in Charge, Marine Inspection, issues an IMO Certificate to a U.S. flag vessel when requested by the owner or representative, if—

(1) The vessel meets the requirements of this part; and

(2) It is a new gas vessel, it meets the IMO Resolution A.328(IX), ''Code for the Construction and Equipment of Ships Carrying Liquefied Gases in Bulk, 1975''; or

(3) It is an existing gas vessel, it meets the IMO ''Code for Existing Ships Carrying Liquefied Gases in Bulk, 1975''.

(b) The IMO Certificate expires on the same date that the vessel's Certificate of Inspection expires.

§ 154.22 Foreign flag vessel: Certificate of Compliance endorsement application.

(a) A person who desires an endorsed Certificate of Compliance to meet § 154.1802(a) for a foreign flag vessel, whose flag administration issues IMO Certificates, must submit to the Commanding Officer, U.S. Coast Guard Marine Safety Center (G–MSC), 400 Seventh St., SW., Washington, DC 20590–0001, an application that includes the following:

(1) The vessel's valid IMO Certificate.

(2) A description of the vessel.

(3) Specifications for the cargo containment system.

(4) A general arrangement plan of the vessel.

(5) A midship section plan of the vessel.

(6) Schematic plans of the liquid and vapor cargo piping.

(7) A firefighting and safety plan.

(8) If the applicant is requesting an endorsement for the carriage of ethylene oxide, a classification society certification that the vessel meets § 154.1725(a) (4), (5), and (7).

(9) If the vessel is a new gas vessel, or an existing vessel that does not meet § 154.12 (b), (c), or (d)—

(i) A certification from a classification society that the vessel—

(A) Has enhanced grades of steel meeting § 154.170 (b)(1) and (b)(2) for crack arresting purposes in the deck stringer, sheer strake, and bilge strake; and

(B) Meets § 154.701, or if the vessel carries methane, meets § 154.703, by having the capability of cargo tank pressure and temperature control without venting; and

(ii) The vessel's valid SOLAS Cargo Ship Safety Construction Certificate and Cargo Ship Safety Equipment Certificate.

(10) Any additional plans, certificates, and information needed by the Commanding Officer, Marine Safety Center to determine whether or not the vessel meets this part.

(b) A person who desires an endorsed Certificate of Compliance to meet § 154.1802(b) for a foreign flag vessel, whose flag administration does not issue IMO Certificates, must submit to the Commanding Officer, Marine Safety Center the plans, calculations, and information under § 154.15(b).

[CGD 77–069, 52 FR 31626, Aug. 21, 1987, as amended by CGD 88–070, 53 FR 34535, Sept. 7, 1988; CGD 89–025, 54 FR 19571, May 8, 1989; CGD 95–072, 60 FR 50466, Sept. 29, 1995; 60 FR 54106, Oct. 19, 1995]

§154.24 Foreign flag vessel: IMO Certificate.

(a) An IMO Certificate issued under the IMO Resolution A.328(IX),''Code for the Construction and Equipment of Ships Carrying Liquefied Gases in Bulk, 1975'' is usually sufficient evidence of compliance with this part for the Coast Guard to endorse a foreign flag vessel's Certificate of Compliance with the name of each cargo in Table 4 (follows §154.1872) that is listed on the IMO Certificate, if the information listed in item 3 of the IMO Certificate shows that—

(1) The design ambient temperatures meet §154.174 and §154.176;

(2) The cargo tank design stress factors and resulting MARVS of independent tanks type B or C meet §154.447 or §154.450; and

(3) The cargo tank MARVS of a type IIPG ship meets §172.175(c) of this chapter.

(b) If a foreign flag existing gas vessel meets §154.12 (b), (c), or (d), the vessel's IMO Certificate issued under the IMO ''Code for Existing Ships Carrying Liquefied Gases in Bulk, 1975'' is usually sufficient evidence of compliance with the requirements of §154.12(e) for the Coast Guard to endorse the Certificate of Compliance with the name of each cargo in Table 4 (follows §154.1872) that is listed on the IMO Certificate; however if a foreign flag existing gas vessel does not meet §154.12 (b), (c), or (d), an IMO Certificate issued under the IMO ''Code for Existing Ships Carrying Liquefied Gases in Bulk, 1975'' is not acceptable evidence of compliance with the requirements of this part for the endorsement of a Certificate of Compliance.

§154.30 Liquefied gases not included in Table 4.

(a) A liquefied gas not appearing in Table 4 (follows §154.1872) must be specially approved by the Commandant (G–MSO) to be carried in bulk in U.S. waters.

(b) A person who desires to ship a liquefied gas in bulk that is not listed in Table 4 must submit to the Commandant (G–MSO) a completed form CG–4355. This form may be obtained from the Commandant (G–MSO) or any Officer in Charge, Marine Inspection (OCMI).

(c) The Commandant (G–MSO) notifies the submitter by letter whether or not the liquefied gas is specially approved for carriage in bulk in U.S. waters and the minimum requirements for that carriage. If the liquefied gas is not specially approved, the reasons why the special approval is not granted are included.

§154.32 Equivalents.

(a) A vessel that fails to meet the standards in this part for an endorsement on a Certificate of Inspection or a Certificate of Compliance may meet an alternate standard if the Commandant (G–MSO) finds that the alternate standard provides an equivalent or greater level of protection for the purpose of safety.

(b) The Commandant (G–MSO) considers issuance of a finding of equivalence to the standard required by this part if the person requesting the finding submits a written application to the Commandant (G–MSO) that includes—

(1) A detailed explanation of the vessel's characteristics that do not meet the requirements in this part; and

(2) An explanation of how each substituted standard would enable the vessel to meet a level of safety that would be equivalent to or greater than the standard in this part.

(c) Operational methods or procedures may not be substituted for a particular fitting, material, appliance, apparatus, item, or type of equipment required in this part.

§154.34 Special approval: Requests.

Each request for special approval must be in writing and submitted to the Commandant (G–MSO), U.S. Coast Guard, 2100 Second Street SW., Washington, DC 20593–0001.

§154.36 Correspondence and vessel information: Submission.

Correspondence to the Coast Guard and all vessel information submitted to the Coast Guard must be in English, except—

(a) IMO Certificates may be in French; and

(b) SOLAS Certificates may be in the official language of the flag administration.

§ 154.40 Right of appeal.

Any person directly affected by a decision or action taken under this part, by or on behalf of the Coast Guard, may appeal therefrom in accordance with subpart 1.03 of this chapter.

[CGD 88–033, 54 FR 50381, Dec. 6, 1989]

Subpart B—Inspections and Tests

EXAMINATION REQUIREMENTS FOR FOREIGN FLAG VESSELS

§ 154.150 Examination required for a Certificate of Compliance.

Before a vessel receives an initial or reissued Certificate of Compliance endorsed with the name of a cargo from Table 4 of this part, the vessel must call at a United States port for an examination, during which the Officer in Charge, Marine Inspection, determines whether or not the vessel meets the requirements of this chapter.

[CGD 81–052, 50 FR 8734, Mar. 5, 1985]

§ 154.151 Procedures for having the Coast Guard examine a vessel for a Certificate of Compliance.

To have the Coast Guard examine the vessel for a Certificate of Compliance, as required in § 154.150, the owner of a foreign flag vessel must proceed as follows:

(a) After submitting an application under § 154.22, await notification by the Commanding Officer, Marine Safety Center that review of the vessel's plans or IMO Certificate and supporting documents is complete.

(b) Except when paragraph (c) of this section applies,

(1) After receiving notification from Commanding Officer, Marine Safety Center that review is complete and the application is acceptable, dispatch the vessel to a United States port;

(2) Notify the Officer in Charge, Marine Inspection, for the port where the vessel is to be inspected at least seven days before the vessel arrives and arrange the exact time and other details of the examination. This notification is in addition to any other pre-arrival notice to the Coast Guard required by other regulations and must include:

(i) The name of the vessel's first U.S. port of call;

(ii) The date the vessel is scheduled to arrive;

(iii) The name and telephone number of the owner's local agent; and

(iv) The names of all cargoes listed in Table 4 of this part that are on board the vessel;

(3) Make sure that the following items are available on board the vessel for the use of the Marine Inspector before beginning the examination required by § 154.150:

(i) A general arrangement (including the location of firefighting, safety, and lifesaving gear); and

(ii) The cargo manual required by § 154.1810.

(c) If the vessel was accepted for U.S. service on the basis of Coast Guard plan review under § 154.5(b), the vessel owner must notify Commanding Officer, Marine Safety Center fourteen days prior to the vessel's arrival at a U.S. port. This notification must include:

(1) The name of the vessel's first U.S. port of call;

(2) The date the vessel is scheduled to arrive;

(3) The name and telephone number of the owner's local agent; and

(4) The names of all cargoes listed in Table 4 of this part that are on board the vessel.

[CGD 81–052, 50 FR 8734, Mar. 5, 1985; 50 FR 15895, Apr. 23, 1985; CGD 77–069, 52 FR 31630, Aug. 21, 1987; CGD 95–072, 60 FR 50466, Sept. 29, 1995; 60 FR 54106, Oct. 19, 1995]

Subpart C—Design, Construction and Equipment

HULL STRUCTURE

§ 154.170 Outer hull steel plating.

(a) Except as required in paragraph (b) of this section, the outer hull steel plating, including the shell and deck plating must meet the material standards of the American Bureau of Shipping published in ''Rules for Building and Classing Steel Vessels'' 1981.

(b) Along the length of the cargo area, grades of steel must be as follows:

(1) The deck stringer and sheer strake must be at least Grade E steel or a grade of steel that has equivalent chemical properties, mechanical properties, and heat treatment, and that is specially approved by the Commandant (G–MSO).

(2) The strake at the turn of the bilge must be Grade D, Grade E, or a grade of steel that has equivalent chemical properties, mechanical properties, and heat treatment, and that is specially approved by the Commandant (G–MSO).

(3) The outer hull steel of vessels must meet the standards in § 154.172 if the hull steel temperature is calculated to be below −5° C (23°F) assuming:

(i) For any waters in the world, the ambient cold conditions of still air at 5°C (41°F) and still sea water at 0°C (32°F);

(ii) For cargo containment systems with secondary barriers, the temperature of the secondary barrier is the design temperature; and

(iii) For cargo containment systems without secondary barriers, the temperature of the cargo tank is the design temperature.

[CGD 74–289, 44 FR 26009, May 3, 1979, as amended by CGD 82–063b, 48 FR 4782, Feb. 3, 1983; CGD 77–069, 52 FR 31630, Aug. 21, 1987]

§ 154.172 Contiguous steel hull structure.

(a) Except as allowed in paragraphs (b) and (c) of this section, plates, forgings, forged and rolled fittings, and rolled and forged bars and shapes used in the construction of the contiguous steel hull structure must meet the thickness and steel grade in Table 1 for the temperatures under §§ 154.174(b) and 154.176(b).

(b) for a minimum temperature, determined under §§ 154,174(b) and 154.176(b), below −25°C (−13°F), the contiguous steel hull structure must meet § 54.25–10 for that minimum temperature.

(c) If a steel grade that is not listed in Table 1 has the equivalent chemical properties, mechanical properties, and heat treatment of a steel grade that is listed, the steel grade not listed may be specially approved by the Commandant (G–MSO), for use in the contiguous hull structure.

Table 1—MINIMUM TEMPERATURE, THICKNESS, AND STEEL GRADES IN CONTIGUOUS HULL STRUCTURES

Minimum temperature	Steel thickness	Steel[1] grade
0°C (32°F)	All	Standards of the American Bureau of Shipping published in ''Rules for Building and Classing Steel Vessels'', 1981
−10°C (14°F)	T≤112.5 mm (½ in.).	B
	12.5< t≤25.5 mm (1 in.).	D
	t;gt;25.5 mm (1 in.)	E
−25°C (−13°F).	t≤112.5 mm (½ in.)	D
	t>12.5 mm (½ in.)	E

[1] Steel grade of the American Bureau of Shipping published in ''Rules for Building and Classing Steel Vessels'', 1981.

[CGD 74–289, 44 FR 26009, May 3, 1979, as amended by CGD 82–063b, 48 FR 4782, Feb. 3, 1983; CGD 77–069, 52 FR 31630, Aug. 21, 1987]

§ 154.174 Transverse contiguous hull structure.

(a) The transverse contiguous hull structure of a vessel having cargo containment systems without secondary barriers must meet the standards of the American Bureau of Shipping published in ''Rules for Building and Classing Steel Vessels'', 1981.

(b) The transverse contiguous hull structure of a vessel having cargo containment systems with secondary barriers must be designed for a temperature that is:

(1) Colder than the calculated temperature of this hull structure when:

(i) The temperature of the secondary barrier is the design temperature, and

(ii) The ambient cold condition under § 154.176(b)(1)(ii) and (iii) are assumed; or

(2) Maintained by the heating system under § 154.178.

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

§ 154.176 Longitudinal contiguous hull structure.

(a) The longitudinal contiguous hull structure of a vessel having cargo containment systems without secondary

barriers must meet the standards of the American Bureau of Shipping published in ''Rules for Building and Classing Steel Vessels'', 1981.

(b) The longitudinal contiguous hull structure of a vessel having cargo containment systems with secondary barriers must be designed for a temperature that is:

(1) Colder than the calculated temperature of this hull structure when:

(i) The temperature of the secondary barrier is the design temperature; and

(ii) For any waters in the world except Alaskan waters, the ambient cold condition of:

(A) Five knots air at −18°C (0°F); and

(B) Still sea water at 0°C (32°F); or

(iii) For Alaskan waters the ambient cold condition of:

(A) Five knots air at −29°C (−20°F); and

(B) Still sea water at −2°C (28°F); or

(2) Maintained by the heating system under §154.178, if, without heat, the contiguous hull structure is designed for a temperature that is colder than the calculated temperature of the hull structure assuming the:

(i) Temperature of the secondary barrier is the design temperature; and

(ii) Ambient cold conditions of still air at 5°C (41°F) and still sea water at 0°C (32°F).

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

§154.178 Contiguous hull structure: Heating system.

The heating system for transverse and longitudinal contiguous hull structure must:

(a) Be shown by a heat load calculation to have the heating capacity to meet §154.174(b)(2) or §154.176(b)(2);

(b) Have stand-by heating to provide 100% of the required heat load and distribution determined under paragraph (a); and

(c) Meet Parts 52, 53, and 54 of this chapter.

§154.180 Contiguous hull structure: Welding procedure.

Welding procedure tests for contiguous hull structure designed for a temperature colder than −18°C (0°F) must meet §54.05–15 and subpart 57.03 of this chapter.

§154.182 Contiguous hull structure: Production weld test.

If a portion of the contiguous hull structure is designed for a temperature colder than −34°C (−30°F) and is not part of the secondary barrier, each 100m (328 ft.) of full penetration butt welded joints in that portion of the contiguous hull structure must pass the following production weld tests in the position that the joint is welded:

(a) Bend tests under §57.06–4 of this chapter.

(b) A Charpy V-notch toughness test under §57.06–5 of this chapter on one set of 3 specimens alternating the notch location on successive tests between the center of the weld and the most critical location in the heat affected zone.[2]

(c) If the contiguous hull structure does not pass the test under paragraph (b) of this section, the retest procedures under §54.05–5(c) must be met.

§154.188 Membrane tank: Inner hull steel.

For a vessel with membrane tanks, the inner hull plating thickness must meet the deep tank requirements of the American Bureau of Shipping published in ''Rules for Building and Classing Steel Vessels'', 1981.

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

§154.195 Aluminum cargo tank: Steel enclosure.

(a) An aluminum cargo tank and its dome must be enclosed by the vessel's hull structure or a separate steel cover.

(b) The steel cover for the aluminum cargo tank must meet the steel structural standards of the American Bureau of Shipping published in ''Rules for Building and Classing Steel Vessels'', 1981.

(c) The steel cover for the aluminum tank dome must be:

[2] The most critical location in the heat affected zone of the weld is based on procedure qualification results, except austenitic stainless steel need have notches only in the center of the weld.

(1) At least 3.2 mm (⅛ in.) thick;
(2) Separated from the tank dome, except at the support points; and
(3) Thermally isolated from the dome.

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

SHIP SURVIVAL CAPABILITY AND CARGO TANK LOCATION

§ 154.200 Stability requirements: General.

Each vessel must meet the applicable requirements in subchapter S of this chapter.

[CGD 79–023, 48 FR 51009, Nov. 4, 1983]

§ 154.235 Cargo tank location.

(a) For type IG hulls, cargo tanks must be located inboard of:
(1) The transverse extent of damage for collision penetration specified in Table 172.180 of this chapter;
(2) The vertical extent of damage for grounding penetration specified in Table 172.180 of this chapter; and
(3) 30 inches (760 mm) from the shell plating.
(b) For type IIG, IIPG, and IIIG hulls, cargo tanks must be located inboard of:
(1) The vertical extent of damage for grounding penetration specified in Table 172.180 of this chapter; and
(2) 30 inches (760 mm) from the shell plating.
(c) In vessels having membrane and semi-membrane tanks, the vertical and transverse extents of damage must be measured to the inner hull.
(d) For type IIG, IIPG, and IIIG hulls, cargo tank suction wells may penetrate into the area of bottom damage specified as the vertical extent of damage for grounding penetration in Table 172.180 of this chapter if the penetration is the lesser of 25% of the double bottom height or 13.8 in. (350 mm).

[CGD 74–289, 44 FR 26009, May 3, 1979, as amended by CGD 79–023, 48 FR 51010, Nov. 4, 1983]

SHIP ARRANGEMENTS

§ 154.300 Segregation of hold spaces from other spaces.

Hold spaces must be segregated from machinery and boiler spaces, accommodation, service and control spaces, chain lockers, potable, domestic and feed water tanks, store rooms and spaces immediately below or outboard of hold spaces by a:
(a) Cofferdam, fuel oil tank, or single gastight A–60 Class Division of all welded construction in a cargo containment system not required by this part to have a secondary barrier;
(b) Cofferdam or fuel oil tank in a cargo containment system required by this part to have a secondary barrier; or
(c) If there are no sources of ignition or fire hazards in the adjoining space, single gastight A–O Class Division of all welded construction.

§ 154.305 Segregation of hold spaces from the sea.

In vessels having cargo containment systems required by this part to have a secondary barrier, hold spaces must be segregated from the sea by:
(a) A double bottom if the cargo tanks meet this part for design temperatures colder than −10°C (14°F); and
(b) Wing tanks if the cargo tanks meet this part for design temperatures colder than −55°C (−67°F).

§ 154.310 Cargo piping systems.

Cargo liquid or vapor piping must:
(a) Be separated from other piping systems, except where an interconnection to inert gas or purge piping is required by § 154.901(a);
(b) Not enter or pass through any accommodation, service, or control space;
(c) Except as allowed under § 154.703, not enter or pass through a machinery space other than a cargo pump or compressor room;
(d) Be in the cargo area except:
(1) As allowed under § 154.703;
(2) Bow and stern loading piping; and
(3) Emergency jettisoning piping.
(e) Be above the weather deck except:
(1) As allowed under § 154.703;
(2) Pipes in a trunk traversing void spaces above a cargo containment system; and
(3) Pipes for draining, venting, or purging interbarrier and hold spaces;
(f) Connect into the cargo containment system above the weather deck except:

(1) Pipes in a trunk traversing void spaces above a cargo containment system; and

(2) Pipes for draining, venting, or purging interbarrier and hold spaces.

(g) Be inboard of the transverse cargo tank location required by §154.235, except for athwartship shore connection manifolds not subject to internal pressure at sea.

§ 154.315 Cargo pump and cargo compressor rooms.

(a) Cargo pump rooms and cargo compressor rooms must be above the weather deck and must be within the cargo area.

(b) Where pumps and compressors are driven by a prime mover in an adjacent gas safe space:

(1) The bulkhead or deck must be gastight; and

(2) The shafting passing through the bulkhead or deck must be sealed by a fixed oil reservoir gland seal, a pressure grease seal, or another type of positive pressure seal 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]

§ 154.320 Cargo control stations.

(a) Cargo control stations must be above the weather deck.

(b) If a cargo control station is in accommodation, service, or control spaces or has access to such a space, the station must:

(1) Be a gas safe space;

(2) Have an access to the space that meets §154.330; and

(3) Have indirect reading instrumentation, except for gas detectors.

(c) Cargo control stations, including a room or area, must contain all alarms, indicators, and remote controls associated with each cargo tank that the station controls.

§ 154.325 Accommodation, service, and control spaces.

(a) Accommodation, service, and control spaces must be outside the cargo area.

(b) If a hold space having a cargo containment system, required by this part to have a secondary barrier, is separated from any accommodation, service, or control space by a cruciform joint, there must be a cofferdam providing at least 760 mm (30 inches) by 760 mm (30 inches) clearance on one side of the cruciform joint.

§ 154.330 Openings to accommodation, service, or control spaces.

(a) Entrances, forced or natural ventilation intakes and exhausts, and other openings to accommodation, service, or control spaces, except as allowed in paragraph (c) of this section, must be:

(1) At least L/25 or 3.05m (10 ft) from the athwartship bulkhead facing the cargo area, whichever is farther, except that the distance need not exceed 5m (16.4 ft); and

(2) On a house athwartship bulkhead not facing the cargo area or on the outboard side of the house.

(b) Each port light, located on the athwartship bulkhead of a house facing the cargo area or the house sides within the distance specified in paragraph (a)(1) of this section, must be a fixed type.

(c) Wheelhouse doors and windows that are not fixed may be within the distance specified in paragraph (a)(1) of this section from the athwartship bulkhead of a house facing the cargo area, if they have gaskets and pass a tightness test with a fire hose at not less than 207 kPa gauge (30 psig).

(d) Port lights in the hull plating below the uppermost continuous deck and in the first tier of the superstructure must be a fixed type.

(e) Air intakes and openings into accommodation, service, and control spaces must have metal closures that pass a tightness test with a fire hose at not less than 207 kPa gauge (30 psig).

(f) On liquefied toxic gas vessels, the closures required in paragraph (e) of this section must be capable of being closed from inside the space.

§ 154.340 Access to tanks and spaces in the cargo area.

(a) Each cargo tank must have a manhole from the weather deck, the clear opening of which is at least 600 mm by 600 mm (23.6 in. by 23.6 in.).

(b) Each access into and through a void space or other gas-dangerous space in the cargo area, except spaces

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:

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

''σ**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:

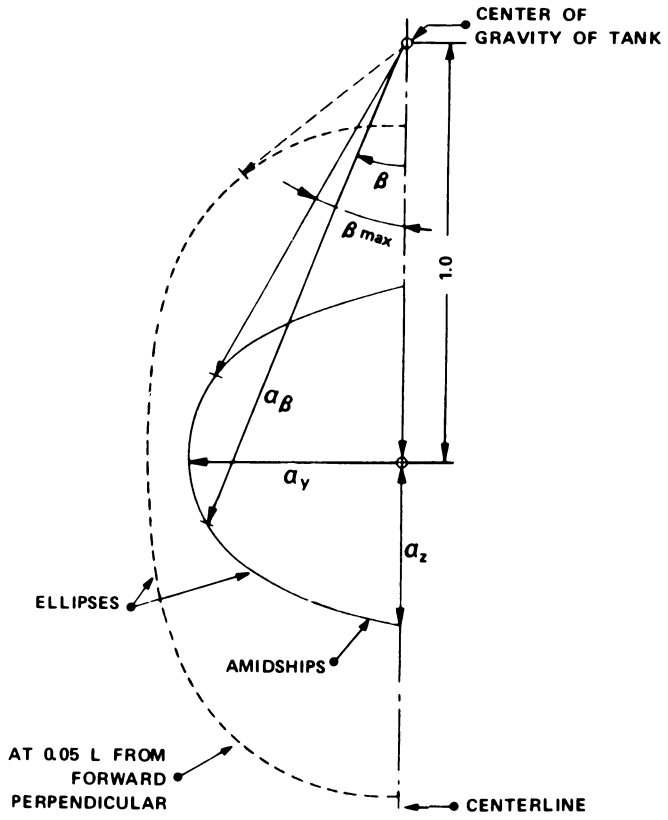
h_{gd} (the value of internal pressure, in meters of fresh water, resulting from the combined effects of gravity and dynamic accelerations of a full tank)$=a_\beta\ Z_\beta\ Y$;

where:

a_β=dimensionless acceleration relative to the acceleration of gravity resulting from gravitational and dynamic loads in the β direction (see figure 1);

Z_β=largest liquid height (m) above the point where the pressure is to be determined in the β direction (see figure 2);

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

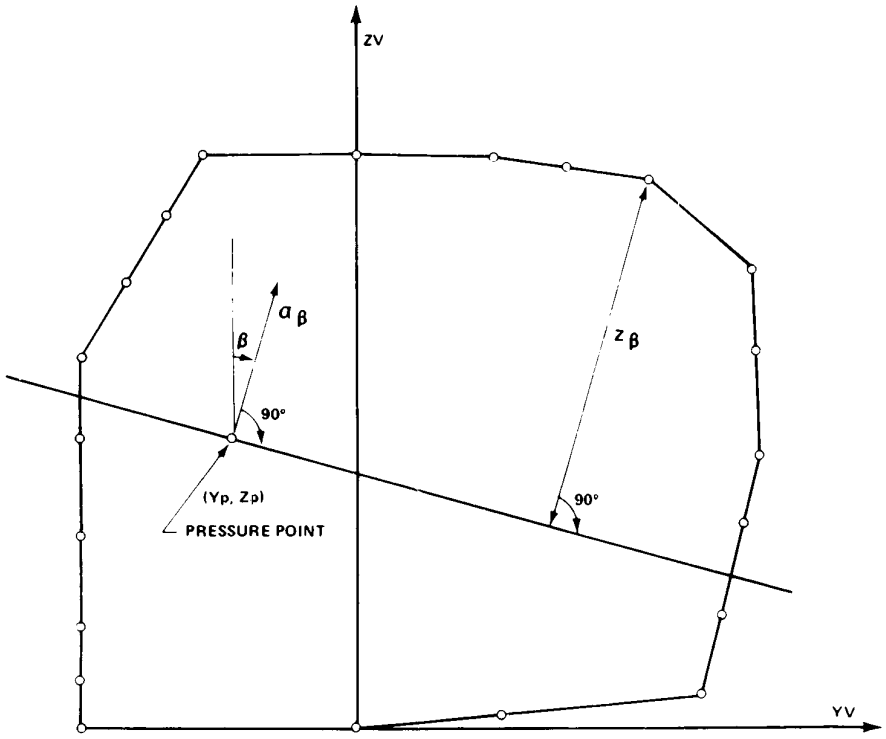


NOTE: RESULTING ACCELERATION (STATIC + DYNAMIC) = a_β IN ARBITRARY DIRECTION β.

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_β

Figure 2. Determination of Internal Pressure Heads

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

specially approved by the Commandant (G–MSO) and if that reduced speed is used in the hull strength calculation under §31.10–5(c) of this chapter.

(b) If the loads determined under paragraphs (c), (d), or (e) of this section result in a design stress that is lower than the allowable stress of the material under §§154.610, 154.615, or 154.620, the allowable stress must be reduced to that stress determined in paragraphs (c), (d), or (e).

(c) If a tank is designed to avoid plastic deformation and buckling, then acceleration components of the dynamic loads must be determined for the largest loads the vessel may experience during an operating life corresponding to the probability level of 10^{-8}, by using one of the following methods:

(1) Method 1 is a detailed analysis of the vessel's acceleration components.

(2) Method 2 applies to vessels of 50 m (164 ft) or more in length and is an analysis by the following formulae that corresponds to a 10^{-8} probability level in the North Atlantic:

(i) Vertical acceleration under paragraph (f)(1) of this section:

$$a_z = \pm a_o \sqrt{1 + \left(5.3 - \frac{45}{L_o}\right)^2 \left(\frac{x}{L_o} + 0.05\right)^2 \left(\frac{0.6}{C_B}\right)^{3/2}}$$

(ii) Transverse acceleration under § 154.409(f)(2):

$$a_y = \pm a_o \sqrt{0.6 + 2.5\left(\frac{x}{L_o} + 0.05\right)^2 + K\left(1 + 0.6K\frac{z}{B}\right)^2}$$

(iii) Longitudinal acceleration under § 154.409(f)(3):

$$a_x = \pm a_o \sqrt{0.06 + A^2 - 0.25A}$$

where:

$$A = \left(0.7 - \frac{L_o}{1200} + 5\frac{z}{L_o}\right)\left(\frac{0.6}{C_B}\right)$$

L_o = the distance in meters on the estimated summer loadline, from the fore side of the stem to the after side of the rudder-post or sternpost: where there is no rudderpost or sternpost, L_o is to be measured to the centerline of the rudder stock, but in any case

L_o is not to be less than 96% and need not be greater than 97% of the length on the summer loadline.

C_B = block coefficent.

B = greatest moulded breadth, in meters.

x = longitudinal distance, in meters, from amidships to the center of gravity of the tank with contents (positive - forward of amidships. negative - aft of amidships).

z = vertical distance in meters, from the vessel's waterline, to center of gravity of tank with contents (positive - above, and negative - below the waterline).

$$a_o = 0.2 \frac{V}{\sqrt{L_o}} + \frac{34-(600/L_o)}{L_o}$$

V = service speed in knots.

K = $1.00 \text{ OR } \frac{13GM}{B}$, whichever is greater.

GM = metacentric height in meters.

a_x = the maximum dimensionless acceleration in the x direction, acting separately for calculation purposes, and includes the component of the static weight in the longitudinal direction due to pitching.

a_y = maximum dimensionless acceleration in the y direction, acting separately for calculation purposes, and includes the component of static weight in the transverse direction due to rolling.

a_z = maximum dimensionless acceleration in the z direction, acting separately for calculation purposes, not including the static weight.

(d) If a cargo tank is designed to avoid fatigue, the dynamic loads determined under paragraph (a) of this section must be used to develop the dynamic spectrum.

(e) If a cargo tank is designed to avoid uncontrolled crack propagation, the dynamic loads are:

(1) Determined under paragraph (a) of this section; and

(2) For a load distribution for a period of 15 days by the method in Figure 3.

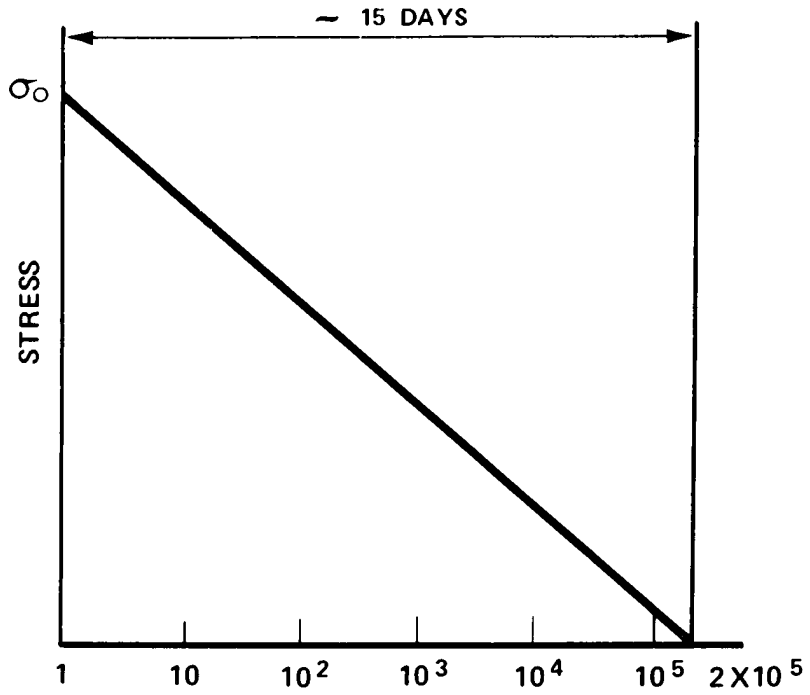


Figure 3. Simplified Load Distribution

(f) When determining the accelerations for dynamic loads under paragraph (a) of this section, the accelerations acting in a cargo tank must be estimated for the cargo tank's center of gravity and include the following component accelerations:

(1) Vertical accelerations, meaning the motion acceleration of heave and pitch, and of any roll normal to the vessel base that has an effect on the component acceleration.

(2) Transverse acceleration, meaning the motion acceleration of sway, yaw and roll, and gravity component of roll.

(3) Longitudinal acceleration, meaning the motion acceleration of surge and pitch and gravity component of pitch.

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

§ 154.410 Cargo tank sloshing loads.

(a) For the calculation required under § 154.406 (a)(5) and (b), the determined sloshing loads resulting from the accelerations under § 154.409(f) must be specially approved by the Commandant (G–MSO).

(b) If the sloshing loads affect the cargo tank scantlings, an analysis of the effects of the sloshing loads in addition to the calculation under paragraph (a) of this section 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]

§ 154.411 Cargo tank thermal loads.

For the calculations required under § 154.406(a)(4), the following determined loads must be specially approved by the Commandant (G–MSO):

(a) Transient thermal loads for the cooling down periods of cargo tanks for design temperatures lower than −55°C (−67°F).

(b) Stationary thermal loads for cargo tanks for design temperatures lower than −55°C (−67°F) that cause high thermal stress.

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

§ 154.412 Cargo tank corrosion allowance.

A cargo tank must be designed with a corrosion allowance if the cargo tank:

(a) is located in a space that does not have inert gas or dry air; or

(b) carries a cargo that corrodes the tank material.

NOTE: Corrosion allowance for independent tank type C is contained in § 54.01–35 of this chapter.

INTEGRAL TANKS

§ 154.418 General.

An integral tank must not be designed for a temperature colder than −10°C (14°F), unless the tank is 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]

§ 154.419 Design vapor pressure.

The P_o of an integral tank must not exceed 24.5 kPa gauge (3.55 psig) unless special approval by the Commandant (G–MSO) allows a P_o between 24.5 kPa gauge (3.55 psig) and 69 kPa gauge (10 psig).

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

§ 154.420 Tank design.

(a) The structure of an integral tank must meet the deep tank scantling standards of the American Bureau of Shipping published in ''Rules for Building and Classing Steel Vessels'', 1981.

(b) The structure of an integral tank must be designed and shown by calculation to withstand the internal pressure determined under § 154.407.

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

§ 154.421 Allowable stress.

The allowable stress for the integral tank structure must meet the American Bureau of Shipping's allowable stress for the vessel's hull published in ''Rules for Building and Classing Steel Vessels'', 1981.

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

MEMBRANE TANKS

§ 154.425 General.

The design of the hull structure and the design of the membrane tank system, that includes the membrane tank, secondary barrier, including welds, the supporting insulation, and pressure control equipment, 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]

§ 154.426 Design vapor pressure.

The P_o of a membrane tank must not exceed 24.5 kPa gauge (3.55 psig) unless special approval by the Commandant (G–MSO) allows a P_o between 24.5 kPa gauge (3.55 psig) and 69 kPa gauge (10 psig).

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

§ 154.427 Membrane tank system design.

A membrane tank system must be designed for:

(a) Any static and dynamic loads with respect to plastic deformation and fatigue;

(b) Combined strains from static, dynamic, and thermal loads;

(c) Preventing collapse of the membrane from:

(1) Over-pressure in the interbarrier space;

(2) Vacuum in the cargo tank;

(3) Sloshing in a partially filled cargo tank; and

(4) Hull vibrations; and

(d) The deflections of the vessel's hull.

§ 154.428 Allowable stress.

The membrane tank and the supporting insulation must have allowable stresses that are 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]

§ 154.429 Calculations.

The tank design load calculations for a membrane tank must include the following:

(a) Plastic deformation and fatigue life resulting from static and dynamic loads in the membrane and the supporting insulation.

(b) The response of the membrane and its supporting insulation to vessel motion and acceleration under the worst weather conditions. Calculations from a similar vessel may be submitted to meet this paragraph.

(c) The combined strains from static, dynamic, and thermal loads.

§ 154.430 Material test.

(a) The membrane and the membrane supporting insulation must be made of materials that withstand the combined strains calculated under § 154.429(c).

(b) Analyzed data of a material test for the membrane and the membrane supporting insulation must be submitted to 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]

§ 154.431 Model test.

(a) The primary and secondary barrier of a membrane tank, including the corners and joints, must withstand the combined strains from static, dynamic, and thermal loads calculated under § 154.429(c).

(b) Analyzed data of a model test for the primary and secondary barrier of the membrane tank must be submitted to 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]

§ 154.432 Expansion and contraction.

The support system of a membrane tank must allow for thermal and physical expansion and contraction of the tank.

SEMI-MEMBRANE TANKS

§ 154.435 General.

(a) The design of a semi-membrane tank, the supporting insulation for the tank, and the supporting hull structure for the tank must be specially approved by the Commandant (G–MSO).

(b) A semi-membrane tank must be designed to meet:

(1) § 154.425 through § 154.432;

(2) § 154.437 through § 154.440; or

(3) § 154.444 through § 154.449.

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

§154.436 Design vapor pressure.

The P_o of a semi-membrane tank must not exceed 24.5 kPa gauge (3.55 psig) unless special approval by the Commandant (G–MSO) allows a P_o between 24.5 kPa gauge (3.55 psig) and 69 kPa gauge (10 psig).

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

INDEPENDENT TANK TYPE A

§154.437 General.

An independent tank type A must meet §154.438 through §154.440.

§154.438 Design vapor pressure.

(a) If the surface of an independent tank type A are mostly flat surfaces,the P_o must not exceed 69 kPa gauge (10 psig).

(b) If the surfaces of an independent tank type A are formed by bodies of revolution, the design calculation of the P_o 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]

§154.439 Tank design.

An independent tank type A must meet the deep tank standard of the American Bureau of Shipping published in ''Rules for Building and Classing Steel Vessels'', 1981, and must:

(a) Withstand the internal pressure determined under §154.407;

(b) Withstand loads from tank supports calculated under §§154.470 and 154.471; and

(c) Have a corrosion allowance that meets §154.412.

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

§154.440 Allowable stress.

(a) The allowable stresses for an independent tank type A must:

(1) For tank web frames, stringers, or girders of carbon manganese steel or aluminum alloys, meet $\sigma\mathbf{B}/2.66$ or $\sigma\mathbf{Y}$ 1.33, whichever is less; and

(2) For other materials, be specially approved by the Commandant (G–MSO).

(b) A greater allowable stress than required in paragraph (a)(1) of this section may be specially approved by the Commandant (G–MSO) if the equivalent stress ($\sigma\mathbf{c}$) is calculated from the formula in Appendix A of this part.

(c) Tank plating must meet the American Bureau of Shipping's deep tank standards, for an internal pressure head that meets §154.439(a), published in ''Rules for Building and Classing Steel Vessels'', 1981.

[CGD 74–289, 44 FR 26009, May 3, 1979, as amended by CGD 82–063b, 48 FR 4782, Feb. 3, 1983; CGD 77–069, 52 FR 31630, Aug. 21, 1987]

INDEPENDENT TANK TYPE B

§154.444 General.

An independent tank type B must be designed to meet §§154.445 through 154.449.

§154.445 Design vapor pressure.

If the surfaces of an independent tank type B are mostly flat surfaces, the P_o must not exceed 69 kPa gauge (10 psig).

§154.446 Tank design.

An independent tank type B must meet the calculations under §154.448.

§154.447 Allowable stress.

(a) An independent tank type B designed from bodies of revolution must have allowable stresses[3] determined by the following formulae:

$\sigma_m \leq f$
$\sigma_L \leq 1.5\ f$
$\sigma_b \leq 1.5\ F$
$\sigma_L + \sigma\mathbf{b} \leq 1.5\ F$
$\sigma_m + \sigma\mathbf{b} \leq 1.5\ F$

where:

σ_m=equivalent primary general membrane stress[4]
σ_L=equivalent primary local membrane stress[4]
σ_b=equivalent primary bending stress[4]
f=the lesser of (σ_B/A) or (σ_Y/B)
F=the lesser of (σ_B/C) or (σ_Y/D)
A, B, C, and D=stress factors in Table 2.

[3] See Appendix B for stress analyses definitions.

[4] See Appendix A for equivalent stress.

TABLE 2—VALUES FOR STRESS FACTORS

	Nickel steel and carbon manganese steel values	Austenitic steel values	Aluminum alloy values
Stress factors:			
A	4.0	4.0	4.0
B	2.0	1.6	1.5
C	3.0	3.0	3.0
D	1.5	1.5	1.5

(b) An independent tank type B designed from plane surfaces must have allowable stresses 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]

§ 154.448 Calculations.

The following calculations for an independent tank type B must be specially approved by the Commandant (G–MSO):

(a) Plastic deformation, fatigue life, buckling, and crack propagation resulting from static and dynamic loads on the tank and its support.

(b) A three-dimensional analysis of the stress exerted by the hull on the tank, its support, and its keys.

(c) The response of the tank and its support to the vessel's motion and acceleration in irregular waves or calculations from a similar vessel.

(d) A tank buckling analysis considering the maximum construction tolerance.

(e) A finite element analysis using the loads determined under § 154.406.

(f) A fracture mechanics analysis using the loads determined under § 154.406.

(g) The cumulative effects of the fatigue load from the following formula:

$$\sum \frac{n_1}{N_1} + \frac{10^3}{N_j} \leq C_w$$

where:

n_i=the number of stress cycles at each stress level during the life of the vessel;
N_i=the number of cycles to failure for corresponding stress levels from the Wohler (S–N) curve;
N_j=the number of cycles to failure from the fatigue load by loading and unloading the tank; and
C_w=0.5 or less. A C_w of greater than 0.5 but not exceeding 1.0 may be specially approved by the Commandant (G–MTH).

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

§ 154.449 Model test.

The following analyzed data of a model test of structural elements for independent tank type B must be submitted to the Commandant (G–MSO) for special approval:

(a) Stress concentration factors.

(b) Fatigue life.

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

INDEPENDENT TANK TYPE C AND PROCESS PRESSURE VESSELS

§ 154.450 General.

Independent tanks type C and process pressure vessels must be designed to meet the requirements under Part 54 of this chapter, except § 54.01–40(b), and:

(a) The calculation under § 54.01–18 (b)(1) must also include the design loads determined under § 154.406;

(b) The calculated tank plating thickness, including any corrosion allowance, must be the minimum thickness without a negative plate tolerance; and

(c) The minimum tank plating thickness must not be less than:

(1) 5mm (3⁄16 in.) for carbon-manganese steel and nickel steel;

(2) 3mm (1⁄8 in.) for austenitic steels; or

(3) 7mm (9⁄32 in.) for aluminum alloys.

§ 154.451 Design vapor pressure.

The P_o (kPa) of an independent tank type C must be calculated by the following formula:

$$P_o = 196 + AC(\rho)^{3/2}$$

where:

$A = 1.813\ (\sigma_m/\Delta\sigma_A)^2$;
σ_m=design primary membrane stress;
$\Delta\sigma_A$=(allowable dynamic membrane stress for double amplitude at probability level $Q = 10^{-8}$) 53.9 MPa (7821 psi) for ferritic and martensitic steels and 24.5 MPa (3555 psi) for 5083–0 aluminum;
C=a characteristic tank dimension that is the greatest of h, 0.75b, or 0.45 l;

where:

h=the height of the tank or the dimension in the vessel's vertical direction, in meters;
b=the width of the tank or the dimension in the vessel's transverse direction; in meters; and
l=the length of the tank or the dimension in the vessel's longitudinal direction, in meters; and
ρ=the specific gravity of the cargo.

§ 154.452 External pressure.

The design external pressure, P_e, for an independent tank type C must be calculated by the following formula:

$$P_e = P_1 + P_2 + P_3 + P_4$$

where:

P_1=the vacuum relief valve setting for tanks with a vacuum relief valve, or 24.5 kPa gauge (3.55 psig) for tanks without a vacuum relief valve.
P_2=0, or the pressure relief valve setting for an enclosed space containing any portion of a pressure vessel.
P_3=total compressive load in the tank shell from the weight of the tank, including corrosion allowance, weight of insulation, weight of dome, weight of pipe tower and piping, the effect of the partially filled tank, the effect of acceleration and hull deflection, and the local effect of external and internal pressure.
P_4=0, or the external pressure from the head of water from any portion of the pressure vessel on exposed decks.

§ 154.453 Failure to meet independent tank type C standards.

If the Commandant (G–MSO) determines during plan review, that a tank designed as an independent tank type C fails to meet the standards under § 154.450, § 154.451, and 154.452 and can not be redesigned to meet those standards, the tank may be redesigned as an independent tank type A or B.

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

SECONDARY BARRIER

§ 154.459 General.

(a) Each cargo tank must have a secondary barrier that meets Table 3 and except as allowed in Table 3, the hull must not be the secondary barrier.

(b) If the Commandant (G–MSO) specially approves an integral tank for a design temperature at atmospheric pressure lower than −10° C (14°F), the integral tank must have a complete secondary barrier that meets § 154.460.

(c) If the Commandant (G–MSO) specially approves a semi-membrane tank under the requirements of an independent tank type B, the semi-membrane tank may have a partial secondary barrier specially approved by the Commandant (G–MSO).

(d) If Table 3 allows the hull to be a secondary barrier, the vessel's hull must:

(1) Meet §§ 154.605 through 154.630; and

(2) Be designed for the stresses resulting from the design temperature.

TABLE 3—SECONDARY BARRIERS FOR TANKS

Tank type	Cargo temperature (T) at atmospheric pressure		
	T≥ −10°C (14°F)	T<–10°C (14°F)≥55°C (−67°F)	T< −55°C (−67°F)
Integral	No secondary barrier required	Tank type not usually allowed[1]	Tank type not allowed.
Membrane	...do	Complete secondary barrier[1]	Complete secondary barrier.
Semi-membrane	...do	...do	Do.
Independent:			
Type A	...do	...do	Do.
Type B	...do	Partial secondary barrier[1]	Partial secondary barrier.
Type C	...do	No secondary barrier required	No secondary barrier required.

[1] The hull may be a secondary barrier.

(14 U.S.C. 632; 46 U.S.C. 369, 375, and 416; 49 U.S.C. 1655(b); 49 CFR 1.46(b))
[CGD 74–289, 44 FR 26009, May 3, 1979, as amended by CGD 82–063b, 48 FR 4782, Feb. 3, 1983]

§ 154.460 Design criteria.

At static angles of heel up through 30°, a secondary barrier must

(a) If a complete secondary barrier is required in § 154.459, hold all of the liquid cargo in the cargo tank for at least 15 days under the dynamic loads in § 154.409(e);

(b) If a partial secondary barrier is permitted in § 154.459, hold any leakage of liquid cargo corresponding to the extent of failure under § 154.448(a) after initial detection or primary barrier leak for at least 15 days under the dynamic loads in § 154.409(e);

(c) If the primary barrier fails, prevent the temperature of the vessel's structure from falling below the minimum allowable service temperature of the steel; and

(d) Be designed so that a cargo tank failure does not cause a failure in the secondary barrier.

INSULATION

§ 154.465 General.

If the design temperature is below −10°C (14°F), the cargo tank insulation must prevent the temperature of the vessel's hull from cooling below the minimum temperature allowed under § 154.172.

§ 154.466 Design criteria.

(a) The insulation for a cargo tank without a secondary barrier must be designed for the cargo tank at the design temperature, and for a vessel operating in:

(1) Any waters in the world, except Alaskan waters, for the ambient cold condition of:

(i) Five knots air at −18°C (0°F); and

(ii) Still sea water at 0°C (32°F); or

(2) Alaskan waters for the ambient cold condition of:

(i) Five knots air at −29°C (20°F); and

(ii) Still sea water at −2°C (28°F).

(b) The insulation for a cargo tank with a secondary barrier must be designed for the secondary barrier at the design temperature, and the ambient cold conditions listed under paragraph (a)(1) or paragraph (a)(2) of this section.

(c) The insulation material must be designed for any loads transmitted from adjacent hull structure.

(d) Insulation for cargo tank and piping must meet § 38.05–20 of this chapter.

(e) Powder or granulated insulation must:

(1) Not compact from vibrations of the vessel;

(2) Maintain the thermal conductivity listed under § 154.467; and

(3) Not exert a static pressure greater than the external design pressure of the cargo tank under § 154.408.

§ 154.467 Submission of insulation information.

The following insulation information must be submitted for special approval by the Commandant (G–MSO):

(a) Compatibility with the cargo.

(b) Solubility in the cargo.

(c) Absorption of the cargo.

(d) Shrinkage.

(e) Aging.

(f) Closed cell content.

(g) Density.

(h) Mechanical properties.

(i) Thermal expansion.

(j) Abrasion.

(k) Cohesion.

(l) Thermal conductivity.

(m) Resistance to vibrations.

(n) Resistance to fire and flame spread.

(o) The manufacturing and installation details of the insulation including:

(1) Fabrication;

(2) Storage;

(3) Handling;

(4) Erection; and

(5) Quality control.

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

SUPPORT SYSTEM

§ 154.470 General.

(a) A cargo tank must have a support system that:

(1) prevents movement of the cargo tank under the static and dynamic loads in § 154.406; and

(2) allows the cargo tank to contract and expand from temperature variation and hull deflection without exceeding the design stress of the cargo tank and the hull.

(b) The cargo tank support system must have a key that prevents rotation of the cargo tank.

(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.

MATERIALS

§ 154.605 Toughness test.

(a) Each toughness test under §§ 154.610 through 154.625 must meet Subpart 54.05 of this chapter.

(b) If subsize test specimens are used for the Charpy V-notch toughness test, the Charpy V-notch energy must meet Table 54.05–20 (a) of this chapter.

§ 154.610 Design temperature not colder than 0° C (32°F).

Materials for cargo tanks for a design temperature not colder than 0°C (32°F) must meet the following:

(a) The tank materials must meet §§ 54.25–1 and 54.25–3 of this chapter.

(b) Plates, forgings, rolled and forged bars and shapes must be carbon manganese steel or other material allowed under §§ 154.615, 154.620, and 154.625.

(c) Plates must be normalized or quenched and tempered and where the thickness exceeds 20 mm (0.787 in.), made with fine grain practice, austenitic grain size of five or finer. A control rolling procedure may be substituted for normalizing if specially approved by the Commandant (G–MSO). Plate for an independent tank type C must also meet the requirements of ASTM A–20–75 and § 54.01–18(b)(5) of this chapter.

(d) For integral and independent type A tanks, the American Bureau of Shipping's grade D not exceeding 20 mm (0.787 in.) in thickness, and Grade E hull structural steel are allowed if the steel meets § 54.05–10 of this chapter.

(e) The tensile properties under paragraph (a) of this section must be determined for:

(1) Each plate as rolled; and

(2) Each five short ton batch of forgings, forged or rolled fittings, and forged or rolled bars and shapes.

(f) The specified yield strength must not exceed 637 MPa (92.43 Ksi) and when it exceeds 490 MPa (71.10 Ksi), the hardness of the weld and the heat affected zone must be specially approved by the Commandant (G–MSO).

(g) The Charpy V-notch impact energy must be determined for:

(1) Each plate as rolled; and

(2) Each five short ton batch of forgings, forged or rolled fittings and rolled or forged bars and shapes.

(h) The orientation and required impact energy of a 10 mm × 10 mm (0.394 in. × 0.394 in.) Charpy V-notch specimen must be:

(1) For plates; transverse specimen and 27.4 J (20 ft-lbs); and

(2) For forgings, forged and rolled fittings and rolled and forged bars: longitudinal specimen and 41.1 J (30 ft-lbs).

(i) The test temperature of the Charpy V-notch specimens is as follows:

Material Thickness	Test Temperature
t≤20 mm (0.788 in.)	0°C (32°F)
20< t<30 mm (1.182 in.)	−20°C (−4°F)
30< t<40 mm (1.576 in.)	−40°C (−40°F)

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

§ 154.615 Design temperature below 0°C (32°F) and down to −55°C (−67°F).

Plates, forgings, forged or rolled or forged bars and shapes for cargo tanks and secondary barriers for a design temperature below 0°C (32°F) and down to −55°C (−67°F) must meet § 54.25–10 of this chapter.

§ 154.620 Design temperature below −55°C (−67°F) and down to −165°C (−265°F).

Plates, forgings and forged or rolled fittings, and rolled, forged or extruded bars and shapes for cargo tanks, secondary barriers, and process pressure vessels for a design temperature below −55°C (−67°F) and down to −165°C (−265°F) must:

(a) Meet § 54.25–10(b)(2), § 54.25–15, or § 54.25–20 of this chapter; or

(b) Be of an aluminum alloy that is 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]

§ 154.625 Design temperature below 0°C (32°F) and down to −165°C (−265°F).

Pipes, tubes, forgings, castings, bolting, and nuts for cargo and process piping for a design temperature below 0°C (32°F) and down to −165°C (−265°F) must meet § 56.50–105 of this chapter.

§ 154.630 Cargo tank material.

(a) If a material of a cargo tank is not listed in §§ 154.610, 154.615 or § 154.620, the allowable stress of that material must be specially approved by the Commandant (G–MSO).

(b) For cargo tanks of aluminum alloys with welded connections, the minimum tensile strength (σ_B) for the calculations under § 154.440, § 154.447 and § 154.450 must be the minimum tensile strength of the alloy in the annealed condition.

(c) Increased yield strength and tensile strength of a material at low temperature for independent tanks type A, B, and C 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]

CONSTRUCTION

§ 154.650 Cargo tank and process pressure vessel welding.

(a) Cargo tank and process pressure vessel welding must meet Subpart 54.05 and Part 57 of this chapter.

(b) Welding consumables used in welding cargo tanks must meet § 57.02–4 of this chapter.

(c) Independent tanks must meet the following:

(1) Each welded joint of the shells must be a full penetration butt weld, except dome to shell connections may have full penetration tee welds.

(2) Each nozzle weld must be of the full penetration type, except for small penetrations on domes.

(d) Each welded joint in an independent tank type C or in a process pressure vessel must meet Part 54 of this chapter, except that any backing rings must be removed unless specially approved by the Commandant (G–MSO).

(e) Each welded joint in a membrane tank must meet the quality assurance measures, weld procedure qualification, design details, materials, construction, inspection, and production testing of components developed during the prototype testing program that are specially approved by the Commandant (G–MSO) under this part.

(f) Each welded joint in a semi-membrane tank must meet paragraph (c) or (e) of this section.

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

§ 154.655 Stress relief for independent tanks type C.

For a design temperature colder than −10°C (14°F), an independent tank type C of:

(a) Carbon and carbon-manganese steel must be stress relieved by post-weld heat treatment under § 54.25–7 of this chapter or by mechanical stress relief under Subpart 54.30 of this chapter; or

(b) Materials other than carbon and carbon manganese steel must be stress relieved as required under Part 54 of this chapter. The procedure for stress relieving must be specially approved by the Commandant (G–MSO).

§ 154.660 Pipe welding.

(a) Pipe welding must meet Part 57 of this chapter.

(b) Longitudinal butt welds, in piping that does not meet a standard or specification under § 56.60–1 of this chapter, and girth butt welds must meet the following:

(1) Butt welds of pipes made from carbon, carbon manganese, or low alloy steels must meet § 56.50–105 of this chapter, including the requirements for post-weld heat treatment.

(2) Except for piping inside an independent cargo tank type A, B, or C, butt welds must be 100% radiographically tested if the design temperature is lower than −10°C (14°F), and:

(i) The wall thickness is greater than 10 mm (0.394 in.); or

(ii) The nominal pipe diameter is greater than 100 mm (nominal 4 in.).

(3) If Table 4 references this section, butt welds for deck cargo piping exceeding 75 mm (3 in.) in diameter must be 100% radiographically tested.

(4) Butt welds of pipes not meeting paragraph (b)(2) or (b)(3) of this section must meet the non-destructive testing requirements under Subpart 56.95 of this chapter.

§154.665 Welding procedures.

Welding procedure tests for cargo tanks for a design temperature colder than 0°C (32°F), process pressure vessels, and piping must meet §54.05–15 and Subpart 57.03 of this chapter.

CARGO PRESSURE AND TEMPERATURE CONTROL

§154.701 Cargo pressure and temperature control: General.

Except as allowed under §154.703, cargo tanks must:

(a) Have their safety relief valves set at a pressure equal to or greater than the vapor pressure of the cargo at 45°C (113°F) but not greater than the MARVS under §154.405; or

(b) Be refrigerated by a system meeting §154.702, and each refrigerated incompatible cargo refrigerated by a separate system.

§154.702 Refrigerated carriage.

(a) Each refrigeration system must:

(1) Have enough capacity to maintain the cargo vapor pressure in each cargo tank served by the system below the set pressure of the relief valves under ambient temperatures of 45°C (113°F) still air and 32°C (89.6°F) still water with the largest unit in the system inoperative; or

(2) Have a standby unit with a capacity at least equal to the capacity of the largest refrigeration unit in the system.

(b) For the purpose of this section, a ''refrigeration unit'' includes a compressor and its motors and controls.

(c) Each refrigeration system must:

(1) Have a heat exchanger with an excess capacity of 25 percent of the required capacity; or

(2) A standby heat exchanger.

(d) Where cooling water is used in a refrigeration system:

(1) The cooling water pump or pumps must be used exclusively for the system;

(2) Each pump must have suction lines from sea chests on the port and starboard sides of the vessel; and

(3) There must be a standby pump, that may be used for:

(i) Non-essential purposes on the vessel; or

(ii) Essential purposes on the vessel, if the pump is sized to simultaneously provide for the capacity requirements for the essential purposes and the refrigeration cooling water.

(e) Each refrigeration system must use refrigerants that are compatible with the cargo and, for cascade units, with each other.

(f) The pressure of the heat transfer fluid in each cooling coil in a tank must be greater than the pressure of the cargo.

§154.703 Methane (LNG).

Unless a cargo tank carrying methane (LNG) can withstand the pressure build up due to boil-off for 21 days, the pressure in the cargo tank must be maintained below the set pressure of the safety relief valve for at least 21 days by:

(a) A refrigeration system that meets §154.702;

(b) A waste heat or catalytic furnace that burns boil-off gas, and:

(1) Maintains the stack exhaust temperature below 535°C (995°F);

(2) Exhibits no visible flame; and

(3) Is specially approved by the Commandant (G–MSO);

(c) Boilers, inert gas generators, and combustion engines in the main propelling machinery space that use boil-off gas as fuel; or

(d) Equipment for services, other than those under paragraph (c) of this section, that use boil-off gas as fuel and that are located:

(1) In the main propelling machinery space; or

(2) a space 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]

§154.705 Cargo boil-off as fuel: General.

(a) Each cargo boil-off fuel system under §154.703(c) must meet §§154.706 through 154.709.

(b) The piping in the cargo boil-off fuel system must have a connection for introducing inert gas and for gas freeing the piping in the machinery space.

(c) A gas fired main propulsion boiler or combustion engine must have a fuel oil fired pilot that maintains fuel flow

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 20m^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 20m^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.

(c) Vessels certificated to carry only nonflammable cargo in cargo containment systems with secondary barriers must:

(1) Meet paragraph (a) of this section; or

(2) Have air drying systems that reduce the dewpoint of air admitted to hold or interbarrier spaces below the temperature of any surface in those spaces or −45° C (−49°F), whichever is warmer.

(d) Vessels with refrigerated independent tanks type C must have inert gas or air drying systems that reduce the dewpoint of any inert gas or air admitted to the hold spaces below the temperature of any surface in those spaces or −45°C (−49°F), whichever is warmer.

§154.903 Inert gas systems: General.

(a) Inert gas carried or generated to meet §§154.901, 154.902, and 154.1848 must be non-flammable and non-reactive with the cargoes that the vessel is certificated to carry and the materials of construction of the cargo tanks, hold and interbarrier spaces, and insulation.

(b) The boiling point and dewpoint at atmospheric pressure of the inert gas must be below the temperature of any surface in those spaces or −45°C (−49°F), whichever is warmer.

(c) For the temperatures and pressures at which the gas is stored and used, storage vessels and inert gas piping must meet §§154.450 and 154.500 respectively.

§154.904 Inert gas system: Controls.

The inert gas system must have:

(a) At least one check valve in the cargo area to prevent the back flow of cargo vapor into the inert gas system, or another means specially approved by the Commandant (G–MSO);

(b) If the inert gas system is in the machinery space or another space outside the cargo area, a second check valve in the cargo area meeting paragraph (a) of this section;

(c) Automatic and manual inert gas pressure controls; and

(d) Valves to isolate each inerted space.

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

§154.906 Inert gas generators.

The inert gas generator must:

(a) Produce an inert gas containing less than 5% oxygen by volume;

(b) Have a device to continuously sample the discharge of the generator for oxygen content; and

(c) Have an audible and visual alarm in the cargo control station that alarms when the inert gas contains 5% or more oxygen by volume.

§154.908 Inert gas generator: Location.

(a) Except as allowed in paragraph (b) of this section, an inert gas generator must be located in the main machinery space or a space that is not in the cargo area and does not have direct access to any accommodation, service, or control space.

(b) An inert gas generator that does not use flame burning equipment may be located in the cargo area 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]

§154.910 Inert gas piping: Location.

Inert gas piping must not pass through or terminate in an accommodation, service, or control space.

§154.912 Inerted spaces: Relief devices.

Inerted spaces must be fitted with relief valves, rupture discs, or other devices specially approved by the Commandant (G–MSO).

[CGD 74–289, 44 FR 26009, May 3, 1979; CGD 82–063b, 48 FR 39629, Sept. 1, 1983]

ELECTRICAL

§154.1000 Applicability.

Sections 154.1005 through 154.1020 apply to flammable cargo and ammonia carriers.

§ 154.1002 Definition.

For the purposes of §§ 154.1005 through 154.1020, ''gas-dangerous'' does not include the weather deck of an ammonia carrier.

§ 154.1005 Equipment approval.

(a) Electrical equipment that is required to be intrinsically safe or explosion proof under § 154.1010 must be specially approved by the Commandant or listed as intrinsically safe or explosion proof by an independent laboratory that is specially approved by the Commandant (G–MSO), for Class I Division I locations and the Group that is specified in Table 4 for the cargo carried.

(b) Each submerged cargo pump motor installation must be specially approved by the Commandant (G–MSO).

(c) Electrical equipment that must be intrinsically safe to meet § 154.1010 must meet the definition in § 110.15–100(i) of this chapter.

(d) Electrical equipment that must be explosion proof to meet § 154.1010 must meet § 110.15–65(e) of this chapter.

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

§ 154.1010 Electrical equipment in gas-dangerous space or zone.

(a) Except as allowed in this section, electrical equipment must not be installed in a gas-dangerous space or zone.

(b) Intrinsically safe electrical equipment and wiring may be in a gas-dangerous space or zone.

(c) A submerged cargo pump motor may be in a cargo tank if:

(1) Low liquid level, motor current, or pump discharge pressure automatically shuts down power to the pump motor if the pump loses suction;

(2) There is an audible and visual alarm at the cargo control station that actuates if the motor shuts down under the requirements of paragraph (c)(1) of this section; and

(3) There is a lockable circuit breaker or lockable switch that disconnects the power to the motor.

(d) A supply cable for a submerged cargo pump motor may be in a hold space.

(e) A hold space that has a tank that is not required to have a secondary barrier under § 154.459 may only have:

(1) Through runs of cable;

(2) Explosion-proof lighting fixtures;

(3) Depth sounding devices in gas-tight enclosures;

(4) Log devices in gas-tight enclosures; and

(5) Impressed current cathodic protection system electrodes in gas-tight enclosures.

(f) A space that is separated by a gas-tight steel boundary from a hold space that has a cargo tank that must have a secondary barrier, under the requirements of § 154.459, may only have:

(1) Through runs of cable;

(2) Explosion-proof lighting fixtures;

(3) Depth sounding devices in gas-tight enclosures;

(4) Log devices in gastight enclosures;

(5) Impressed current cathodic protection system electrodes in gastight enclosures;

(6) Explosion-proof motors that operate cargo system valves or ballast system valves; and

(7) Explosion-proof bells for general alarm systems.

(g) A cargo handling room may only have:

(1) Explosion-proof lighting fixtures; and

(2) Explosion-proof bells for general alarm systems.

(h) A space for cargo hose storage may only have:

(1) Explosion-proof lighting fixtures; and

(2) Through runs of cable.

(i) A space that has cargo piping may only have:

(1) Explosion-proof lighting fixtures; and

(2) Through runs of cable.

(j) A gas-dangerous zone on the weather deck may only have:

(1) Explosion-proof equipment that is for the operation of the vessel; and

(2) Through runs of cable.

(k) A space, except those under paragraphs (e) through (j) of this section, that has a direct opening to a gas-dangerous space or zone may only have the electrical equipment allowed in the gas-dangerous space or zone.

§154.1015 Lighting in gas-dangerous space.

(a) Each gas-dangerous space that has lighting fixtures must have at least two branch circuits for lighting.

(b) Each switch and each overcurrent protective device for any lighting circuit that is in a gas-dangerous space must open each conductor of the circuit simultaneously.

(c) Each switch and each overcurrent protective device for lighting in a gas-dangerous space must be in a gas-safe space.

§154.1020 Emergency power.

The emergency generator must be designed to allow operation at the final angle of heel under §154.230(a).

FIREFIGHTING

Firefighting System: Exterior Water Spray

§154.1105 Exterior water spray system: General.

Each liquefied flammable gas vessel and each liquefied toxic gas vessel must have an exterior water spray system that meets §§154.1110 through 154.1135.

§154.1110 Areas protected by system.

Each water spray system must protect:

(a) All cargo tank surfaces that are not covered by the vessel's hull structure or a steel cover;

(b) Each cargo tank dome;

(c) Each on-deck storage vessel for flammable or toxic liquefied gases;

(d) Each cargo discharge and loading manifold;

(e) Each quick-closing valve under §§154.530, 154.532, and 154.538, and other control valves essential to cargo flow;

(f) Each boundary facing the cargo area of each superstructure that contains accommodation, service, or control spaces;

(g) Each boundary facing the cargo area of each deckhouse that contains accommodation, service, or control spaces; and

(h) Each boundary of each deckhouse that is within the cargo area and that is manned during navigation of the vessel or during cargo transfer operations, except the deckhouse roof if it is 2.4 m (8 ft.) or higher above the cargo containing structure.

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

§154.1115 Discharge.

(a) The discharge density of each water spray system must be at least:

(1) 10000 $cm^3/m^2/min.$ (0.25 $gpm/ft.^2$) over each horizontal surface; and

(2) 4000 $cm^3/m^2/min.$ (0.10 $gpm/ft.^2$) against vertical surface, including the water rundown.

(b) The water spray protection under §154.1110 (d) and (e) must cover an area in a horizontal plane extending at least 0.5 m (19 in.) in each direction from the pipes, fittings, and valves, or the area of the drip tray, whichever is greater.

§154.1120 Nozzles.

(a) Nozzles for the water spray system must be spaced to provide the minimum discharge density under §154.1115 in each part of the protected area.

(b) The vertical distance between water spray nozzles for the protection of vertical surfaces must be 3.7 m (12 ft.) or less.

§154.1125 Pipes, fittings, and valves.

(a) Each pipe, fitting, and valve for each water spray system must meet Part 56 of this chapter.

(b) Each water spray main that protects more than one area listed in §154.1110 must have at least one isolation valve at each branch connection and at least one isolation valve downstream of each branch connection to isolate damaged sections.

(c) Each valved cross-connection from the water spray system to the fire main must be outside of the cargo area.

(d) Each pipe, fitting, and valve for the water spray system must be made of fire resistant and corrosion resistant materials, such as galvanized steel or galvanized iron pipe.

(e) Each water spray system must have a means of drainage to prevent corrosion of the system and freezing of accumulated water in subfreezing temperatures.

(f) Each water spray system must have a dirt strainer that is located at the water spray system manifold or pump.

§ 154.1130 Sections.

(a) If a water spray system is divided into sections, each section must at least include the entire deck area bounded by the length of a cargo tank and the full beam of the vessel.

(b) If a water spray system is divided into sections, the control valves must be at a single manifold that is aft of the cargo area.

§ 154.1135 Pumps.

(a) Water to the water spray system must be supplied by:

(1) A pump that is only for the use of the system;

(2) A fire pump; or

(3) A pump specially approved by the Commandant (G–MSO).

(b) Operation of a water spray system must not interfere with simultaneous operation of the fire main system at its required capacity. There must be a valved cross-connection between the two systems.

(c) Except as allowed under paragraph (d) of this section, each pump for each water spray system must have the capacity to simultaneously supply all areas named in § 154.1110.

(d) If the water spray system is divided into sections, the pump under paragraph (a) of this section must have the capacity to simultaneously supply the required discharge density under § 154.1115(a) for:

(1) The areas in §§ 154.1110(f) through (h) and 154.1115(b); and

(2) The largest section that includes the required protection under § 154.1110 (a), (b), and (c).

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

FIREFIGHTING SYSTEM: DRY CHEMICAL

§ 154.1140 Dry chemical system: General.

Each liquefied flammable gas carrier must have a dry chemical firefighting system that meets §§ 154.1145 through 154.1170, Part 56 and Subpart 162.039 of this chapter.

§ 154.1145 Dry chemical supply.

(a) A vessel with a cargo carrying capacity less that 1000 m^3 (35,300 $ft.^3$) must have at least one self-contained dry chemical storage unit for the cargo area with an independent inert gas pressurizing source adjacent to each unit.

(b) A vessel with a cargo carrying capacity of 1000 m^3 (35,300 $ft.^3$) or more must have at least two self-contained dry chemical storage units for the cargo area with an independent inert gas pressurizing source adjacent to each unit.

(c) A vessel with bow and stern loading and discharge areas must have at least one self-contained dry chemical storage unit with an independent inert gas pressurizing source adjacent to the unit for each area.

(d) Each dry chemical storage unit and associated piping must be designed for:

(1) Sequential discharge of each hose line and each monitor for 45 seconds; and

(2) Simultaneous discharge of all hose lines and monitors for 45 seconds.

(e) Each fully charged dry chemical storage unit must have the greater of the following:

(1) Enough dry chemical to provide for sequential discharge of each attached hose and monitor for 45 seconds.

(2) Enough dry chemical to provide for simultaneous discharge of all attached hoses and monitors for 45 seconds.

§ 154.1150 Distribution of dry chemical.

(a) All locations on the above deck cargo area and the cargo piping outside that cargo area must be protected by:

(1) At least two dry chemical hand hose lines; or

(2) At least one dry chemical hand hose line and one dry chemical monitor.

(b) At least one dry chemical storage unit and hand hose line or monitor must be at the after end of the cargo areas.

(c) Each cargo loading and discharge manifold must be protected by at least one dry chemical monitor.

§ 154.1155 Hand hose line: Coverage.

The coverage for the area for a hand hose line under § 154.1150 must not exceed the length of the hand hose line except the coverage for the protection

of areas that are inaccessible to personnel must not exceed one-half the projection of the hose at its rated discharge, or 10 m (32.8 ft.), whichever is less.

§154.1160 Monitor coverage of system.

The coverage of each dry chemical system monitor under §154.1150 must not exceed:

(a) 10 m (32.8 ft.) at 10 kg/sec (22 lb/sec);

(b) 30 m (98.4 ft.) at 25 kg/sec (55 lb/sec);

(c) 40 m (131.2 ft.) at 45 kg/sec (99 lb/sec);

(d) An interpolation between 10 m (32.8 ft.) at 10 kg/sec (22 lb/sec) and 30 m (98.4 ft.) at 25 kg/sec (55 lb/sec); or

(e) An interpolation between 30 m (98.4 ft.) at 25 kg/sec (55 lb/sec) and 40 m (131.2 ft.) at 45 kg/sec (99 lb/sec).

§154.1165 Controls.

(a) Each dry chemical hand hose line must be one that can be actuated at its hose reel or hose storage cabinet.

(b) Each dry chemical monitor must be one that can be actuated and controlled at the monitor.

(c) A dry chemical monitor for the cargo loading and discharging manifold areas must be one that can be:

(1) Actuated from a location other than the monitor and manifold area; and

(2) Except for pre-aimed monitors, controlled from a location other than the monitor and manifold area.

(d) Each dry chemical storage unit must have independent piping with a stop valve in the piping for each remote hand hose line and remote monitor where the piping connects to the storage container, if the unit has:

(1) More than one hand hose line;

(2) More than one monitor; or

(3) A combination of hand hose lines and monitors.

(e) Each stop valve under paragraph (d) of the section must be capable of:

(1) Manual operation; and

(2) Being opened from the hose reel or monitor to which it is connected.

(f) Damage to any dry chemical system hose, monitor, pipe or control circuits must not prevent the operation of other hoses, monitors, or control circuit that are connected to the same storage unit.

§154.1170 Hand hose line: General.

Each dry chemical hand hose line must:

(a) Not be longer than 33m (108 ft.);

(b) Be stored on a hose reel or in a hose cabinet and be one that is operable whether or not it is unwound from a hose reel or removed from a hose cabinet;

(c) Be non-kinkable;

(d) Have a nozzle with a valve to start and stop the flow of chemical;

(e) Have a capacity of at least 3.5 kg/sec (7.7 lb./sec); and

(f) Be one that can be operated by one person.

CARGO AREA: MECHANICAL VENTILATION SYSTEM

§154.1200 Mechanical ventilation system: General.

(a) Each cargo compressor room, pump room, gas-dangerous cargo control station, and space that contains cargo handling equipment must have a fixed, exhaust-type mechanical ventilation system.

(b) The following must have a supply-type mechanical ventilation system:

(1) Each space that contains electric motors for cargo handling equipment.

(2) Each gas-safe cargo control station in the cargo area.

(3) Each gas-safe space in the cargo area.

(4) Each space that contains inert gas generators, except main machinery spaces.

§154.1205 Mechanical ventilation system: Standards.

(a) Each exhaust type mechanical ventilation system required under §154.1200 (a) must have ducts for vapors from the following:

(1) The deck level.

(2) Bilges.

(3) If the vapors are lighter than air, the top of each space that personnel enter during cargo handling operations.

(b) The discharge end of each duct under paragraph (a) of this section must be at least 10 m (32.8 ft.) from

ventilation intakes and openings to accommodations, service, control station, and other gas-safe spaces.

(c) Each ventilation system under § 154.1200 (a) and (b)(1) must change the air in that space and its adjoining trunks at least 30 times each hour.

(d) Each ventilation system for a gas-safe cargo control station in the cargo area must change the air in that space at least eight times each hour.

(e) A ventilation system must not recycle vapor from ventilation discharges.

(f) Each mechanical ventilation system must have its operational controls outside the ventilated space.

(g) No ventilation duct for a gas-dangerous space may pass through any machinery, accommodation, service, or control space, except as allowed under § 154.703.

(h) Each electric motor that drives a ventilation fan must not be within the ducts for any space that may contain flammable cargo vapors.

(i) Ventilation impellers and the housing in way of those impellers on a flammable cargo carrier must meet one of the following:

(1) The impeller, housing, or both made of non-metallic material that does not generate static electricity.

(2) The impeller and housing made of non-ferrous material.

(3) The impeller and housing made of austenitic stainless steel.

(4) The impeller and housing made of ferrous material with at least 13mm (0.512 in.) tip clearance.

(j) No ventilation fan may have any combination of fixed or rotating components made of an aluminum or magnesium alloy and ferrous fixed or rotating components.

(k) Each ventilation intake and exhaust must have a protective metal screen of not more than 13mm (0.512 in.) square mesh.

§ 154.1210 Hold space, void space, cofferdam, and spaces containing cargo piping.

(a) Each hold space, void space, cofferdam, and spaces containing cargo piping must have:

(1) A fixed mechanical ventilation system; or

(2) A fixed ducting system that has a portable blower that meets § 154.1205(i) and (j).

(b) A portable blower in any personnel access opening must not reduce the area of that opening so that the opening does not meet § 154.340.

INSTRUMENTATION

§ 154.1300 Liquid level gauging system: General.

(a) If Table 4 lists a closed gauge for a cargo, the liquid level gauging system under § 154.1305 must be closed gauges that do not have any opening through which cargo liquid or vapor could escape, such as an ultrasonic device, float type device, electronic or magnetic probe, or bubble tube indicator.

(b) If Table 4 lists a restricted gauge for a cargo, the liquid level gauging system under § 154.1305 must be closed gauges that meet paragraph (a) of this section or restricted gauges that do not vent the cargo tank's vapor space, such as a fixed tube, slip tube, or rotary tube.

§ 154.1305 Liquid level gauging system: Standards.

(a) Each cargo tank must have at least one liquid level gauging system that is operable:

(1) At pressures up to, and including, the MARVS of the tank; and

(2) At temperatures that are within the cargo handling temperature range for all cargoes carried.

(b) Unless the cargo tank has one liquid gauging system that can be repaired and maintained when the tank contains cargo, each cargo tank must have at least two liquid level gauging systems that meet paragraph (a) of this section.

(c) Each liquid level gauging system must measure liquid levels from 400 mm (16 in.) or less from the lowest point in the cargo tank, except collection wells, to 100 percent full.

§ 154.1310 Closed gauge shut-off valve.

Each closed gauge that is not mounted directly on the cargo tank must have a shut-off valve that is as close to the tank as practical.

§154.1315 Restricted gauge excess flow valve.

Each restricted gauge that penetrates a cargo tank must have an excess flow valve unless the gauge meets §154.536.

§154.1320 Sighting ports, tubular gauge glasses, and flat plate type gauge glasses.

(a) Cargo tanks may have sighting ports as a secondary means of liquid level gauging in addition to the gauges under §154.1305, if:

(1) The tank has a MARVS that is less than 69 kPa gauge (10 psig);

(2) The port has a protective cover and an internal scale; and

(3) The port is above the liquid level.

(b) Tubular gauge glasses must not be liquid level gauges for cargo tanks.

(c) Plate type gauge glasses must not be liquid level gauges for cargo tanks, except deck tanks if the gauge connections have excess flow valves.

§154.1325 Liquid level alarm system: All cargo tanks.

Except as allowed under §154.1330, each cargo tank must have a high liquid level alarm system that:

(a) Is independent of the liquid level gauging system under §154.1305;

(b) Actuates quick-closing valves under §§154.530, 154.532, and 154,538 or a stop valve in the cargo tank loading line to prevent the tank from becoming 100 percent liquid full and without causing the pressure in the loading lines to exceed the design pressure; and

(c) Actuates an audible and visual alarm at the cargo control station at the liquid level at which the valves under paragraph (b) of this section are actuated or at some lower liquid level.

§154.1330 Liquid level alarm system: Independent tank type C.

Independent tanks type C need not have the high liquid level alarm system under §154.1325 if:

(a) The tank volume is less than 200 m^3 (7,060 $ft.^3$); or

(b) The tank can withstand the maximum possible pressure during loading, that pressure is below the relief valve setting, and overflow of the tank cannot occur.

§154.1335 Pressure and vacuum protection.

(a) Each cargo tank must have the following:

(1) A pressure gauge that:

(i) Monitors the vapor space;

(ii) Is readable at the tank; and

(iii) Has remote readouts at the cargo control station.

(2) If vacuum protection is required under §154.804, a vacuum gauge meeting paragraphs (a)(1)(i), (a)(1)(ii), and (a)(1)(iii) of this section.

(b) The vessel must have at least one high pressure alarm that:

(1) Actuates before the pressure in any cargo tank exceeds the maximum pressure specially approved by the Commandant (G–MSO); and

(2) Actuates an audible and visual alarm at the cargo control station, and a remote group alarm in the wheelhouse.

(c) If vacuum protection is required under §154.804, the vessel must have at least one low pressure alarm that:

(1) Actuates before the pressure in any cargo tank falls below the minimum pressure specially approved by the Commandant (G–MSO); and

(2) Actuates an audible and visual alarm at the cargo control station, and a remote group alarm in the wheelhouse.

(d) At least one pressure gauge must be fitted on each:

(1) Enclosed hold;

(2) Enclosed interbarrier space;

(3) Cargo pump discharge line;

(4) Liquid cargo manifold; and

(5) Vapor cargo manifold.

(e) There must be a local manifold pressure gauge between each manifold stop valve and each hose connection to the shore.

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

§154.1340 Temperature measuring devices.

(a) Each cargo tank must have devices that measure the temperature:

(1) At the bottom of the tank; and

(2) Near the top of the tank and below the maximum liquid level allowed under §154.1844.

(b) Each device required by paragraph (a) must have a readout at the cargo control station.

(c) Except for independent tanks type C, each cargo containment system for a design temperature colder than −55° C (−67°F) must have temperature measuring devices that meet the following:

(1) The number and location of the devices must be specially approved by the Commandant (G–MSO).

(2) The devices must be within the cargo tank's insulation or on the adjacent hull structure.

(3) Each device must show the temperature continuously or at regular intervals of one hour or less.

(4) Each device must actuate an audible and visual alarm at the cargo control station and a remote group alarm in the wheelhouse before the temperature of the steel of the adjacent hull structure is cooled below the lowest temperature allowed for the steel under § 154.172.

(d) For each cargo tank with a design temperature colder than −55°C (−67°F), the number and arrangement of the devices that show the temperature of the tank during cool down procedures 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]

§ 154.1345 Gas detection.

(a) Each vessel carrying a cargo that is designated with an ''I'' or ''I and T'' in Table 4 must have:

(1) A fixed flammable gas detection system that meets § 154.1350; and

(2) Two portable gas detectors that can each measure 0 to 100% of the lower flammable limit of the cargo carried.

(b) Each vessel carrying a cargo that is designated with a ''T'' or ''I and T'' in Table 4 must have:

(1) Two portable gas detectors that show if the concentration of cargo is above or below the threshold limit value listed in 29 CFR 1910.1000 for that cargo; and

(2) Fixed gas sampling tubes in each hold space and interbarrier space with:

(i) The number of tubes specially approved by the Commandant (G–MSO);

(ii) Each tube valved and capped above the main deck unless it is connected to a fixed toxic gas detector;

(iii) If the vessel carries cargo that is heavier than the atmosphere of the space, each tube's open end in the lower part of the space;

(iv) If the vessel carries cargo that is lighter than the atmosphere of the space, each tube's open end in the upper part of the space;

(v) If the vessel carries cargo that is heavier than the atmosphere of the space and another cargo that is lighter than the atmosphere of the space, tubes with their open ends in the lower part of the space and tubes with their open ends in the upper part of the space; and

(vi) If the vessel carries cargo that can be both heavier and lighter than the atmosphere of the space, tubes with their open ends in the lower part of the space and tubes with their open ends in the upper part of the space.

(c) A vessel that carries methyl bromide or sulfur dioxide must have a fixed gas detection system that is not located in a gas-safe space.

(d) A vessel that carries sulfur dioxide must have a fixed gas detection system that meets § 154.1350 except paragraph (j).

(e) Each alarm under § 154.1350(e) on a vessel that carries methyl bromide or sulfur dioxide must be set at or below the threshold limit value listed in 29 CFR 1910.1000 for the cargo carried.

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

§ 154.1350 Flammable gas detection system.

(a) The vessel must have a fixed flammable gas detection system that has sampling points in:

(1) Each cargo pump room;

(2) Each cargo compressor room;

(3) Each motor room for cargo handling machinery;

(4) Each cargo control station that is not gas-safe;

(5) Each hold space, interbarrier space, and other enclosed spaces, except fuel oil or ballast tanks, in the cargo area, unless the vessel has independent tanks type C; and

(6) Each space between the doors of an air lock under §154.345.

(b) The sampling points under paragraph (a) of this section must meet §154.1345(b)(2) (iii) through (vi).

(c) Gas sampling lines for the flammable gas detection system must not pass through any gas-safe space, except the gas-safe space in which the gas detection equipment is located.

(d) Gas detection systems must have a readout with meters that show flammable gas concentration over the concentration or volume ranges under paragraph (t) or (u) of this section.

(e) Each flammable gas detection system must have audible and visual alarms that are actuated at a cargo concentration that is 30% or less of the lower flammable limit in air of the cargo carried.

(f) Each flammable gas detection system must have an audible and visual alarm for power failure and loss of gas sampling flow.

(g) The alarms under paragraphs (e) and (f) of this section must signal in the space where the gas detection system's readout is located and must meet §154.1365.

(h) Remote group alarms, that indicate that one of the alarm conditions under paragraphs (e) and (f) of this section exists, must meet §154.1365 and must be in each wheelhouse and in each cargo control station if the gas detection system's readout is not located in those spaces.

(i) Each flammable gas detection system must monitor each sampling point at 30 minute or shorter intervals.

(j) Electrical equipment for each flammable gas detection system that is in a gas-dangerous space or area must meet §§154.1000 through 154.1015.

(k) Each flammable gas detection system must have enough flame arrestors for all gas sampling lines to prevent flame propagation to the spaces served by the system through the sampling lines.

(l) Each flammable gas detection system must have a filter that removes particulate matter in each gas sampling line.

(m) Each filter under paragraph (l) of this section must be located where it can be removed during vessel operation, unless it can be freed by back pressure.

(n) Each flammable gas detection system in a gas-safe space must:

(1) Have a shut-off valve in each sampling line from an enclosed space, such as a hold or interbarrier space; and

(2) Exhaust gas to a safe location in the open atmosphere and away from all ignition sources.

(o) Each flammable gas detection system must not have common sampling lines, except sampling lines may be manifolded at the gas detector location if each line has an automatic valve that prevents cross-communication between sampling points.

(p) Each flammable gas detection system must have at least one connection for injecting zero gas and span gas into the system for testing and calibration.

(q) Each flammable gas detection system must have span gas for testing and calibration that is of known concentration.

(r) The calibration test procedure and type and concentration of span gas under paragraph (q) of this section must be on or in each gas analyzer cabinet.

(s) Each flammable gas detection system must have at least one flow meter capable of measuring the flow to the gas analyzer, and must provide a means for ensuring that there is a positive flow in the right direction in each sampling line at all times.

(t) Each flammable gas detection system must measure gas concentrations that:

(1) Are at least 0% through 200% of the alarm concentration; and

(2) Allow calibration of the equipment with span gas.

(u) In each hold and each interbarrier space that contains tanks other than independent tanks type A, B, or C, the flammable gas detection system must measure cargo concentrations of 0 to 100% by volume with:

(1) An analyzer other than the one under paragraph (t) of this section; or

(2) The analyzer under paragraph (t) of this section with a scale switch that automatically returns the analyzer to the concentration range under paragraph (t) of this section when released.

§ 154.1360 Oxygen analyzer.

The vessel must have a portable analyzer that measures oxygen levels in an inert atmosphere.

§ 154.1365 Audible and visual alarms.

(a) Each audible alarm must have an arrangement that allows it to be turned off after sounding. For remote group alarms this arrangement must not interrupt the alarm's actuation by other faults.

(b) Each visual alarm must be one that can be turned off only after the fault that actuated it is corrected.

(c) Each visual alarm must be marked to show the type and, except for remote group alarms, the location of each fault that actuates it.

(d) Each vessel must have means for testing each alarm.

§ 154.1370 Pressure gauge and vacuum gauge marking.

Each pressure gauge and vacuum gauge under § 154.1335(a) must be marked with the maximum and minimum pressures that are specified on the vessel's certificate for the cargo carried.

§ 154.1375 Readout for temperature measuring device: Marking.

Each readout under § 154.1340 for a device that measures temperature in a cargo tank must be marked with the design temperature specified for the cargo tank on the vessel's certificate.

SAFETY EQUIPMENT

§ 154.1400 Safety equipment: All vessels.

(a) Instead of the equipment under § 35.30–20 of this chapter, a vessel of less than 25,000 m^3 cargo capacity must have the following personnel safety equipment:

(1) Six self-contained, pressure-demand-type, air-breathing apparatus approved by the Mining Enforcement and Safety Administration (MESA) or the National Institute for Occupational Safety and Health (NIOSH), each having at least a 30 minute capacity.

(2) Nine spare bottles of air for the self-contained air-breathing apparatus, each having at least a 30 minute capacity.

(3) Six steel-cored lifelines.

(4) Six Type II or Type III flashlights constructed and marked in accordance with ASTM F1014–1986.

(5) Three fire axes.

(6) Six helmets that meet ANSI Safety Requirements for Industrial Head Protection, Z–89.1 (1969).

(7) Six sets of boots and gloves that are made of rubber or other electrically non-conductive material.

(8) Six sets of goggles that meet the specifications of ANSI Practice for Occupational and Educational Eye and Face Protection, Z–87.1 (1979).

(9) Three outfits that protect the skin from scalding steam and the heat of a fire, and that have a water resistant outer surface.

(10) Three chemical protective outfits that protect the wearers from the particular personnel hazards presented by the cargo vapor.

(b) Instead of the equipment under § 35.30–20 of this chapter, a vessel of 25,000 m^3 cargo capacity or more must have the following personnel safety equipment:

(1) Eight self-contained, pressure-demand-type, air-breathing apparatus approved by the Mining Enforcement and Safety Administration (MESA) or the National Institute for Occupational Safety and Health (NIOSH), each having at least a 30 minute capacity.

(2) Nine spare bottles of air for the self-contained air-breathing apparatus, each having at least a 30 minute capacity.

(3) Eight steel-cored lifelines.

(4) Eight Type II or Type III flashlights constructed and marked in accordance with ASTM F1014–1986.

(5) Three fire axes.

(6) Eight helmets that meet ANSI Safety Requirements for Industrial Head Protection, Z–89.1 (1969).

(7) Eight sets of boots and gloves that are made of rubber or other electrically non-conductive material.

(8) Eight sets of goggles that meet the specifications of ANSI Practice for Occupational and Educational Eye and Face Protection, Z–87.1 (1979).

(9) Five outfits that protect the skin from scalding steam and the heat of a fire, and that have a water resistant outer surface.

(10) Three chemical protective outfits that protect the wearers from the particular personnel hazards presented by the cargo vapor.

(c) When Table 4 references this section, a vessel carrying the listed cargo must have the following additional personnel protection equipment:

(1) Three self-contained, pressure-demand-type, air-breathing apparatus approved by the Mining Enforcement and Safety Administration (MESA) or the National Institute for Occupational Safety and Health (NIOSH), each having at least a 30 minute capacity.

(2) Nine spare bottles of air for the self-contained air-breathing apparatus, each having at least a 30 minute capacity.

(3) Three steel-cored lifelines.

(4) Three Type II or Type III flashlights constructed and marked in accordance with ASTM F1014–1986.

(5) Three helmets that meet ANSI Safety Requirements for Industrial Head Protection, Z–89.1 (1969).

(6) Three sets of boots and gloves that are made of rubber or other electrically non-conductive material.

(7) Three sets of goggles that meet the specifications of ANSI Practice for Occupational and Educational Eye and Face Protection, Z–87.1 (1979).

(8) Three chemical protective outfits that protect the wearers from the particular personnel hazards presented by the cargo vapor.

[CGD 74–289, 44 FR 26009, May 3, 1979, as amended by CGD 77–069, 52 FR 31630, Aug. 21, 1987; CGD 82–042, 17705, May 18, 1988]

§154.1405 Respiratory protection.

When Table 4 references this section, a vessel carrying the listed cargo must have:

(a) Respiratory protection equipment for each person on board that protects the person from the cargo vapor for at least 5 minutes; and

(b) Two additional sets of respiratory protection equipment that:

(1) Are stowed in the wheelhouse; and

(2) Protects the wearer from the cargo vapor for at least 5 minutes.

§154.1410 Decontamination shower.

When Table 4 references this section, a vessel carrying the listed cargo must have a decontamination shower and an eye wash that:

(a) Are on the weatherdeck; and

(b) Have their location marked EMERGENCY SHOWER in letters:

(1) 7.6 cm (3 in.) high; and

(2) 5.1 cm (2 in.) wide.

§154.1415 Air compressor.

Each vessel must have an air compressor to recharge the bottles for the air-breathing apparatus.

§154.1420 Stretchers and equipment.

Each vessel must have:

(a) Two stretchers or wire baskets; and

(b) Equipment for lifting an injured person from a cargo tank, hold, or void space.

§154.1430 Equipment locker.

One of each item of equipment under §§154.1400 and 154.1420 must be stowed in a marked locker:

(a) On the open deck in or adjacent to the cargo area; or

(b) In the accommodation house, near to a door that opens onto the main deck.

§154.1435 Medical first aid guide.

Each vessel must have a copy of the *IMO Medical First Aid Guide for Use in Accidents Involving Dangerous Goods,* printed by IMO, London, U.K.

§154.1440 Antidotes.

Each vessel must have the antidotes prescribed in the *IMO Medical First Aid Guide for Use in Accidents Involving Dangerous Goods,* printed by IMO, London, U.K. for the cargoes being carried.

§154.1445 Lifesaving devices.

The design of the lifeboats and liferafts must allow for launching at the final angle of heel from the lower side of the vessel.

EFFECTIVE DATE NOTE: At 62 FR 51209, Sept. 30, 1997, §154.1445 was removed by CGD 95–028, effective Oct. 30, 1997.

Subpart D—Special Design and Operating Requirements

§ 154.1700 Purpose.

This subpart prescribes design and operating requirements that are unique for certain cargoes regulated by this part.

§ 154.1702 Materials of construction.

When Table 4 references one of the following paragraphs in this section, the materials in the referenced paragraph must not be in components that contact the cargo liquid or vapor:

(a) Aluminum and aluminum bearing alloys.

(b) Copper and copper bearing alloys.

(c) Zinc or galvanized steel.

(d) Magnesium.

(e) Mercury.

(f) Acetylide forming materials, such as copper, silver, and mercury.

§ 154.1705 Independent tank type C.

The following cargoes must be carried in an independent tank type C that meets § 154.701(a):

(a) Ethylene oxide.

(b) Methyl bromide.

(c) Sulfur dioxide.

§ 154.1710 Exclusion of air from cargo tank vapor spaces.

When a vessel is carrying acetaldehyde, butadiene, ethylene oxide, or vinyl chloride, the master shall ensure that air is:

(a) Purged from the cargo tanks and associated piping before the cargo is loaded; and

(b) Excluded after the cargo is loaded by maintaining a positive pressure of at least 13.8 kPa gauge (2 psig) by:

(1) Introducing a gas that:

(i) Is not reactive;

(ii) Is not flammable; and

(iii) Does not contain more than 0.2% oxygen by volume; or

(2) Controlling the cargo temperature.

§ 154.1715 Moisture control.

When a vessel is carrying sulfur dioxide, the master shall ensure that:

(a) A cargo tank is dry before it is loaded with sulfur dioxide; and

(b) Air or inert gas admitted into a cargo tank carrying sulfur dioxide during discharging or tank breathing has a moisture content equal to or less than the moisture content of air with a dewpoint of −45° C (−49°F) at atmospheric pressure.

§ 154.1720 Indirect refrigeration.

A refrigeration system that is used to cool acetaldehyde, ethylene oxide, or methyl bromide, must be an indirect refrigeration system that does not use vapor compression.

§ 154.1725 Ethylene oxide.

(a) A vessel carrying ethylene oxide must:

(1) Have cargo piping, vent piping, and refrigeration equipment that have no connections to other systems;

(2) Have valves, flanges, fittings, and accessory equipment made of steel, stainless steel, except types 416 and 442, or other material specially approved by the Commandant (G–MSO);

(3) Have valve disk faces, and other wearing parts of valves made of stainless steel containing not less than 11% chromium;

(4) Have gaskets constructed of spirally wound stainless steel with teflon or other material specially approved by the Commandant (G–MSO);

(5) Not have asbestos, rubber, or cast iron components in the cargo containment system and piping;

(6) Not have threaded joints in cargo piping;

(7) Have a water spray system under § 154.1105 that protects the above deck cargo piping; and

(8) Have a nitrogen inerting system or on board nitrogen gas storage that can inert the vapor space of an ethylene oxide cargo tank for a period of 30 days under the condition of paragraph (e) of this section.

(b) Cargo hose used for ethylene oxide must:

(1) Be specially approved by the Commandant (G–MSO); and

(2) Be marked ''For (Alkylene or Ethylene) Oxide Transfer Only.''

(c) Ethylene oxide must be maintained at less than 30°C (86°F).

(d) Cargo tank relief valves for tanks containing ethylene oxide must be set at 539 kPa gauge (78.2 psig) or higher.

(e) The vapor space of a cargo tank carrying ethylene oxide must be maintained at a nitrogen concentration of 45% by volume.

(f) A vessel must have a method for jettisoning ethylene oxide that meets §§154.356 and 154.1872.

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

§154.1730 Ethylene oxide: Loading and off loading.

(a) The master shall ensure that before ethylene oxide is loaded into a cargo tank:

(1) The tank is thoroughly clean, dry, and free of rust;

(2) The hold spaces are inerted with an inert gas that meets §154.1710(b)(1); and

(3) The cargo tank vapor space is inerted with nitrogen.

(b) Ethylene oxide must be off loaded by a deepwell pump or inert gas displacement.

(c) Ethylene oxide must not be carried in deck tanks.

§154.1735 Methyl acetylene-propadiene mixture.

(a) The composition of the methyl acetylene-propadiene mixture at loading must be within the following limits or specially approved by the Commandant (G–MSO):

(1) One composition is:

(i) Maximum methyl acetylene and propadiene molar ratio of 3 to 1;

(ii) Maximum combined concentration of methyl acetylene and propadiene of 65 mole percent;

(iii) Minimum combined concentration of propane, butane, and isobutane of 24 mole percent, of which at least one-third (on a molar basis) must be butanes and one-third propane; and

(iv) Maximum combined concentration of propylene and butadiene of 10 mole percent.

(2) A second composition is:

(i) Maximum methyl acetylene and propadiene combined concentration of 30 mole percent;

(ii) Maximum methyl acetylene concentration of 20 mole percent;

(iii) Maximum propadiene concentration of 20 mole percent;

(iv) Maximum propylene concentration of 45 mole percent;

(v) Maximum butadiene and butylenes combined concentration of 2 mole percent;

(vi) A minimum saturated C_4 hydrocarbon concentration of 4 mole percent; and

(vii) A minimum propane concentration of 25 mole percent.

(b) A vessel carrying a methyl acetylene-propadiene mixture must have a refrigeration system without vapor compression or have a refrigeration system with the following features:

(1) A vapor compressor that does not raise the temperature and pressure of the vapor above 60°C (140°F) and 1.72 MPa gauge (250 psig) during its operation and that does not allow vapor to stagnate in the compressor while it continues to run.

(2) Discharge piping from each compressor stage or each cylinder in the same stage of a reciprocating compressor that has:

(i) Two temperature actuated shutdown switches set to operate at 60°C (140°F) or less;

(ii) A pressure actuated shutdown switch set to operate at 1.72 MPa gauge (250 psig) or less; and

(iii) A safety relief valve set to relieve at 1.77 MPa gauge (256 psig) or less.

(3) A relief valve that vents to a mast meeting §154.805 and that does not relieve into the compressor suction line.

(4) An alarm that sounds in the cargo control station and in the wheelhouse when any of the high pressure or high temperature switches under paragraphs (b)(2)(i) and (b)(2)(ii) of this section operate.

(c) A vessel carrying a methyl acetylene-propadiene mixture must have separate cargo piping, vent piping, and refrigeration equipment for methyl acetylene-propadiene that are segregated from other cargo piping, vent piping and refrigeration equipment on the vessel.

[CGD 74–289, 44 FR 26009, May 3, 1979; 44 FR 59234, Oct. 15, 1979; CGD 82–063b, 48 FR 4782, Feb. 3, 1983]

§ 154.1740 Vinyl chloride: Inhibiting and inerting.

When a vessel is carrying vinyl chloride, the master shall ensure that:

(a) Section 154.1818 is met; or

(b) Section 154.1710 is met, and the oxygen content of inert gas is less than 0.1% by volume.

§ 154.1745 Vinyl chloride: Transferring operations.

A vessel carrying vinyl chloride must meet the requirements of § 151.50–34(g) through (k) of this chapter.

[CGD 95–012, 60 FR 48051, Sept. 18, 1995]

§ 154.1750 Butadiene or vinyl chloride: Refrigeration system.

A refrigeration system for butadiene or vinyl chloride must not use vapor compression unless it:

(a) Avoids any stagnation points where uninhibited liquid can accumulate; or

(b) Has inhibited liquid from the cargo tank added to the vapor upstream of the condenser.

§ 154.1755 Nitrogen.

Except for deck tanks and their piping systems, cargo containment systems and piping systems carrying nitrogen 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]

§ 154.1760 Liquid ammonia.

The master shall ensure that no person sprays liquid ammonia into a cargo tank containing more than 8% oxygen by volume.

Subpart E—Operations

§ 154.1800 Special operating requirements under Part 35 of this chapter.

Each vessel must meet the requirements of Part 35 of this chapter except § 35.30–20.

§ 154.1801 Certificates, letters, and endorsements: U.S. flag vessels.

No person may operate a U.S. flag vessel unless the vessel has a Certificate of Inspection, issued under Subchapter D of this chapter, which is endorsed with the name of the cargo that it is allowed to carry.

§ 154.1802 Certificates, letters and endorsements: Foreign flag vessels.

(a) No person may operate on the navigable waters of the United States a foreign flag vessel, whose flag administration issues IMO Certificates, unless the vessel has:

(1) An IMO Certificate issued by the flag administration that is endorsed with the name of the cargo that it is allowed to carry, and, except when entering United States waters to be examined as required by § 154.150, a Certificate of Compliance[1] issued by the Coast Guard endorsed under this part with the name of the cargo that it is allowed to carry; or

(2) Special approval under § 154.30.

(b) No person may operate on the navigable waters of the United States a foreign flag vessel, whose flag administration does not issue IMO Certificates, unless the vessel has:

(1) Except when entering United States waters to be examined as required by § 154.150, a Certificate of Compliance[1] issued by the Coast Guard endorsed under this part with the name of the cargo it is allowed to carry; or

(2) Special approval under § 154.30.

(c) No person may operate on the navigable waters of the United States a foreign flag vessel unless the vessel has onboard the following plans and information which except for the certificates under paragraph (c)(1) of this section, are in English:

(1) The vessel's Cargo Ship Safety Construction Certificate and Cargo Ship Safety Equipment Certificate issued under the International Convention for Safety of Life at Sea, 1974.

(2) A description and schematic plan of the arrangement for inerting cargo tanks, hold spaces, and interbarrier spaces.

(3) A description of the cargo tank gauging equipment.

[1] Until the Certificate of Compliance form is developed, the Letter of Compliance with a Subchapter O endorsement for the carriage of liquefied gases will serve the purpose of the endorsed Certificate of Compliance.

(4) A description and instruction manual for the calibration of the cargo leak detector equipment.

(5) A schematic plan that shows the locations of leak detectors and sampling points.

(6) If the vessel carries methane, a description of the systems for cargo temperature and pressure control. (See §§154.703 through 154.709).

[CGD 74–289, 44 FR 26009, May 3, 1979, as amended by CGD 81–052, 50 FR 8735, Mar. 5, 1985; CGD 77–069, 52 FR 31631, Aug. 21, 1987; CGD 90–008, 55 FR 30663, July 26, 1990]

§154.1803 Expiration of Certificates of Compliance.

(a) A Certificate of Compliance expires after a period not to exceed twenty-four months from the date of the examination under §154.150.

(b) If a vessel's IMO Certificate of Fitness expires or otherwise becomes invalid, its Certificate of Compliance becomes invalid for the carriage of cargoes listed in Table 4 of this part or authorized by special approval under §154.12. To maintain the validity of the Certificate of Compliance, the vessel's owner must submit a copy of any revised or reissued IMO Certificate to Commanding Officer, Marine Safety Center.

[CGD 81–052, 50 FR 8735, Mar. 5, 1985; CGD 95–072, 60 FR 50466, Sept. 29, 1995; 60 FR 54106, Oct. 19, 1995]

§154.1804 Document posted in wheelhouse.

No person may operate a U.S. flag vessel unless the documents under §154.1801 are under glass in a conspicuous place in the wheelhouse.

§154.1806 Regulations on board.

No person may operate a U.S. flag vessel unless a copy of this part and a copy of Part 35 of this chapter are on board.

§154.1808 Limitations in the endorsement.

No person may operate a vessel unless that person complies with all limitations in the endorsement on the vessel's Certificate of Inspection or Certificate of Compliance.

[CGD 81–052, 50 FR 8735, Mar. 5, 1985]

§154.1809 Loading and stability manual.

(a) No person may operate a vessel unless that vessel has on board a loading and stability manual.

(b) The loading and stability manual must contain:

(1) Information that enables the master to load and ballast the vessel while keeping structural stresses within design limits; and

(2) The information required by §170.110 of this chapter.

[CGD 74–289, 44 FR 26009, May 3, 1979, as amended by CGD 79–023, 49 FR 51010, Nov. 4, 1983]

§154.1810 Cargo manual.

(a) No person may operate a foreign flag vessel, whose flag administration does not issue IMO Certificates, on the navigable waters of the United States, or a U.S. flag vessel, unless the vessel has on board a cargo manual containing the following information:

(1) A description of each cargo carried, its handling hazards as a liquid or as a gas including frostbite or asphyxiation, its safety equipment and necessary first aid measures required by this part.

(2) A description of the dangers of asphyxiation from the inerting gases used on the vessel.

(3) The measures that mitigate embrittlement of steel structure in way of cargo leakage.

(4) The use of the firefighting systems on the vessel.

(5) The features of the cargo containment system that affect its operation and maintenance, including pressure and temperature ranges and relief valve settings.

(6) Pressures, temperatures, and liquid levels for all operations.

(7) General information derived from the first loading of the vessel.

(8) Alarm settings.

(9) Descriptions of the components of the cargo system, including the following:

(i) Liquid cargo system.

(ii) Liquid recirculating or condensate return system.

(iii) Cargo tank cool-down system.

(iv) Cargo tank warm-up or vaporization system.

(v) Gas main system.

(vi) Cargo tank or compressor relief system and blocked liquid or gas relief system.

(vii) Inerting system.

(viii) Boil-off gas compressor or reliquefaction system.

(ix) Gas detection systems.

(x) Alarm or safety indication systems.

(xi) Cargo jettisoning system.

(xii) The system for using boil-off gas as fuel.

(10) A description of cargo loading and discharge operations, including simultaneous handling of multigrades of cargo and ballast.

(11) A description of cargo operations during the voyage.

(12) A description of cargo tank cooldown and warm-up operations including purging with inert gas and air.

(13) A description of hull and cargo tank temperature monitoring systems.

(14) A description of gas detection systems and alarm or safety systems.

(15) A description of the following conditions and their symptoms, including emergency measures and corrective actions:

(i) Cargo or ballast valve malfunction.

(ii) Low cargo tank gas pressure.

(iii) High fill level shutdown.

(iv) Gas compressor shutdown.

(v) Hull cold spots.

(vi) Cargo piping leaks.

(vii) Primary or secondary barrier failure.

(viii) Hold boundary structural failure.

(ix) Fire in vent mast head.

(x) Reliquefaction plant failure.

(xi) Vaporizer malfunction or failure.

(xii) Piping or cargo valve freeze-up.

(16) Any other matters relating to operation of the cargo systems.

(17) The operational means to maintain the vessel in a condition of positive stability in accordance with the loading and stability manual under § 154.1809 through all conditions of:

(i) Loading and deballasting; and

(ii) Unloading and ballasting.

(b) The master shall ensure that the cargo manual is kept up-to-date.

§ 154.1812 Operational information for terminal personnel.

The master shall ensure that terminal personnel are told the operational information required by § 154.1810(a)(17).

§ 154.1814 Cargo information cards.

(a) No person may operate a vessel unless a cargo information card for each cargo being transported is carried either in the wheelhouse, in the ship's office, or in another location easily accessible to the person in charge of the watch.

(b) When a vessel is moored at a terminal, the master shall ensure that a set of information cards is in the possession of the terminal's person in charge of cargo transfer operations.

(c) Each card must be at least 17 cm × 24 cm (6¾ in. × 9½ in.), have printing on one side only, and must contain the following information about the cargo:

(1) Name as listed in Table 4.

(2) Appearance.

(3) Odor.

(4) Safe handling procedures, including special handling instructions, and handling hazards.

(5) Procedures to follow in the event of spills, leaks, or uncontrolled cargo release.

(6) Procedures to be followed if a person is exposed to the cargo.

(7) Firefighting procedures and materials.

§ 154.1816 Cargo location plan.

The master shall ensure that:

(a) A cargo location plan is prepared that gives:

(1) The location and number of each cargo tank; and

(2) The name of the cargo in each tank;

(b) One cargo location plan is kept with the sets of cargo information cards required under § 154.1814; and

(c) The cargo names in the cargo location plan do not differ from the names of the cargoes listed in Table 4.

§ 154.1818 Certification of inhibition.

(a) Except as provided in § 154.1740(b), no person may operate a vessel carrying butadiene or vinyl chloride without

carrying in the wheelhouse written certification from the shipper that the product is inhibited.

(b) The certification required by this section must contain the following information:

(1) The name and concentration of the inhibitor.

(2) The date the inhibitor was added.

(3) The expected duration of the inhibitor's effectiveness.

(4) Any temperature limitations qualifying the inhibitor's effective lifetime.

(5) The action to be taken if the time of the voyage exceeds the inhibitor's lifetime.

§154.1820 Shipping document.

No person may operate a vessel without carrying a shipping document in the wheelhouse that lists for each cargo on board:

(a) The cargo tank in which the cargo is stowed;

(b) The name of the shipper;

(c) The location of the loading terminal;

(d) The cargo name as listed in Table 4; and

(e) The approximate quantity of the cargo.

§154.1822 Shipping document: Copy for transfer terminal.

While a vessel is moored at a transfer terminal, the master shall ensure that at least one copy of the shipping document is given to the terminal's person in charge of cargo transfer.

§154.1824 Obstruction of pumproom ladderways.

The master shall ensure that each cargo pumproom access is unobstructed.

§154.1826 Opening of cargo tanks and cargo sampling.

(a) The master shall ensure that each cargo tank opening is fully closed at all times.

(b) The master may authorize the opening of a cargo tank:

(1) During tank cleaning; and

(2) To sample a cargo that Table 4 allows to be carried in a containment system having a restricted gauging system if:

(i) The cargo tank is not being filled during sampling;

(ii) The vent system has relieved any pressure in the tank; and

(iii) The person sampling the cargo wears protective clothing.

(c) The master shall ensure that cargoes requiring closed gauging as listed in Table 4 are sampled only through the controlled sampling arrangement of the cargo tank.

§154.1828 Spaces containing cargo vapor: Entry.

(a) No person may enter a cargo handling space without the permission of the master or without following a safety procedure established by the master.

(b) Before allowing anyone to enter a cargo handling space, the master shall ensure that:

(1) The space is free of toxic vapors and has an oxygen concentration of at least 19.5 percent oxygen by volume; or

(2) Those entering the space wear protective equipment with breathing apparatus and an officer closely supervises the entire operation in the space.

§154.1830 Warning sign.

(a) The master shall ensure that a vessel transferring cargo, while fast to a dock or while at anchor in port, displays a warning sign:

(1) At the gangway facing the shore so that the sign may be seen from the shore; and

(2) Facing outboard towards the water so that the sign may be seen from the water.

(b) Except as provided in paragraph (e) of this section, each warning sign must have the following words:

(1) Warning.

(2) Dangerous Cargo.

(3) No Visitors.

(4) No Smoking.

(5) No Open Lights.

(c) Each letter in the words on the sign must:

(1) Be block style;

(2) Be black on a white background;

(3) Be 7.6 cm (3 in.) high;

(4) Be 5.1 cm (2 in.) wide, except for ''M'' and ''W'' which must be 7.6 cm (3 in.) wide, and the letter ''I'' which may be 1.3 cm (½ in.) wide; and

(5) Have 1.3 cm (½ in.) stroke width.

(d) The spacing between letters must be:

(1) 1.3 cm (½ in.) between letters of the same word on the sign;

(2) 5.1 cm (2 in.) between words;

(3) 5.1 cm (2 in.) between lines; and

(4) 5.1 cm (2 in.) at the borders of the sign.

(e) The words ''No Smoking'' and ''No Open Lights'' may be omitted when the cargoes on board a vessel are not flammable.

(f) When a vessel carries or transfers vinyl chloride, the warning sign under paragraph (b) of this section must also have the words ''Cancer Suspect Agent.''

§ 154.1831 Persons in charge of transferring liquid cargo in bulk or preparing cargo tanks.

(a) The owner and operator of the vessel, and his or her agent, and each of them, shall ensure that—

(1) Enough ''Tankerman-PICs'' or restricted ''Tankerman-PICs'', and ''Tankerman-Assistants'', authorized for the classification of cargo carried, are on duty to safely conduct a transfer of liquid cargo in bulk or a cool-down, warm-up, gas-free, or air-out of each cargo tank;

(2) Each transfer of liquid cargo in bulk, and each cool-down, warm-up, gas-free, or air-out of a cargo tank, is supervised by a person designated as a person in charge of the transfer that possesses the qualifications required by 33 CFR 155.710;

(3) On each foreign tankship, the person in charge of either a transfer of liquid cargo in bulk or a cool-down, warm-up, gas-free, or air-out of a cargo tank possesses the qualifications required by 33 CFR 155.710;

(4) When cargo regulated under this part is being transferred, the person in charge of the transfer has received special training in the particular hazards associated with the cargo and in all special procedures for its handling; and

(5) On each foreign vessel, the person in charge understands his or her responsibilities as described in this subchapter.

(b) Upon request by the Officer in Charge, Marine Inspection, in whose zone the transfer will take place, the owner and operator of the vessel, and his or her agent, and each of them, shall provide documentary evidence that the person in charge has received the training specified by paragraph (a)(4) of this section and is capable of competently performing the procedures necessary for the cargo.

[CGD 79–116, 60 FR 17158, Apr. 4, 1995]

§ 154.1834 Cargo transfer piping.

The person in charge of cargo transfer shall ensure that cargo is transferred to or from a cargo tank only through the cargo piping system.

§ 154.1836 Vapor venting as a means of cargo tank pressure and temperature control.

When the vessel is on the navigable waters of the United States, the master shall ensure that the cargo pressure and temperature control system under §§ 154.701 through 154.709 is operating and that venting of cargo is unnecessary to maintain cargo temperature and pressure control, except under emergency conditions.

§ 154.1838 Discharge by gas pressurization.

The person in charge of cargo transfer may not authorize cargo discharge by gas pressurization unless:

(a) The tank to be offloaded is an independent tank type B or C;

(b) The pressurizing medium is the cargo vapor or a nonflammable, nontoxic gas that is inert with the cargo; and

(c) The pressurizing line has:

(1) A pressure reducing valve that has a setting that is 90 percent or less of the tank's relief valve setting; and

(2) A manual control valve between the pressure reducing valve and the tank.

§ 154.1840 Protective clothing.

The person in charge of cargo transfer shall ensure that each person involved in a cargo transfer operation, except those assigned to gas-safe cargo control rooms, wears protective clothing.

§ 154.1842 Cargo system: Controls and alarms.

The master shall ensure that the cargo emergency shut-down system

and the alarms under §154.1325 are tested and working before cargo is transferred.

§154.1844 Cargo tanks: Filling limits.

(a) Unless a higher limit is specified on the certificate the master shall ensure that a cargo tank is not loaded:

(1) More than 98 percent liquid full; or

(2) In excess of the volume determined under the following formula:

$$V_L = (0.98\,V)\left(\frac{d_r}{d_L}\right)$$

where:

V_L=maximum volume to which the tank may be loaded;
V=volume of the tank;
d_r=density at the reference temperature specified in paragraph (b) of this section; and
d_L=density of the cargo at the loading temperature and pressure.

(b) The reference temperature to be used in paragraph (a)(2) of this section is the temperature corresponding to the vapor pressure of the cargo at the set pressure of the pressure relief valves.

§154.1846 Relief valves: Changing set pressure.

The master shall:

(a) Supervise the changing of the set pressure of relief valves under §154.802(b);

(b) Enter the change of set pressure in the vessel's log; and

(c) Ensure that a sign showing the set pressure is posted:

(1) In the cargo control room or station; and

(2) At each relief valve.

§154.1848 Inerting.

(a) The master shall ensure that:

(1) Hold and interbarrier spaces on a vessel with full secondary barriers are inerted so that the oxygen concentration is 8 percent or less by volume when flammable cargoes are carried;

(2) Hold and interbarrier spaces contain only dry air or inert gas on:

(i) A vessel with partial secondary barriers;

(ii) A vessel with full secondary barriers when non-flammable cargoes are carried; and

(iii) A vessel with refrigerated independent tanks type C;

(3) When cargo tanks containing flammable vapor are to be gas freed, the flammable vapors are purged from the tank by inert gas before air is admitted; and

(4) When gas free cargo tanks are to be filled with a flammable cargo, air is purged from the tank by inert gas until the oxygen concentration in the tank is 8 percent or less by volume before cargo liquid or vapor is introduced.

(b) Inert gas must be supplied from the shore or from the vessel's inert gas system.

§154.1850 Entering cargo handling spaces.

(a) The master shall ensure that the ventilation system under §154.1200 is in operation for 30 minutes before a person enters one of the following:

(1) Spaces containing cargo pumps, compressors, and compressor motors.

(2) Gas-dangerous cargo control spaces.

(3) Other spaces containing cargo handling equipment.

(b) The master shall ensure that a warning sign listing the requirement for use of the ventilation system, is posted outside of each space under paragraph (a) of this section.

(c) The master shall ensure that no sources of ignition are put in a cargo handling space on a vessel carrying flammable cargo unless the space is gas free.

§154.1852 Air breathing equipment.

(a) The master shall ensure that a licensed officer inspects the compressed air breathing equipment at least once each month.

(b) The master shall enter in the vessel's log a record of the inspection required under paragraph (a) of this section that includes:

(1) The date of the inspection; and

(2) The condition of the equipment at the time of the inspection.

§154.1854 Methane (LNG) as fuel.

(a) If methane (LNG) vapors are used as fuel in the main propulsion system

of a vessel, the master shall ensure that the fuel oil fired pilot under § 154.705(c) is used when the vessel is on the navigable waters of the United States.

(b) When the methane (LNG) fuel supply is shut down due to loss of ventilation or detection of gas, the master shall ensure that the methane (LNG) fuel supply is not used until the leak or other cause of the shutdown is found and corrected.

(c) The master shall ensure that the required procedure under paragraph (b) of this section is posted in the main machinery space.

(d) The master shall ensure that the oxygen concentration in the annular space of the fuel line under § 154.706(a)(1) is 8% or less by volume before methane (LNG) vapors are admitted to the fuel line.

§ 154.1858 Cargo hose.

The person in charge of cargo transfer shall ensure that cargo hose used for cargo transfer service meets §§ 154.552 through 154.562.

§ 154.1860 Integral tanks: Cargo colder than −10° C (14°F).

The master shall ensure that an integral tank does not carry a cargo colder than −10°C (14°F) unless that carriage is 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]

§ 154.1862 Posting of speed reduction.

If a speed reduction is specially approved by the Commandant under § 154.409, the master shall ensure that the speed reduction is posted in the wheelhouse.

§ 154.1864 Vessel speed within speed reduction.

The master shall ensure that the speed of the vessel is not greater than the posted speed reduction.

§ 154.1866 Cargo hose connection: Transferring cargo.

No person may transfer cargo through a cargo hose connection unless the connection has the remotely controlled quick closing shut off valve required under § 154.538.

§ 154.1868 Portable blowers in personnel access openings.

The master shall ensure that a portable blower in a personnel access opening does not reduce the area of the opening so that it does not meet § 154.340.

§ 154.1870 Bow and stern loading.

(a) When the bow or stern loading piping is not in use, the master shall lock closed the shut-off valves under § 154.355(a)(4) or remove the spool piece under § 154.355(a)(4).

(b) The person in charge of cargo transfer shall ensure that after the bow or stern loading piping is used it is purged of cargo vapors with inert gas.

(c) The person in charge of cargo transfer shall ensure that entrances, forced or natural ventilation intakes, exhausts, and other openings to any deck house alongside the bow or stern loading piping are closed when this piping is in use.

(d) The person in charge of cargo transfer shall ensure that bow or stern loading piping installed in the area of the accommodation, service, or control space is not used for transfer of the following:

(1) Acetaldehyde.
(2) Ammonia, anhydrous.
(3) Dimethylamine.
(4) Ethylamine.
(5) Ethyl Chloride.
(6) Methyl Chloride.
(7) Vinyl Chloride.

§ 154.1872 Cargo emergency jettisoning.

(a) The master shall ensure that emergency jettisoning piping under § 154.356, except bow and stern loading and discharging piping, is only used when an emergency exists.

(b) Emergency jettisoning piping when being used may be outside of the transverse tank location under § 154.310.

(c) The master shall ensure that cargo is not jettisoned in a U.S. port.

(d) When ethylene oxide is carried, the master shall ensure that the emergency jettisoning piping with associated pumps and fittings is on-line and ready for use for an emergency.

(e) The master shall lock closed the shut-off valves under § 154.356 when the emergency jettisoning piping is not in use.

(f) The person in charge of cargo transfer shall ensure that after the emergency jettisoning piping is used it is purged of cargo vapors with inert gas.

(g) The person in charge of cargo transfer shall ensure that entrances, forced or natural ventilation intakes, exhausts, and other openings to accommodation, service, or control spaces facing the emergency jettisoning piping area and alongside the emergency jettisoning piping are closed when this piping is in use.

TABLE 4—SUMMARY OF MINIMUM REQUIREMENTS

Cargo name[1]	Ship type	Independent tank type C required	Control of cargo tank vapor space	Vapor detection[2]	Gauging[3]	Electrical hazard class and group[4]	Special requirements
Acetaldehyde	IIG/IIPG		Inert	I & T	C	I–C	154.1410 (c), 154.1410, 154.1710, 154.1720, 154.1870.
Ammonia, anhydrous.	IIG/IIPG			T	C	I–D	154.1000, 154.1400 (c), 154.1405, 154.1410, 154.1702 (b), (c), (e), 154.1760, 154.1870.
Butadiene	IIG/IIPG		Inert	I	R	I–B	154.1702 (b), (d), (f), 154.1710, 154.1750, 154.1818.
Butane	IIG/IIPG			I	R	I–D	None.
Butylene	IIG/IIPG			I	R	I–D	None.
Dimethylamine	IIG/IIPG			I & T	C	I–C	154.1400 (c), 154.1405, 154.1410, 154.1702 (b), (c), (e), 154.1870.
Ethane	IIG			I	R	I–D	None.
Ethylamine	IIG/IIPG			I & T	C	I–C	154.1400 (c), 154.1405, 154.1410, 154.1702 (b), (c), (e), 154.1870.
Ethyl Chloride	IIG/IIPG			I & T	R	I–D	154.1870.
Ethylene	IIG			I	R	I–C	None.
Ethylene oxide	IG	Yes	Inert	I & T	C	I–B	154.660 (b) (3), 154.1400 (c), 154.1405, 154.1410, 154.1702 (b), (d), (f), 154.1705, 154.1710, 154.1720, 154.1725, 154.1730, 154.1870 (a), (b).
Methane (LNG).	IIG			I	C	I–D	154.703 through 154.709, 154.1854.
Methyl acetylene-propadiene mixture.	IIG/IIPG			I	R	I	154.1735.
Methyl bromide.	IG	Yes		I & T	C	I–D	154.660 (b) (3), 154.1345 (c) (d), 154.1400 (c), 154.1405, 154.1410, 154.1702 (a), (d), 154.1705, 154.1720, 154.1870 (a), (b).
Methyl chloride.	IIG/IIPG			I & T	C	I–D	154.1702 (a), 154.1870.
Nitrogen	IIIG			O	C		154.1755.
Propane	IIG/IIPG			I	R	I–D	None.
Propylene	IIG/IIPG			I	R	I–D	None.
Refrigerant	IIIG				R		None.

TABLE 4—SUMMARY OF MINIMUM REQUIREMENTS—Continued

Cargo name[1]	Ship type	Independent tank type C required	Control of cargo tank vapor space	Vapor detection[2]	Gauging[3]	Electrical hazard class and group[4]	Special requirements
Sulfur dioxide	IG	Yes	Dry	T	C	.....	154.660 (b) (3), 154.1345 (c), (d), 154.1400 (c), 154.1405, 154.1410, 154.1705, 154.1715, 154.1720, 154.1870 (a), (b).
Vinyl chloride	IIG/IIPG ..	.....	.....	I & T	C	I–D	154.1405, 154.1410, 154.1702 (a) (b) (d) (f), 154.1710, 154.1740, 154.1745, 154.1750, 154.1818, 154.1830 (f), 154.1870.

[1]Refrigerant gases include non-toxic, non-flammable gases such as: dichlorodifluoromethane, dichloromonofluoromethane, dichlorotetrafluoroethane, monochlorodifluoromethane, monochlorotetrafluoroethane, and monochlorotrifluoromethane.
[2]As used in this column: ''I'' stands for flammable vapor detection; ''T'' stands for toxic vapor detection; ''O'' stands for oxygen detection; and see §§154.1345 thru 154.1360.
[3]As used in this column: ''C'' stands for closed gauging; ''R'' stands for restricted gauging; and see §154.1300.
[4]The designations used in this column are from the National Electrical Code.

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

APPENDIX A—EQUIVALENT STRESS

I. Equivalent stress (σ_c) is calculated by the following formula or another formula specially approved by the Commandant (G–MSO) as equivalent to the following:

$$\sigma_c = \sqrt{\sigma_x^2 + \sigma_y^2 - \sigma_x\sigma_y + 3\tau_{xy}^2}$$

where:

σ_x=total normal stress in ''x'' direction.

σ_y=total normal stress in ''y'' direction.

τ_{xy}=total shear stress in ''xy'' plane.

II. When the static and dynamic stresses are calculated separately, the total stresses in paragraph I are calculated from the following formulae or another formulae specially approved by the Commandant (G–MSO) as equivalent to the following:

$$\sigma_x = \sigma_x(\text{static}) \pm \sqrt{\sum(\sigma_x(\text{dynamic}))^2}$$

$$\sigma_y = \sigma_y(\text{static}) \pm \sqrt{\sum(\sigma_y(\text{dynamic}))^2}$$

$$\tau_{xy} = \tau_{xy}(\text{static}) \pm \sqrt{\sum(\tau_{xy}(\text{dynamic}))^2}$$

III. Each dynamic and static stress is determined from its acceleration component and its hull strain component from hull deflection and torsion.

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

APPENDIX B—STRESS ANALYSES DEFINITIONS

The following are the standard definitions of stresses for the analysis of an independent tank type B:

Normal stress means the component of stress normal to the plane of reference.

Membrane stress means the component of normal stress that is uniformly distributed and equal to the average value of the stress across the thickness of the section under consideration.

Bending stress means the variable stress across the thickness of the section under consideration, after the subtraction of the membrane stress.

Shear stress means the component of the stress acting in the plane of reference.

Primary stress means the stress produced by the imposed loading that is necessary to balance the external forces and moments. (The

basic characteristic of a primary stress is that it is not self-limiting. Primary stresses that considerably exceed the yield strength result in failure or at least in gross deformations.)

Primary general membrane stress means the primary membrane stress that is so distributed in the structure that no redistribution of load occurs as a result of yielding.

Primary local membrane stress means the resulting stress from both a membrane stress, caused by pressure or other mechanical loading, and a primary or a discontinuity effect that produces excessive distortion in the transfer of loads to other portions of the structure. (The resulting stress is a primary local membrane stress although it has some characteristics of a secondary stress.) A stress region is local if:

$$S_1 \leq 0.5\sqrt{Rt};\ \text{and}$$

$$S_2 \leq 2.5\sqrt{Rt}$$

Where:

S_1=distance in the meridional direction over which the equivalent stress exceeds 1.1 f.

S_2=distance in the meridional direction to another region where the limits for primary general membrane stress are exceeded.

R=mean radius of the vessel.

t=wall thickness of the vessel at the location where the primary general membrane stress limit is exceeded.

f=allowable primary general membrane stress.

Secondary stress means a normal stress or shear stress caused by constraints of adjacent parts or by self-constraint of a structure. The basic characteristic of a secondary stress is that it is self-limiting. Local yielding and minor distortions can satisfy the conditions that cause the stress to occur.

PART 155 [RESERVED]