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 TO PART 154—EQUIVALENT STRESS

I. Equivalent stress (σ c) is calculated by the following formula or another formula specially approved by the Commandant (CG–522) 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 (CG–522) 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 TO PART 154—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]

# SUBCHAPTER P—MANNING OF VESSELS [RESERVED]