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Flammable Liquids

Recommended Regulatory Standard
for
TANK VEHICLES FOR FLAMMABLE LIQUIDS

May
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Thirty-five Cents*

NATIONAL FIRE PROTECTION ASSOCIATION
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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 over a hundred and eighty national and regional societies and associations (list on outside back cover) and more than fifteen 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; a complete list is available without charge on request. 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 National Fire Protection 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—1954

This recommended state or provincial regulatory standard for Tank Motor Vehicles for Flammable Liquids prepared by the NFPA Sectional Committee on Transportation of Flammable Liquids and approved by the NFPA Flammable Liquids Committee was officially adopted by the National Fire Protection Association at its 1954 annual meeting, May 17-21, 1954. The present text supersedes the 1953 edition.

This standard was initiated by the Committee on Flammable Liquids in 1926 as a Recommended Good Practice for the Construction and Operation of Gasoline Tank Trucks. It was finally adopted by the NFPA in revised form in 1929. In 1933 it was again revised and adopted as a Suggested Ordinance. In 1948 it was revised and reissued with the present title and again amended in 1953.

This standard has been prepared principally to cover normal petroleum products under normal conditions. Additional safeguards may be necessary where other flammable liquids with different characteristics, such as rates of expansion, corrosiveness, etc., are transported. For tank trucks for liquefied petroleum gases see NFPA Standard No. 58.

This standard is prepared for issuance by state and provincial authorities as a regulatory standard.

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TANK VEHICLES FOR FLAMMABLE LIQUIDS.

100. GENERAL.

110. Scope.

This standard applies to tank motor vehicles to be used for the transportation of flammable liquids. 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.

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, corrosiveness and toxicity.

120. Definitions.

121. Tank Truck. Any single self-propelled motor vehicle equipped with a cargo tank mounted thereon, and used for the transportation of flammable liquids.

122. 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, and so constructed that, practically all of its weight and load rests on its own wheels.

123. 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, 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.

124. Tank Vehicle. Any tank truck, tank full trailer, or tractor and tank semi-trailer combination.

125. Cargo Tank. Any container having a liquid capacity in excess of 100 gallons, used for the carrying of flammable liquids, 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.

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

127. Compartment. A liquid-tight division in a cargo tank.

128. Head and Bulkhead. A liquid-tight transverse closure at the end of a cargo tank or between compartments of a cargo tank.

129. Flammable Liquids. Liquids having a flash point below 200° F. and a vapor pressure not exceeding 40 psi absolute 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. D56–52. This method is also the Standard of the National Fire Protection Association (National Fire Codes Vol. I), and the Standard of the American Standards Association (ASA Z11.24–1952).

The flash point of flammable liquids having a flash point of 70° F. or below shall be determined by the apparatus and procedure called for in Sections 7 and 8 of this A.S.T.M. Method (D56–52).

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). This method is also the Standard of the National Fire Protection Association (National Fire Codes Vol. I), the Standard of the American Association State Highway Officials (A.A. S.H.O.–T73–46), and Standard of the American Standards Association (ASA Z11.7–1952).

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. D323-52, and of the American Standards Association (ASA Z11.44–1952).

200. CARGO TANKS, PIPING AND CONNECTIONS.

210. Cargo Tanks Constructed of Mild Steel.

211. 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

212. 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; as follows:

Mild Steel

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
U. S. Standard Gauge 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
U. S. Standard Gauge for Maximum Shell Radius of less than 70 inches:			
10 gallons or less	14	14	14
Over 10 to 14 gallons	14	14	13
Over 14 to 18 gallons	14	13	12
Over 18 gallons	13	12	11
U. S. Standard Gauge for Maximum Shell Radius of 70 inches or more, but less than 90 inches:			
10 gallons or less	14	14	13
Over 10 to 14 gallons	14	13	12
Over 14 to 18 gallons	13	12	11
Over 18 gallons	12	11	10

*Thickness of exterior head sheets shall never be less than the maximum requirements for shell sheets in any specific unit.

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
U. S. Standard Gauge for Maximum Shell Radius of 90 inches or more, but less than 125 inches:			
10 gallons or less	14	13	12
Over 10 to 14 gallons	13	12	11
Over 14 to 18 gallons	12	11	10
Over 18 gallons	11	10	9
U. S. Standard Gauge for Maximum Shell Radius of 125 inches or more:			
10 gallons or less	13	12	11
Over 10 to 14 gallons	12	11	10
Over 14 to 18 gallons	11	10	9
Over 18 gallons	10	9	8

220. Cargo Tanks Constructed of Aluminum.

221. Material. All sheets for such cargo tanks shall be of aluminum alloy, known as 3S or other alloy of equal or greater properties, as defined in Specification D209–51T of the American Society for Testing Materials, meeting the following minimum requirements:

Ultimate Strength, minimum .....19,500 pounds per square inch
Minimum Elongation, standard 2-inch sample .....6 per cent

222. 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 the case of shell sheets as follows:

Aluminum

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
Brown & Sharpe's Standard Gauge	7	6	5	4

*Thickness of exterior head sheets shall never be less than the maximum requirements for shell sheets.

MINIMUM THICKNESS OF SHELL SHEETS

Aluminum

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
Brown & Sharpe's Standard Gauge for Maximum Shell Radius of less than 70 inches:			
10 gallons or less	7	7	7
Over 10 to 14 gallons	7	7	6
Over 14 to 18 gallons	7	6	5
Over 18 gallons	6	5	4
Brown & Sharpe's Standard Gauge for Maximum Shell Radius of 70 inches or more, but less than 90 inches:			
10 gallons or less	7	7	6
Over 10 to 14 gallons	7	6	5
Over 14 to 18 gallons	6	5	4
Over 18 gallons	5	4	3
Brown & Sharpe's Standard Gauge for Maximum Shell Radius of 90 inches or more, but less than 125 inches:			
10 gallons or less	7	6	6
Over 10 to 14 gallons	6	5	4
Over 14 to 18 gallons	5	4	3
Over 18 gallons	4	3	3
Brown & Sharpe's Standard Gauge for Maximum Shell Radius of 125 inches or more:			
10 gallons or less	6	6	5
Over 10 to 14 gallons	5	4	4
Over 14 to 18 gallons	4	3	3
Over 18 gallons	3	3	2

COMPARATIVE THICKNESS OF METAL SHEETS

Approximate Thickness		Steel Sheets	Aluminum Sheets
Fractions of Inch	Decimals of Inch	U. S. Standard Gauge No.	Brown & Sharpe's Gauge No.
1/16	0.0588	16	
	0.0673	15	
	0.0747	14	
	0.0897	13	
	0.1046	12	
1/8	0.1196	11	
	0.1345	10	
	0.1443		7
	0.1495	9	
	0.1620		6
3/16	0.1819		5
	0.2043		4
	0.2294		3
	0.2576		2

230. Cargo Tanks Constructed of Low Alloy Low Carbon (High Tensile) Steel.

231. Material. All sheets for such cargo tanks shall be of low alloy, low carbon steel, commonly known as high tensile, meeting the following requirements:

Yield Point, minimum .....50,000 pounds per square inch
Ultimate Strength, minimum .....65,000 pounds per square inch
Minimum Elongation, standard 2-inch sample .....20 per cent

232. 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 the case of shell sheets; as follows:

Low Alloy Low Carbon (High Tensile) Steel
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
U. S. Standard Gauge No.	15	14	13	12

*Thickness of exterior head sheets shall never be less than the maximum requirements for shell sheets in any specific unit.

MINIMUM THICKNESS OF SHELL SHEETS

Low Alloy Low Carbon (High Tensile) 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
U. S. Standard Gauge for Maximum Shell Radius of less than 70 inches:			
10 gallons or less	16	16	15
Over 10 to 14 gallons	16	15	14
Over 14 to 18 gallons	15	14	13
Over 18 gallons	14	13	12
U. S. Standard Gauge for Maximum Shell Radius of 70 inches or more, but less than 90 inches:			
10 gallons or less	16	15	14
Over 10 to 14 gallons	15	14	13
Over 14 to 18 gallons	14	13	12
Over 18 gallons	13	12	11
U. S. Standard Gauge for Maximum Shell Radius of 90 inches or more, but less than 125 inches:			
10 gallons or less	15	14	13
Over 10 to 14 gallons	14	13	12
Over 14 to 18 gallons	13	12	11
Over 18 gallons	12	11	10
U. S. Standard Gauge for Maximum Shell Radius of 125 inches or more:			
10 gallons or less	14	13	12
Over 10 to 14 gallons	13	12	11
Over 14 to 18 gallons	12	11	10
Over 18 gallons	11	10	9

240. Joints.

241. Joints shall be made 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. Low alloy, low carbon (high tensile) steel sheets, however, shall be joined by fusion welding.

242. Mild steel and low alloy low carbon steel may be used in the construction of a single tank, provided each material, where used, shall comply with the minimum requirements of its respective specifications for that section of the tank.

250. Test.

251. At the time of manufacture every cargo tank shall be tested by a minimum air or hydrostatic pressure of 3 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 5 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 gauged 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.

260. Tank Outlets.

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

270. Bulkheads and Baffles.

271. Every cargo tank having a total capacity in excess of 1500 gallons and used for the distribution of Class I and II flammable liquids to service stations or other premises to which the public is invited shall be divided into compartments, no one of which shall exceed 1200 gallons. A construction tolerance of 10 per cent shall be allowed for capacities of individual compartments or tanks.

272. Bulkheads or compartments shall not be required in any cargo tank used for transportation service, regardless of total capacity, which, when loaded and transporting its cargo over streets and highways will contain not less than 80 per cent of the total tank capacity and will discharge its entire contents at one unloading point, 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.

NOTE: In areas requiring seasonal reduction in sizes of cargo, the 80 per cent requirement shall be waived during the period in which such restriction is in effect.

273. Every cargo tank, and every compartment over 90 inches in length, 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.

274. 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.

275. 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.

280. Vents.

281. Each cargo tank or compartment 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.

290. Valve and Faucet Connections.

291. Draw-off 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.

300. Emergency-Discharge Control.

301. The outlets of each cargo tank or compartment used for transportation of Class I and II flammable liquids shall be equipped with a reliable and efficient shut-off 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.

302. 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.

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

304. In every case there shall be provided, between the shut-off 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 shut-off valve seat intact.

400. TANK-VEHICLE CHASSIS, ASSEMBLY AND APPURTENANCES.

410. Tires.

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

420. Assembly.

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

430. Static Protection.*

431. Cargo tanks, and vehicle chassis, shall be electrically bonded.

432. Provision shall be made in the tank structure of the vehicle for the bonding of vehicle to the fill pipe during truck loading operations.

440. Protection Against Collision.

441. Draw-off 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.

450. Lighting.

451. 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.

460. Fuel System.

461. 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.

462. 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

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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.

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 shut-off valve or stop-cock. 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.

470. Exhaust System.

471. 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.

472. The exhaust system, including all units, shall be constructed and installed in a workmanlike manner. A muffler (or silencer) cut-out shall not be used.

480. Full Trailers and Semi-Trailers.

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

482. 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.

483. 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.

490. Fire Extinguishers.

491. Each tank vehicle shall be equipped and maintained with at least one approved hand fire extinguisher of a type suitable for extinguishing flammable-liquid fires. 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.

492. Fire extinguishers shall be of type and sizes to make one unit of first aid fire protection for Class "B" fires as defined

by the National Fire Protection Association Standard for the Installation, Maintenance and Use of First Aid Fire Appliances, NFPA No. 10.

500. Auxiliary Internal Combustion Engines.

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

502. 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.

503. 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.

504. 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.

505. 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.

506. 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.