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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 ($\sigma_c$) 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:

$\sigma_x$=total normal stress in ''x'' direction.

$\sigma_y$=total normal stress in ''y'' direction.

$\tau_{xy}$=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]