NFPA No.

385

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*Flammable Liquids*

**Recommended Regulatory Standard**

**for**

# TANK VEHICLES FOR FLAMMABLE LIQUIDS

**June**

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Fifty Cents*



**NATIONAL FIRE PROTECTION ASSOCIATION**
**International**
**60 Batterymarch Street, Boston 10, Mass.**

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# National Fire Protection Association

International

Executive Office: 60 Batterymarch St., Boston 10, Mass.

The National Fire Protection Association was organized in 1896 to promote the science and improve the methods of fire protection and prevention, to obtain and circulate information on these subjects and to secure the cooperation of its members in establishing proper safeguards against loss of life and property by fire. Its membership includes two hundred national and regional societies and associations (list on outside back cover) and seventeen thousand individuals, corporations, and organizations. Anyone interested may become a member; membership information is available on request.

This pamphlet is one of a large number of publications on fire safety issued by the Association including periodicals, books, posters and other publications; a complete list is available without charge on request. All NFPA standards adopted by the Association are published in six volumes of the **National Fire Codes** which are re-issued annually and which are available on an annual subscription basis. The standards, prepared by the technical committees of the National Fire Protection Association and adopted in the annual meetings of the Association, are intended to prescribe reasonable measures for minimizing losses of life and property by fire. All interests concerned have opportunity through the Association to participate in the development of the standards and to secure impartial consideration of matters affecting them.

NFPA standards are purely advisory as far as the Association is concerned, but are widely used by law enforcing authorities in addition to their general use as guides to fire safety.

## Definitions

The official NFPA definitions of shall, should and approved are:

SHALL is intended to indicate requirements.

SHOULD is intended to indicate recommendations, or that which is advised but not required.

APPROVED refers to approval by the authority having jurisdiction.

Units of measurements used here are U. S. standard. 1 U. S. gallon = 0.83 Imperial gallons = 3.785 liters.

## Approved Equipment

The National Fire Protection Association does not "approve" individual items of fire protection equipment, materials or services. The standards are prepared, as far as practicable, in terms of required performance, avoiding specifications of materials, devices or methods so phrased as to preclude obtaining the desired results by other means. The suitability of devices and materials for installation under these standards is indicated by the listings of nationally recognized testing laboratories, whose findings are customarily used as a guide to approval by agencies applying these standards. Underwriters' Laboratories, Inc., Underwriters' Laboratories of Canada and the Factory Mutual Laboratories test devices and materials for use in accordance with the appropriate standards, and publish lists which are available on request.

# RECOMMENDED REGULATORY STANDARD FOR TANK VEHICLES FOR FLAMMABLE LIQUIDS.

**NFPA No. 385 — 1959**

This standard is prepared for issuance by state and provincial authorities as a regulatory standard. It supersedes the edition of 1958 and prior editions.

This standard was prepared by the NFPA Sectional Committee on Transportation of Flammable Liquids, approved by the Flammable Liquids Committee and adopted by the National Fire Protection Association at its meeting, June 3, 1959.

This standard was initiated in 1926, first officially adopted in 1929, and later revised and issued in the following editions: 1933, 1948, 1953, 1954, 1955, 1957 and 1958. The editions prior to 1948 had different titles.

## Changes in 1959 Edition

For the first time, tank vehicles transporting flammable liquids having a vapor pressure in excess of 18 psia at 100° F. are included and this required a complete change in the numbering system. Other amendments include limitations on the loading temperature, since transportation of products at high temperatures may affect the strength of the cargo tank. New provisions are also included for stainless steel cargo tanks as well as for a new aluminum alloy; new operating conditions are also included to assure compliance with the above requirements; and, an increase was made in the compartment size of tank vehicles delivering Class I and Class II flammable liquids to premises where the public is invited.

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# TANK VEHICLES FOR FLAMMABLE LIQUIDS

NFPA No. 385

## CHAPTER 1. GENERAL PROVISIONS.

### 10. Scope.

**1010.** This standard applies to tank motor vehicles to be used for the transportation of normally stable flammable liquids or asphalt. It is intended to provide minimum requirements for the design, construction and operation of tank motor vehicles, their appurtenances, and certain features of tank motor vehicle chassis.

NOTE: Normally stable materials are those having the relative capacity to resist changes in their chemical composition which would produce violent reactions or detonations despite exposure to air, water, heat, including the normal range of conditions encountered in handling, storage, or transportation. Unstable (reactive) flammable liquid shall mean a liquid which in the pure state or as commercially produced or transported will vigorously polymerize, decompose, condense, or will become self-reactive under conditions of shock, pressure, or temperature.

**1020.** Additional safeguards may be necessary for tank vehicles used for the transportation of flammable liquids having characteristics introducing additional factors such as high rates of expansion, in stability, corrosiveness and toxicity.

**1030.** Attention is directed to the fact that cutback asphalts can have flash points in the range of Class I or Class II flammable liquids. Also liquids having a flash point higher than 200° F., such as asphalt, may assume the characteristics of lower flash point liquids when heated. Under such conditions it shall be appropriate to apply the provisions of these standards unless otherwise specifically exempted.

**1040.** The requirements for aircraft fuel servicing tank vehicles are contained in NFPA No. 407, Fueling Aircraft on the Ground.

### 11. Definitions.

ASPHALT. The term asphalt shall include other materials having similar characteristics when heated above ambient temperatures. (See Section 1030.)

AUTOMOTIVE SERVICE STATION. That portion of a property where flammable liquids used as motor fuels are stored and dispensed from fixed equipment into the fuel tanks of motor vehicles.

BAFFLE. A non-liquid-tight transverse partition in a cargo tank.

CARGO TANK. Any container having a liquid capacity in excess of 100 gallons used for carrying of flammable liquids or asphalt and mounted permanently or otherwise upon a tank vehicle. The term "cargo tank" does not apply to any container used solely for the purpose of supplying fuel for the propulsion of the tank vehicle upon which it is mounted.

COMPARTMENT. A liquid-tight division in a cargo tank.

FLAMMABLE LIQUIDS. Liquids have a flash point below 200°F. and a vapor pressure not exceeding 40 psi absolute at 100°F. which, for the purpose of this specification shall be divided into three classes, viz:

Class I shall include those having flash points at or below 20°F.

Class II shall include those having flash points above 20°F. but at or below 70°F.

Class III shall include those having flash points above 70° F.

The flash point of flammable liquids having a flash point below 175° F. (79° C.) shall be determined by the Standard Method of Test for Flash point by means of the Tag Closed Tester, of the American Society for Testing Materials (A.S.T.M. D56–56.

The flash point of flammable liquids having a flash point of 175° F. or higher shall be determined by the Standard Method of Test for Flash point by means of the Pensky-Martens Closed Tester of the American Society for Testing Materials (A.S.T.M. D93–52).

Vapor pressure shall be determined by the Standard Method of Test for Vapor Pressure of Petroleum Products (Reid Method) of the American Society for Testing Materials (A.S.T.M. D323–56).

HEAD AND BULKHEAD. A liquid-tight transverse closure at the end of a cargo tank or between compartments of a cargo tank.

MARINE SERVICE STATION. That portion of a property where flammable liquids used as motor fuels are stored and dispensed from fixed equipment on shore, piers, wharves, or floating docks into the fuel tanks of motor craft, and shall include all facilities used in connection therewith.

TANK FULL TRAILER. Any vehicle with or without auxiliary motive power, equipped with a cargo tank mounted thereon or built as an integral part thereof and used for the transportation of flammable liquids or asphalt and so constructed that practically all of its weight and load rests on its own wheels.

TANK SEMI-TRAILER. Any vehicle with or without auxiliary motive power, equipped with a cargo tank mounted thereon or built as an integral part thereof, and used for the transportation of flammable liquids or asphalt, and so constructed that, when drawn by a tractor by means of a fifth wheel connection, some part of its load and weight rests upon the towing vehicle.

TANK TRUCK. Any single self-propelled motor vehicle equipped with a cargo tank mounted thereon, and used for the transportation of flammable liquids or asphalt.

TANK VEHICLE. Any tank truck, tank full trailer, or tractor and tank semi-trailer combination.

## CHAPTER 2. VEHICLE DESIGN.

### 20. Basic Design.

**2010.** Design of the tank vehicle shall give engineering consideration to the structural relationship between the cargo tank, the propulsion equipment and the supporting members if any, with due regard to the weight and temperature of the cargo, road performance, braking, and required ruggedness. The metal thicknesses specified in Chapter 2 are minimum thicknesses dictated by the structure of the tank itself, and it may be necessary that these thicknesses be increased where the tank shell is to be subjected to additional stress.

**2020.** Any tank vehicle designed or used for transporting materials at liquid temperatures above ambient temperature shall have a red warning sign permanently attached to the vehicle containing at least the following:

"Maximum allowable cargo temperature is ____° F."

This maximum allowable cargo temperature shall be specified by the manufacturer of the vehicle.

**2030.** Cargo tanks used for transporting flammable liquids

with a vapor pressure of 18 psia or over at 100°F. shall be constructed in accordance with Article 21.

**2040.** Cargo tanks used for transporting flammable liquids with a vapor pressure under 18 psia at 100°F. shall be constructed in accordance with the provisions of Article 22 or Article 21.

**2050.** The material used in the construction of the cargo tanks shall be compatible with the chemical characteristics of the flammable liquid to be transported.

NOTE: In case of doubt, the supplier or producer of the flammable liquid or other competent authority should be consulted as to the suitability of the material of construction to be used.

## 21. Cargo Tanks, Piping and Connections Designed for Flammable Liquids Having a Vapor Pressure of 18 psia or Over at 100° F.

**2110.** Cargo tanks, piping and connections designed for flammable liquids having a vapor pressure of 18 psia or over at 100° F. shall be built in accordance with Specification MC 304 or MC 330 of Part 78 of Title 49, Code of Federal Regulations (Regulations of the Interstate Commerce Commission) or in accordance with Division III of the Standard for the Storage and Handling of Liquefied Petroleum Gases, NFPA No. 58.

## 22. Cargo Tanks, Piping and Connections Designed for Flammable Liquids Having a Vapor Pressure Under 18 psia at 100° F.

### 2210. Cargo Tank Construction.

2211. Cargo Tanks Constructed of Mild Steel.

(a) **Material.** All sheets for such cargo tanks shall be of mild steel to meet the following requirements:

Yield Point, minimum.....25,000 pounds per square inch
Ultimate Strength, minimum....45,000 pounds per square inch
Minimum Elongation, standard 2-inch sample.....20 per cent

(b) **Thickness of Sheets.** The minimum thicknesses of tank sheets shall be limited by the volume capacity of the tank expressed in terms of gallons per inch of length; and by the distance between bulkheads, baffles, or other shell stiffeners, as well as by the radius of shell curvature in case of shell sheets. Thickness of exterior head sheets shall never be less than the maximum requirements for shell sheets in any specific unit.

## MINIMUM THICKNESS OF HEAD, BULKHEAD AND BAFFLE SHEETS

### Mild Steel

| Heads, Bulkheads, or Baffles (Dished, Corrugated, Reinforced or Rolled) | | | | |
|---|---|---|---|---|
| Volume Capacity of Tank in Gallons per Inch of Length | 10 or Less | Over 10 to 14 | Over 14 to 18 | Over 18 |
| Manufacturers Std. Gage No. | 14 | 13 | 12 | 11 |

## MINIMUM THICKNESS OF SHELL SHEETS

### Mild Steel

| Volume Capacity of Tank in Gallons Per Inch of Length | Distance Between Attachments of Bulkheads, Baffles or Other Shell Stiffeners: 36 inches or less | | Over 36 inches to 54 inches | | Over 54 inches | |
|---|---|---|---|---|---|---|
| **Maximum Shell Radius of less than 70 inches:** | Gage* No. | Approx. Thick. Decimals of in. | Gage* No. | Approx. Thick. Decimals of in. | Gage* No. | Approx. Thick. Decimals of in. |
| 10 gallons or less . . . | 14 | 0.0747 | 14 | 0.0747 | 14 | 0.0747 |
| Over 10 to 14 gallons . | 14 | 0.0747 | 14 | 0.0747 | 13 | 0.0897 |
| Over 14 to 18 gallons . | 14 | 0.0747 | 13 | 0.0897 | 12 | 0.1046 |
| Over 18 gallons . . . | 13 | 0.0897 | 12 | 0.1046 | 11 | 0.1196 |
| **Maximum Shell Radius of 70 inches or more, but less than than 90 inches:** | | | | | | |
| 10 gallons or less . . . | 14 | 0.0747 | 14 | 0.0747 | 13 | 0.0897 |
| Over 10 to 14 gallons . | 14 | 0.0747 | 13 | 0.0897 | 12 | 0.1046 |
| Over 14 to 18 gallons . | 13 | 0.0897 | 12 | 0.1046 | 11 | 0.1196 |
| Over 18 gallons . . . | 12 | 0.1046 | 11 | 0.1196 | 10 | 0.1345 |
| **Maximum Shell Radius of 90 inches or more, but less than 125 inches:** | | | | | | |
| 10 gallons or less . . . | 14 | 0.0747 | 13 | 0.0897 | 12 | 0.1046 |
| Over 10 to 14 gallons . | 13 | 0.0897 | 12 | 0.1046 | 11 | 0.1196 |
| Over 14 to 18 gallons . | 12 | 0.1046 | 11 | 0.1196 | 10 | 0.1345 |
| Over 18 gallons . . . | 11 | 0.1196 | 10 | 0.1345 | 9 | 0.1495 |
| **Maximum Shell Radius of 125 inches or more:** | | | | | | |
| 10 gallons or less . . . | 13 | 0.0897 | 12 | 0.1046 | 11 | 0.1196 |
| Over 10 to 14 gallons . | 12 | 0.1046 | 11 | 0.1196 | 10 | 0.1345 |
| Over 14 to 18 gallons . | 11 | 0.1196 | 10 | 0.1345 | 9 | 0.1495 |
| Over 18 gallons . . . | 10 | 0.1345 | 9 | 0.1495 | 8 | 0.1685 |

*Manufacturers Standard Gage and approximate equivalent thickness in decimals of inch.

2212. Cargo tanks constructed of low alloy low carbon (high tensile) steel and stainless steel.

(a) All low alloy low carbon (high tensile) steel sheets for such cargo tanks shall meet the following requirements:

Yield Point, minimum.....45,000 pounds per square inch
Ultimate Strength, minimum....60,000 pounds per square inch
Minimum Elongation, standard 2-inch sample.....25 per cent

(b) All stainless steel sheets for such cargo tanks shall meet the following minimum requirements:

Yield Point, minimum.....32,000 pounds per square inch
Ultimate Strength, minimum....75,000 pounds per square inch
Minimum Elongation, standard 2-inch sample.....20 per cent

(c) Thickness of high tensile and stainless steel sheets: The minimum thickness of high tensile and stainless steel tank sheets shall be limited by the volume capacity of the tank expressed in terms of gallons per inch of length; and by the distance between bulkheads, baffles, or other shell sheets; as follows:

**Low Alloy Low Carbon (High Tensile) Steel and Stainless Steel Sheets**

**MINIMUM THICKNESS OF HEAD, BULKHEAD AND BAFFLE SHEETS**

| **Heads, Bulkheads, or Baffles** | **(Dished, Corrugated, Reinforced or Rolled)** | | | |
|---|---|---|---|---|
| Volume Capacity of Tank in Gallons per Inch of Length | 10 or Less | Over 10 to 14 | Over 14 to 18 | Over 18 |
| Manufacturers Std. Gage No. | 15 | 14 | 13 | 12 |

## MINIMUM THICKNESS OF SHELL SHEETS

### Low Alloy Low Carbon (High Tensile) Steel and Stainless Steel

| Volume Capacity of Tank in Gallons Per Inch of Length | Distance Between Attachments of Bulkheads, Baffles or Other Shell Stiffeners: 36 inches or less | | Over 36 inches to 54 inches | | Over 54 inches | |
|---|---|---|---|---|---|---|
| **Maximum Shell Radius of less than 70 inches*:** | Gage** No. | Approx. Thick. Decimals of in. | Gage** No. | Approx. Thick. Decimals of in. | Gage** No. | Approx. Thick. Decimals of in. |
| 10 gallons or less . . . | 16 | 0.0588 | 16 | 0.0588 | 15 | 0.0673 |
| Over 10 to 14 gallons . | 16 | 0.0588 | 15 | 0.0673 | 14 | 0.0747 |
| Over 14 to 18 gallons . | 15 | 0.0673 | 14 | 0.0747 | 13 | 0.0897 |
| Over 18 gallons . . . | 14 | 0.0747 | 13 | 0.0897 | 12 | 0.1046 |
| **Maximum Shell Radius of 70 inches or more, but less than than 90 inches*:** | | | | | | |
| 10 gallons or less . . . | 16 | 0.0588 | 15 | 0.0673 | 14 | 0.0747 |
| Over 10 to 14 gallons . | 15 | 0.0673 | 14 | 0.0747 | 13 | 0.0897 |
| Over 14 to 18 gallons . | 14 | 0.0747 | 13 | 0.0897 | 12 | 0.1046 |
| Over 18 gallons . . . | 13 | 0.0897 | 12 | 0.1046 | 11 | 0.1196 |
| **Maximum Shell Radius of 90 inches or more, but less than 125 inches*:** | | | | | | |
| 10 gallons or less . . . | 15 | 0.0673 | 14 | 0.0747 | 13 | 0.0897 |
| Over 10 to 14 gallons . | 14 | 0.0747 | 13 | 0.0897 | 12 | 0.1046 |
| Over 14 to 18 gallons . | 13 | 0.0897 | 12 | 0.1046 | 11 | 0.1196 |
| Over 18 gallons . . . | 12 | 0.1046 | 11 | 0.1196 | 10 | 0.1345 |
| **Maximum Shell Radius of 125 inches or more*:** | | | | | | |
| 10 gallons or less . . . | 14 | 0.0747 | 13 | 0.0897 | 12 | 0.1046 |
| Over 10 to 14 gallons . | 13 | 0.0897 | 12 | 0.1046 | 11 | 0.1196 |
| Over 14 to 18 gallons . | 12 | 0.1046 | 11 | 0.1196 | 10 | 0.1345 |
| Over 18 gallons . . . | 11 | 0.1196 | 10 | 0.1345 | 9 | 0.1495 |

*If other than circular cross section, the radius used shall be the maximum for that portion of the cross section under consideration.

**Manufacturers Standard Gage and approximate equivalent thickness in decimals of inch.

2213. Cargo Tanks Constructed of Aluminum Alloys for High Strength Welded Construction.

(a) **Material.** All sheets for shell, heads and bulkheads of such cargo tanks shall be of aluminum alloys GR20A (5052 commercial designation), GM31A (5454) commercial designation), GR40A (5154 commercial designation) or GM40A (5086 commercial designation), conforming to American Society for Testing Materials Specification B209–57T.

All heads, bulkheads, baffles and other shell stiffeners may use O temper (annealed) or stronger tempers. All shells shall be of H32 temper or H34 temper, except that when shell thicknesses of 0.250 inch or thicker are used, the H112 temper is additionally permitted.

(b) **Thickness of Sheets.** The minimum nominal thicknesses of tank sheets shall be limited by the volume capacity of the tank, expressed in terms of gallons per inch of length; and by the distance between bulkheads, baffles, or other shell stiffeners, as well as by the radius of shell curvature in the case of shell sheets. Thickness of exterior head sheets shall never be less than the maximum requirements for shell sheets.

(c). When aluminum is used for cargo tanks intended to transport cargoes at liquid temperatures above 250° F. the minimum thicknesses in the following tables shall be increased by one per cent for each 10° F. or portion thereof above 250° F. When the liquid temperatures are above 500° F. there shall be an additional one per cent for each 10° F. or portion thereof above 500° F. Aluminum shall not be used for cargo tanks transporting cargoes at temperatures above 550° F.

**MINIMUM THICKNESS OF HEAD, BULKHEAD AND BAFFLE SHEETS**

**Aluminum Alloys GR20A, GM 31A, GR40A, and GM40A**

| Heads, Bulkheads, or Baffles | (Dished, Corrugated, Reinforced or Rolled) | | | |
|---|---|---|---|---|
| Volume Capacity of Tank in | 10 or | Over 10 | Over 14 | Over |
| Gallons per Inch of Length | Less | to 14 | to 18 | 18 |
| Thickness in decimals of inch | .096 | .109 | .130 | .151 |

MINIMUM THICKNESS OF SHELL SHEETS
Aluminum Alloys GR20A, GM31A, GR40A and GM40A

| Volume Capacity of Tank in Gallons Per Inch of Length | Distance Between Attachments of Bulkheads, Baffles or Other Shell Stiffeners: 36 inches or less | Over 36 inches to 54 inches | Over 54 inches |
|---|---|---|---|
| **Inch Decimal Thickness for Maximum Shell Radius of Less than 70 inches:** | | | |
| 10 gallons or less | .087 | .087 | .096 |
| Over 10 to 14 gallons | .087 | .096 | .109 |
| Over 14 to 18 gallons | .096 | .109 | .130 |
| Over 18 gallons | .109 | .130 | .151 |
| **Inch Decimal Thickness for Maximum Shell Radius of 70 inches or more, but less than 90 inches:** | | | |
| 10 gallons or less | .087 | .096 | .109 |
| Over 10 to 14 gallons | .096 | .109 | .130 |
| Over 14 to 18 gallons | .109 | .130 | .151 |
| Over 18 gallons | .130 | .151 | .173 |
| **Inch Decimal Thickness for Maximum Shell Radius of 90 inches or more, but less than 125 inches:** | | | |
| 10 gallons or less | .096 | .109 | .130 |
| Over 10 to 14 gallons | .109 | .130 | .151 |
| Over 14 to 18 gallons | .130 | .151 | .173 |
| Over 18 gallons | .151 | .173 | .194 |
| **Inch Decimal Thickness for Maximum Shell Radius of 125 inches or more:** | | | |
| 10 gallons or less | .109 | .130 | .151 |
| Over 10 to 14 gallons | .130 | .151 | .173 |
| Over 14 to 18 gallons | .151 | .173 | .194 |
| Over 18 gallons | .173 | .194 | .216 |

## 2220. Joints.

2221. Joints shall be welded in accordance with recognized good practice and the efficiency of any joint shall be not less than 85 per cent of that of the adjacent metal in the tank.

2222. Mild steel sheets as specified in paragraph 2211 may be used in combination with high tensile steel sheets or stainless steel sheets as specified in paragraph 2212 in the construction

of a single tank, provided each material, where used, shall comply with the minimum requirements for the material used in the construction of that section of the tank. Whenever stainless steel sheets are used in combination with sheets of other types of steel, joints made by welding shall be formed by the use of stainless steel electrodes or filler rods on condition that the stainless steel electrodes or filler rods used in the welding be suitable for use with the grade of stainless steel concerned, according to the recommendations of the manufacturer of the stainless steel electrodes or filler rods.

2223. In cargo tanks constructed of aluminum alloys, all joints in and to tank shells, heads and bulkheads shall be welded. All welded aluminum joints shall be made in accordance with recognized good practice, and the efficiency of a joint shall not be less than 85 per cent of the annealed properties of the material in question. Aluminum alloys for high strength welded construction shall be joined by an inert gas arc welding process using filler metals R–GR40A, E–GR40A (5154 alloy) and R–GM50A, E–GM50A (5356 alloy) as conforming to American Society for Testing Materials Specification No. B285–57T (American Welding Society Specification No. A5. 10–57).

### 2230. Bulkheads and Baffles.

2231. Every cargo tank having a total capacity in excess of 3000 gallons and used for the distribution of Class I and Class II flammable liquids to automotive and marine service stations to which the public is invited shall be divided into compartments, no one of which shall exceed 2500 gallons. A design tolerance of ten per cent shall be allowed for capacities of individual compartments or tanks.

2232. Bulkheads or compartments shall not be required in any cargo tank used for transportation service, regardless of total capacity, provided such cargo tank is not used for the delivery of flammable liquids to service stations or other premises to which the public is invited. Bulkheads or compartments shall not be required in any cargo tank used for asphalt service.

2233. Every cargo tank, and every compartment over 90 inches in length, except those used in asphalt service, shall be provided with baffles, the number of which shall be such that the linear distance between any two adjacent baffles, or between any tank head or bulkhead and the baffles nearest it, shall in no case exceed 60 inches.

2234. The cross sectional area of each baffle shall be not less than 80 per cent of the cross sectional area of the tank and the thickness of such baffle shall be not less than that required for heads and bulkheads of the cargo tank in which installed.

2235. Cargo tanks with compartments carrying flammable liquids of different classes shall be provided with an air space between compartments and this air space shall be equipped and maintained with drainage facilities operative at all times.

### 2240. Test.

2241. At the time of manufacture every cargo tank shall be tested by a minimum air or hydrostatic pressure of three pounds per square inch applied to each compartment, or to the whole tank if it be not divided into compartments. Such pressure shall be maintained for a period of at least five minutes, during which, if the test is by air pressure, the entire exterior surface of all the joints shall be coated with a solution of soap and water, heavy oil or other material suitable for the purpose, foaming or bubbling of which will indicate the presence of leaks. Hydrostatic pressure, if used, shall be gaged at the top of the tank; and the tank shall be inspected at the joints for the issuance of liquid to indicate leaks. Any leakage discovered by either of the methods above described, or by any other method shall be deemed as evidence of failure to meet the requirements of this specification.

### 2250. Outlet Valve and Faucet Connections.

2251. Outlets shall be substantially made and so attached to the tank.

2252. Drawoff valves and faucets shall have discharge ends threaded, or they shall be designed so as to permit being tightly connected to hose extending to fill pipe.

### 2260. Vents and Emergency Relief.

2261. Each cargo tank or compartment, except those used in asphalt service, shall be provided with a vacuum and pressure operated vent with a minimum effective opening of 0.44 square inch, and shall also be provided with an emergency venting facility so constructed as to provide a minimum free-venting opening having a net area in square inches equal to 1.25 plus 0.0025 times the capacity of the cargo tank or compartment in gallons. If the emergency venting facility operates in response to elevated temperatures, the critical temperature for such operation shall not exceed 200° F.

2262. Each cargo tank used in asphalt service shall be provided with a vent having an effective opening at least equivalent to a nominal two-inch pipe.

2263. Each cargo tank for asphalt service shall be provided with a manhole at least 16 inches in diameter designed to relieve internal pressure at between two and three pounds per square inch gage or an equivalent relief device.

### 2270. Emergency-Discharge Control.

### Liquids Having Viscosities Less Than 45 SSU.

2271. The outlets of each cargo tank or compartment used for transportation of Class I and Class II flammable liquids, and trucks constructed hereafter for transportation of Class III flammable liquids having a viscosity less than 45 seconds Saybolt Universal at 100° F., shall be equipped with a reliable and efficient shutoff valve located inside the shell; or in the sump when it is an integral part of the shell; and designed so that the valve must be kept closed except during loading and unloading operations.

NOTE: The 45 second viscosity limit is included for the purposes of requiring internal valves when transporting free-flowing distillate oils, such as kerosene, diesel oil and domestic heating oil, and of excluding this requirement when transporting viscous oils such as residual fuel oil, bunker fuel oil, and asphalt products.

2272. The operating mechanism for the valve shall be provided with a secondary control, remote from the fill openings and discharge faucets, for use in the event of accidents or fire during delivery operations.

2273. The control mechanism shall be provided with a fusible section which will permit valves to close automatically in case of fire.

2274. In every case there shall be provided, between the shutoff valve seat and discharge faucet, a shear section which will break under strain unless the discharge piping is so arranged as to afford the same protection and leave the shutoff valve seat intact.

### Liquids of Viscosities of 45 SSU or More.

2275. The outlets of each cargo tank used for the transportation of liquids having a viscosity equal to or greater than 45 seconds Saybolt Universal at 100° F. shall be equipped with a suitable shutoff valve, located internally, designed so that the valve will remain operable if the external connection is sheared off or a front or rear-head mounted valve securely reinforced and protected against shock or road hazards.

### 2280. Overflows and Drains for Asphalt Tank Vehicles.

2281. Overflow protection for asphalt tank vehicles shall be provided in the form of reservoirs or flashing around fill and vent pipes. Overflow and drain pipes shall have thicknesses heavier than the tank shell and shall be designed so that hot asphalt will not spill onto tires, brakes, burner equipment or vehicle's exhaust system.

## CHAPTER 3. TANK-VEHICLE CHASSIS, ASSEMBLY AND APPURTENANCES.

### 30. Tires.

**3010.** All tank motor vehicles shall be equipped with rubber tires on all wheels.

### 31. Assembly.

**3110.** Every cargo tank shall be adequately supported upon and securely attached to or be a part of the tank vehicle upon which it is carried.

### 32. Static Protection.*

**3210.** Cargo tanks, and vehicle chassis, shall be electrically bonded.

**3220.** Provisions shall be made in the tank structure of the vehicle for the bonding of vehicle to the fill pipe during truck loading operations.

### 33. Protection Against Collision or Overturn.

**3310.** Drawoff valves or faucets projecting beyond the frame at the rear of a tank vehicle shall be adequately protected against collision by bumpers or similar means.

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*Drag chains and straps, formerly specified for the purpose of eliminating static charges, have been shown to be ineffective and their elimination is recommended.

**3320.** On tank vehicles constructed hereafter, all closures for filling openings shall be protected from damage in the event of overturning of the tank vehicle by being enclosed within the body of the tank or a dome attached thereto, or by the use of suitable metal guards securely attached to the tank or the frame of the tank vehicle.

## 34. Lighting.

**3410.** No lighting device other than electric lights shall be used on tank vehicles. Lighting circuits shall have suitable overcurrent protection (fuses or automatic circuit breakers). The wiring shall have sufficient carrying capacity and mechanical strength, and shall be secured, insulated, and protected against physical damage, in keeping with recognized good practice.

## 35. Fuel System.

**3510.** Fuel tanks shall be so designed, constructed and installed as to present no unusual hazard, and shall be so arranged as to vent during filling operations and permit drainage without removal from their mountings.

**3520.** All portions of the fuel-feed system, including carburetor, pumps, and all auxiliary mechanisms and connections shall be constructed and installed in a workmanlike manner, and so constructed and located as to minimize the fire hazard, with no readily combustible materials used therein, and shall, except for Diesel fuel connections, be well separated from the engine exhaust system. A pressure-release device shall be provided where necessary. The fuel-feed lines shall be made of materials not adversely affected by the fuel to be used or by other materials likely to be encountered, of adequate strength for their purpose, well secured to avoid chafing or undue vibration, having a readily accessible and reliable shutoff valve or stopcock. Joints depending upon solder for mechanical strength and liquid tightness shall not be used in the fuel system at or near the engine, or its accessories, unless the solder has a melting point of not less than 340° F., or unless a self-closing, thermally controlled valve set to operate at not exceeding 300° F., or other equivalent automatic device, shall be installed in the fuel line on the fuel-tank side of such joint.

**3530.** Fuel tanks for the vehicle engine and fuel tanks for the burners on asphalt trucks shall be located remotely from the burner or protected by a noncombustible shield from the burner to prevent flashback.

## 36. Exhaust System.

**3610.** The exhaust system, including muffler (or silencer) and exhaust line shall have ample clearance from the fuel system and combustible materials, and shall not be exposed to leakage or spillage of product or accumulations of grease, oil or gasoline.

**3620.** The exhaust system, including all units, shall be constructed and installed in a workmanlike manner. A muffler (or silencer) cutout shall not be used.

## 37. Full Trailers and Semi-Trailers.

**3710.** Trailers shall be firmly and securely attached to the vehicle drawing them, in a manner conforming with recognized good practice.

**3720.** Each full trailer, and semi-trailer, shall be equipped with reliable brakes on all wheels, and adequate provision shall be made for their efficient operation from the driver's seat of the vehicle drawing the trailer, or semi-trailer.

**3730.** Trailer connections shall be such as to prevent the towed vehicle from whipping or swerving from side to side dangerously or unreasonably and shall cause the trailer to follow substantially in the path of the towing vehicle.

## 38. Fire Extinguishers.

**3810.** Each tank vehicle shall be provided with at least one portable fire extinguisher having at least a 12-B, C rating or when more than one is provided, each extinguisher shall have at least a 6-B rating. Ratings shall be in accordance with the Standard for Installation, Maintenance and Use of Portable Fire Extinquishers, No. 10.

**3820.** Fire extinguishers shall be kept in good operating condition at all times, and they shall be located in an accessible place on each tank vehicle.

## CHAPTER 4. AUXILIARY EQUIPMENT.

### 40. Auxiliary Internal Combustion Engines.

**4010.** Internal combustion engines, other than those providing propulsive power, installed or carried upon a tank vehicle transporting Class I and Class II flammable liquids for the purpose of providing power for the operation of pumps or other devices, shall meet the following requirements:

4011. The engine air intake shall be equipped with an effective flame arrester, or an air cleaner having effective flame arrester characteristics, substantially installed and capable of preventing emission of flame from the intake side of the engine in event of backfiring.

4012. The fuel system shall be so located or constructed as to minimize the fire hazard. If the fuel tank is located above or immediately adjacent to the engine, suitable shielding shall be provided to prevent spillage during the filling operation, or leakage from the tank or fuel system, from coming in contact with the engine or any parts of the ignition and exhaust systems. All parts of the fuel system shall be constructed and installed in a workmanlike manner.

4013. Pumps and other appurtenances carrying or containing flammable liquids shall be so located in relation to the engine that spillage or leakage from such parts shall be prevented from coming in contact with the engine or any parts of the ignition and exhaust system, or adequate shielding shall be provided to attain the same purpose. The engine cooling fan shall be so positioned, rotated or shielded as to minimize the possibility of drawing flammable vapors toward the engine.

4014. When the engine is located in a position where spillage from the cargo tank or its appurtenances or from side racks might constitute a hazard, suitable shielding shall be provided to prevent such spillage from contacting the engine or engine exhaust system and for draining such spillage away from the vicinity of the engine.

4015. Where the engine is carried within an enclosed space adequate provision shall be made for air circulation at all times, to prevent accumulation of explosive vapors and to avoid overheating.

4016. The exhaust system shall be substantially constructed and installed and free from leaks. The exhaust line and muffler

shall have adequate clearance from combustible materials and the exhaust gases shall be discharged at a location which will not constitute a hazard. When engines are carried as in Paragraph 4015, the exhaust gases shall be discharged outside of each such closed space.

4017. The ignition wiring shall be substantially installed with firm connections, and spark plug and all other terminals shall be suitably insulated, to prevent sparking in event of contact with conductive materials. The ignition switch shall be of the enclosed type.

## 41. Auxiliary Electric Generators and Motors.

**4110.** Electrical equipment installed or carried upon a tank vehicle transporting Class I and Class II flammable liquids, for the operation of pumps or other devices used for the handling of product and operating product handling accessories shall meet the following requirements:

4111. Generators which are mounted on the engine providing propulsive power for the vehicle or an auxiliary engine, or located in the immediate vicinity of such engine or its exhaust system, may have general purpose enclosure. Generators located elsewhere shall be provided with explosion-proof enclosure.

4112. Motors having sparking contacts shall be provided with explosion-proof enclosures.

4113. Wiring shall be adequate for maximum loads to be carried, and shall be installed so as to be protected from physical damage and contact with possible product spill either by location or by being enclosed in metal conduit or other oil-resistant protective covering. Junction boxes shall be sealed.

4114. Switches, overload protection devices and other sparking equipment shall be located and enclosed as provided for generators in Paragraph 4111.

4115. Where the generator or motor is located within an enclosed space adequate provision shall be made for air circulation to prevent overheating and possible accumulation of explosive vapor.

## 42. Burner and Burner Tubes for Asphalt Tank Vehicles.

**4210.** Burner tubes shall be properly installed and maintained.